Beyond Traditional Management: Transforming Islamic Boarding School Management through Orange Data Mining

Mochamad Arif Faizin*, Muhammad Ainun Najib

Universitas Islam Negeri Sayyid Ali Rahmatullah Tulungagung, Mayor Sujadi Timur St. No. 46, Tulungagung, East Java, 66221, Indonesia

*Corresponding author, email: arif.faizin@uinsatu.ac.id

https://doi.org/10.17977/um065.v7.i1.2027.8

Article history

Submitted: 11 April 2026

Revised: 14 July 2026

Accepted: 16 August 2026

Published: 17 August 2026

Keywords

Data mining

Pesantren

Transformation

Abstract

The management of Indonesian Islamic boarding schools (*pesantren*) generally remains rooted in traditional administrative practices with limited use of data-driven decision-making, which constrains strategic development and organizational effectiveness. This study aims to develop a transformative management model for a *pesantren* in Blitar, Indonesia by integrating data mining techniques with quantitative strategic planning to enhance institutional performance and responsiveness to stakeholder needs. The research involved multiple stakeholders, including administrators, students, parents, alumni, and community members. Data were collected through a structured questionnaire administered via an online platform and analyzed using data mining software. The analytical process included data cleaning, normalization, text preprocessing, and the application of clustering, classification, and association rule techniques to identify patterns, themes, and sentiments. Strategic alternatives were then prioritized using a quantitative strategic planning approach based on weighted internal and external factors. The analysis produced twenty strategic recommendations across key domains such as learning systems, governance, communication, and financial management, with five priority strategies identified: strengthening data-driven learning, improving teachers' technological competence, enhancing parent communication, implementing academic risk monitoring, and ensuring transparent financial governance. The integration of data mining and quantitative strategic planning provides an effective and systematic framework for transforming *pesantren* management, promoting accountability and supporting sustainable institutional development.

1. Introduction

Islamic boarding schools (*pesantren*) are currently facing increasingly complex managerial challenges amid the rapid transformation of the educational landscape. In addition to maintaining their religious and cultural values, *pesantren* are also required to improve institutional quality, strengthen competitiveness, optimize resource management, and respond adaptively to the evolving needs of society. Governance that relies solely on conventional experiences and intuition is often insufficient to address these multidimensional challenges. Therefore, *pesantren* require more strategic, systematic, and measurable management approaches to support sustainable institutional development.

In this context, data-driven governance has become increasingly important for educational institutions. Technological advancement has encouraged institutions to transform their approaches to strategic decision-making through the utilization of data mining. Operational data, feedback, perceptions, and various institutional reports can be processed using data mining techniques such as classification, clustering, and association analysis. Through these techniques, hidden patterns, behavioral trends, and potential risks or opportunities can be identified accurately and efficiently. The results of these analyses support evidence-based decision-making processes, including predicting student achievement, evaluating program effectiveness, improving service quality, and formulating policies that are responsive to the actual needs of learners and stakeholders (Hananto, 2017; Rizmayanti et al., 2021).

The use of data mining in educational institutions has been increasingly implemented in recent years. Accessible tools such as Orange Data Mining provide opportunities for institutions to process and visualize data more effectively without requiring advanced programming skills. In the context of *pesantren*, student data, parental feedback, participation records, and disciplinary reports can be systematically analyzed to identify student potential, formulate guidance strategies, and design more responsive educational programs. Through data-based management practices, *pesantren* can foster innovation, optimize institutional resources, and enhance educational quality while maintaining their relevance within contemporary social dynamics (Agneresa

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

et al., 2022; Harani & Prianto, 2019). Furthermore, the integration of data mining results into strategic planning frameworks such as the Quantitative Strategic Planning Matrix (QSPM) enables institutions to formulate more measurable and evidence-based development strategies.

Despite the growing discussion on *pesantren* management in Indonesia, previous studies have predominantly focused on curriculum modernization (Aji & Setyarini, 2020; Bashori, 2017; Shulhan, 2021), kiai leadership (Aini, 2020; Hamidah & Chasannudin, 2021; Rahayani, 2017; Samiya, 2023), and community-based economic empowerment. Studies examining data-driven governance in *pesantren* remain relatively limited. Meanwhile, research on the implementation of Orange Data Mining for decision-making processes has been widely conducted in schools and universities (Hozairi et al., 2021; Silvana Nazuah et al., 2023), yet its application in religious educational institutions such as *pesantren* is still scarcely explored. Similarly, studies employing the Quantitative Strategic Planning Matrix (QSPM) are mostly situated within business and higher education contexts and rarely integrated with data mining approaches for strategic planning in *pesantren*. This gap demonstrates the need for further research that combines data mining and quantitative strategic analysis within *pesantren* governance.

An Islamic boarding school in East Java, Indonesia, hereafter referred to as Pesantren X, serves as a relevant case study due to its need to strengthen institutional governance amidst ongoing educational transformation. Accordingly, this study aims to explore how institutional data are processed and analyzed using Orange Data Mining, how the results are interpreted through the Quantitative Strategic Planning Matrix (QSPM), and to identify the most appropriate strategic development directions for Pesantren X. This study is expected to contribute both practically and theoretically by offering an evidence-based management framework that integrates data mining technology and quantitative strategic planning within the context of *pesantren* governance.

2. Method

This study was conducted at Pesantren X in Blitar City using a descriptive quantitative approach supported by data mining and strategic planning analysis. The study involved 79 respondents selected through purposive sampling, consisting of *santri* (students), teachers/ustadz, administrators and educational staff, alumni, parents of *santri*, and supervisors/advisors from Nahdlatul Ulama. The distribution of respondents was intended to represent both internal and external stakeholders of the *pesantren* in order to obtain comprehensive perspectives regarding institutional governance and development needs.

Data were collected through a Google Form containing open- and closed-ended questions related to respondents' experiences, perceptions, and expectations toward *pesantren* management. The data were processed using Orange Data Mining through stages of cleaning, normalization, tokenization, and stemming, followed by clustering and classification analyses to identify patterns and sentiments. The findings were then used as the basis for strategy formulation using the Quantitative Strategic Planning Matrix (QSPM), in which internal and external factors were weighted and evaluated to determine the priority strategies for *pesantren* development. To ensure validity, the results were confirmed through preprocessing validation and discussions with *pesantren* administrators and parents.

3. Results and Discussion

3.1. Results

3.1.1. Current State of Management at Pesantren X

Pondok Pesantren X, located in Blitar City, East Java, Indonesia is an Islamic educational institution that integrates both formal and non-formal education. The *pesantren* implements a comprehensive curriculum that combines traditional *diniyah* learning with general education in accordance with national standards, serving more than 850 *santri* (students). The institution continuously strives to innovate to adapt to the dynamics of contemporary society. The increasing complexity of social change, demands for public accountability, and rapid development of digital technology require the *pesantren* to renew and modernize its management model.

In terms of management, Pesantren X is supported by relatively competent human resources. Its leadership does not rely solely on the kiai's religious authority but is also reinforced by *asatidz* (teachers) and administrators who possess strong academic backgrounds in education, management, and social sciences. Furthermore, the *pesantren* operates under the supervision of Nahdlatul Ulama (NU), which provides both institutional legitimacy and ideological guidance in maintaining the Ahlussunnah wal Jama'ah tradition. The synergy between traditional authority, modern academic competence, and NU's supervisory role enables the establishment of more professional governance that remains responsive to the needs of stakeholders, including students, parents, and the surrounding community.

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

Nevertheless, the existing managerial capacity still requires reinforcement through leadership training, the implementation of management information systems, and data-based evaluation mechanisms. Strengthening these aspects would enable the *pesantren's* human resources to accelerate institutional innovation while ensuring the *pesantren's* sustainability as a relevant Islamic educational institution in the face of contemporary challenges.

3.1.2. Data Analysis Results Using Orange Data Mining

This study employed 13 survey questions directed at *santri* (students), alumni, *pesantren* administrators, stakeholders, and community members to obtain a comprehensive understanding of Pondok Pesantren X The questions covered evaluations of the strengths and weaknesses of pondok pesantren x, the strategic role of the *pesantren* in society, the effectiveness of institutional management, and the management of student and financial data. In addition, the survey examined the urgency of adopting modern technology to support decision-making and improve service quality. The final question allowed respondents to provide feedback and suggestions, making the collected data not only descriptive but also reflective and prospective regarding the future development direction of Pondok Pesantren X.

Text data processing was conducted systematically through a series of critical stages, ranging from corpus construction and preprocessing to topic modeling, with the aim of extracting substantive patterns from questionnaire responses related to *pesantren* management. Selected columns focused solely on relevant data, while non-essential information was eliminated to prevent analysis distortion. Preprocessing included text normalization, tokenization, and the application of Indonesian stopwords, which significantly filtered out non-analytical words, resulting in a cleaner and more accurate textual representation. This stage was not merely technical but also methodological, as it determined the quality of input that directly influenced the reliability of the results.

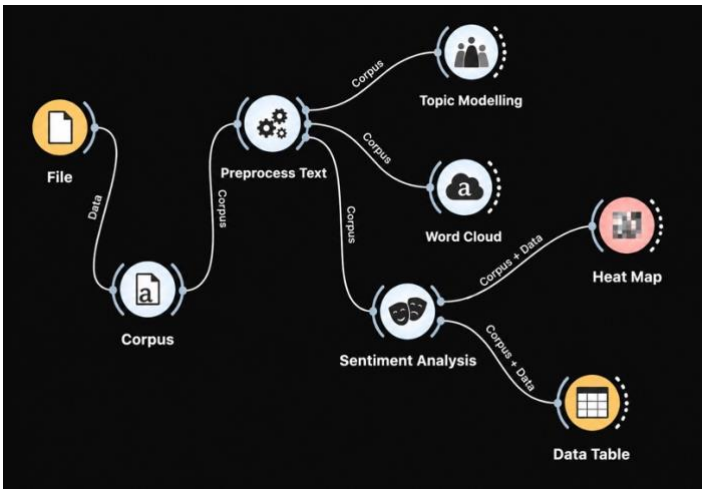


Figure 1. Data Processing in Orange Data Mining

Subsequently, the application of topic modeling using LDA and LSI revealed dominant themes related to NU, the *pondok*, *santri*, teachers, and facilities, which consistently reflected the core issues in *pesantren* educational management. This approach underscores the significance of integrating text mining techniques in Islamic education research, not only to reduce researcher bias but also to open new horizons for understanding the dynamics of *pesantren* management through the authentic voices of its stakeholders.



Figure 2. Topic Modeling Stage in Orange Data Mining

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

The topic modeling results indicated a dominance of themes related to NU and *santri*, highlighting the strong role of the NU organization and the quality of students in the discourse on *pesantren* management. Word cloud visualizations reinforced these findings by displaying the most frequently occurring keywords, such as NU, *pondok*, *santri*, education, facilities, and welfare, reflecting respondents' attention to *pesantren* identity, educational quality, and the need to strengthen infrastructure and student well-being. Together, these visualizations consistently emphasize the primary concerns of respondents and provide a solid foundation for formulating data-driven strategies for *pesantren* management development.



Figure 3. Word Cloud Results in Orange Data Mining

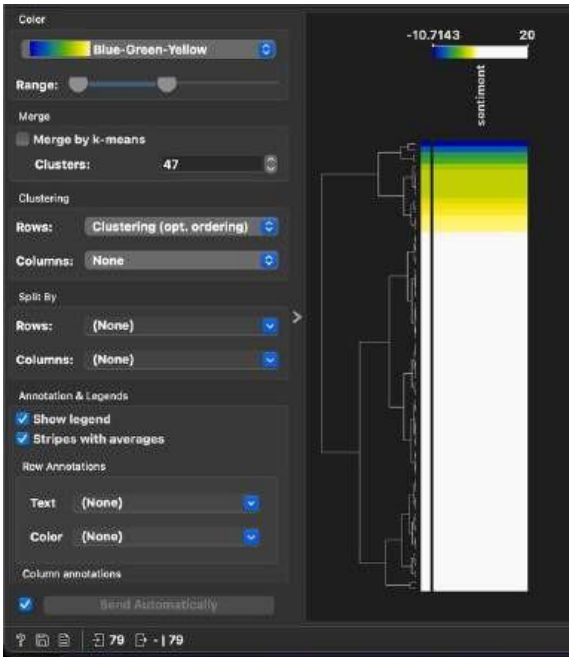


Figure 4. Word Cloud Results in Orange Data Mining

Sentiment analysis was conducted using the "Sentiment Analysis" widget with the Multilingual Sentiment setting configured for Indonesian, to analyze the emotional polarity within the text corpus. This setting was selected because the survey responses were predominantly in Indonesian, and the widget employs a pre-trained model to detect positive, negative, or neutral sentiments. The results revealed a varied distribution of sentiments, illustrated through a heat map with the "Show Legend" and "Stripes with Averages" options enabled. The visualization indicated a value of -10.7141 on the left side, reflecting the dominance of negative sentiments in certain comments, and a value of 20 on the right side, indicating positive sentiments in other thematic areas.

3.1.3. QSPM Analysis

The strategic SWOT factors derived in this analysis originated from the process of converting individual words or word combinations listed in Table 3. This conversion involved transforming frequently mentioned

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

terms that represent key issues into strategic factors with deeper analytical value. The process grouped words based on semantic similarity and their relevance to the internal and external conditions of the organization or *pesantren* under study. Consequently, the strategic factors resulting from this conversion systematically and measurably reflect strengths, weaknesses, opportunities, and threats.

The conversion of words or word combinations served as the foundation for developing a comprehensive and structured set of SWOT strategic factors. Through this process, initially isolated or combined words were transformed into indicators that could be analyzed both quantitatively and qualitatively, facilitating the formulation of appropriate strategies. These converted factors were then integrated into the IFAS and EFAS matrices, which display the weight and influence of each factor on the organization's position. Developing these strategic factors is crucial as it bridges qualitative data with a quantitative analytical framework in a systematic manner.

Overall, the strategic factors derived from word or phrase conversion provide a strong empirical basis for a more comprehensive SWOT analysis. With this approach, the formulated strategies are no longer subjective or solely assumption-based but are supported by measurable and structured data. Thus, the conversion of words into strategic factors represents a critical step that strengthens the validity of SWOT analysis and serves as a foundation for developing more accurate and relevant strategic policies for *pesantren* management as well as other organizations.

3.1.4. Quantitative Strategic Planning Matrix (QSPM) Strategy Analysis

The following table presents the key strategic factors derived from the IFAS and EFAS analyses, along with two selected strategies. Strategy 1 focuses on Technology-Based Management Modernization through Orange Data Mining, emphasizing improvements in institutional efficiency, transparency, and data management. Strategy 2 centers on Strengthening Leadership Development and Promotion through NU Networks, prioritizing the optimization of social networks, alumni engagement, and organizational support to expand the pesantren's reach and visibility.

Table 1. QSPM Strategic Factors Table

No	Key Strategic Factor	Score	AS (Strategy 1)	TAS (Strategy 1)	AS (Strategy 2)	TAS (Strategy 2)
1	Strong pesantren reputation with transparent management	0.10	4	0.40	3	0.30
2	High-quality and experienced teaching staff	0.08	3	0.24	3	0.24
3	The management system has not yet been integrated	0.12	4	0.48	2	0.24
4	Limited digital technology facilities	0.10	4	0.40	2	0.20
5	Strong support from NU networks and alumni	0.10	3	0.30	4	0.40
6	Advances in educational technology	0.08	4	0.32	2	0.16
7	Competition with other educational institutions	0.10	3	0.30	4	0.40
8	Changes in modern social values	0.08	3	0.24	3	0.24
Total		0.76		2.68		2.18

Note: AS = Attractiveness Score (1–4); TAS = Total Attractiveness Score = Score × AS.

The strategy with the highest Total Attractiveness Score (TAS = 2.68) indicates the most recommended implementation priority, namely Technology-Based Management Modernization through Orange Data Mining. The QSPM table analysis highlights the internal and external dynamics of Pondok Pesantren X in Blitar City during the process of modernizing educational management. The *pesantren* occupies a strategic position as a NU-based institution that integrates formal and *diniyah* education, yet it still faces challenges such as teacher welfare, weak managerial coordination, and limited digital infrastructure. These conditions reveal a gap between institutional potential and the management capacity required to meet the demands of the digital era.

The two main strategies management modernization via Orange Data Mining and strengthening NU leadership development through social networks were selected as the foundation for enhancing internal and external capacities, enabling the *pesantren* to transform efficiently, adaptively, and while remaining rooted in NU values. The selection of these strategies in the QSPM table ensures focus on alternatives with the most significant impact on institutional development. The management modernization strategy aims to improve efficiency and transparency through digital technology utilization, while the NU identity strengthening strategy emphasizes expanding social networks and enhancing the institution's competitiveness at both local and national levels.

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

These two strategies were further developed into five primary strategic actions: (1) strengthening data-driven learning systems, (2) enhancing teacher capacity in technology utilization, (3) optimizing communication with parents, (4) implementing a student academic risk monitoring system, and (5) improving transparent financial management. Collectively, these strategies are expected to reinforce the *pesantren's* foundation as a modern Islamic educational institution capable of adapting to social and technological changes without compromising its ideological character.

3.2. Discussion

This study confirms the complexity of integrating *pesantren* traditions with the demands of modern education, aligning with institutional theory perspectives that emphasize legitimacy pressures in religious organizations (Meyer & Rowan, 2021). The findings from topic modeling and sentiment analysis demonstrate that stakeholders generally maintain positive perceptions toward Pondok Pesantren X, particularly regarding its religious values, transparent leadership, educational reputation, and commitment to character formation. Positive sentiments frequently emerged around the *pesantren's* strong social legitimacy, collective leadership patterns, and support from NU networks and alumni communities. These findings correspond with transformational leadership theory (Ghufron, 2020; Longshore & Bass, 1987), which highlights the importance of adaptive leadership, institutional vision, and responsiveness to changing external dynamics. However, several negative sentiments were also identified, especially regarding management systems that are not yet fully integrated, limited digital technology facilities, administrative inefficiency, and challenges in adapting to the rapid transformation of educational technology and modern social values. This indicates that although Pesantren X has shown adaptive responses, institutional modernization remains incomplete and still faces pressures from globalization, educational competition, and value homogenization.

In terms of curriculum and governance, *pesantren* education has undergone considerable transformation. Nevertheless, the use of data processing tools in strategic decision-making remains relatively limited. The sentiment analysis results reveal an imbalance between structural strengths, such as institutional reputation, student trust, and social support, and functional aspects including digital management systems, staff capacity development, and operational effectiveness. This condition suggests that the institutional strengths of *pesantren* are often not yet supported by evidence-based governance capable of systematically identifying problems, predicting risks, and recognizing opportunities for institutional development. Consequently, managerial decisions tend to rely more heavily on intuition and the experiences of individual leaders rather than on empirical analysis and measurable institutional indicators (Dacholfany et al., 2024; Syafrizal et al., 2024). Based on these findings, several managerial recommendations can be proposed, including strengthening integrated management systems, improving digital infrastructure, conducting continuous training for teachers and staff, optimizing data-based administrative services, and enhancing collaboration with alumni, parents, and NU stakeholders to support sustainable institutional development.

The transformation of qualitative narratives into strategic factors through SWOT and QSPM analysis demonstrates the rigor of evidence-based strategic planning in *pesantren* governance. The QSPM results indicate that modernization-oriented strategies possess the highest Total Attractiveness Scores (TAS), making them the primary priorities for institutional policy development. The most prioritized strategies include integrating management systems, strengthening digital technology facilities, improving the utilization of educational technology, and enhancing institutional competitiveness amid increasing competition among educational institutions. These findings are consistent with literature emphasizing the importance of digital transformation in educational organizations. However, this study critically emphasizes that technological modernization should not merely focus on automation and infrastructure development, but must also be accompanied by organizational culture change, managerial readiness, and human resource development. This aligns with organizational change theory, which highlights the importance of unfreezing, changing, and refreezing processes in achieving sustainable institutional transformation (Selwyn, 2011; Teräs, 2022).

In general, this research provides important insights into *pesantren* management through its integration of topic modeling, sentiment analysis, and QSPM-based strategic prioritization. The study demonstrates that data-driven governance can support *pesantren* in formulating more measurable, responsive, and evidence-based policies while maintaining their religious and socio-cultural identity. At the same time, Geertz (1960) and Bowen (1998) emphasize that Islamic education studies must consider broader socio-cultural contexts and the pressures of globalization, which frequently challenge traditional local authority structures (Zuhri, 2022). Therefore, the development strategy for Pondok Pesantren X should adopt a balanced approach that integrates technological modernization, institutional professionalism, preservation of *pesantren* traditions, and socio-cultural adaptation, ensuring that the institution remains both relevant and authentic in the context of contemporary educational transformation.

3.3. Implication

The findings of this study provide significant theoretical and practical implications for the development of Islamic educational management, particularly within *pesantren* contexts. Theoretically, this research advances

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

a hybrid framework by integrating data mining techniques with strategic management tools such as the Quantitative Strategic Planning Matrix (QSPM), demonstrating that data-driven decision-making is applicable beyond business and higher education sectors and can be effectively adapted to traditional religious institutions. This approach strengthens the role of evidence-based analysis in reducing subjectivity in managerial decision-making while offering a systematic way to transform qualitative stakeholder inputs into measurable strategic priorities. As such, the study contributes to the growing discourse on the digital transformation of education by positioning *pesantren* as dynamic institutions capable of aligning tradition with technological advancement.

Practically, the study offers a concrete and replicable model for modernizing *pesantren* management through the utilization of Orange Data Mining to generate actionable insights from stakeholder data. The five key strategies identified strengthening data-driven learning systems, enhancing teachers' technological competence, optimizing communication with parents, implementing academic risk monitoring systems, and improving transparent financial governance serve as strategic guidelines for institutional improvement. These findings underscore the importance of human resource readiness, particularly in digital literacy and data interpretation, as a critical factor for successful implementation. Furthermore, the study highlights the need for policy support and institutional commitment to foster innovation, accountability, and transparency, ultimately enhancing public trust and ensuring the sustainability and relevance of *pesantren* in responding to contemporary educational challenges.

3.4. Limitations

This study has several limitations that should be acknowledged. First, the research was conducted in a single institution, Pondok Pesantren X in Blitar, which may limit the generalizability of the findings to other *pesantren* with different socio-cultural backgrounds, organizational structures, or resource capacities. Each *pesantren* operates within a unique context; therefore, the applicability of the proposed data-driven management model may vary depending on institutional readiness, leadership style, and technological infrastructure. Second, the study relied primarily on self-reported data collected through questionnaires, which may be subject to response bias, including social desirability and subjective interpretation of questions. Although data preprocessing and validation were applied, such biases cannot be eliminated.

Third, the use of Orange Data Mining focused mainly on text mining, clustering, and classification techniques, which, while effective in identifying patterns and sentiments, may not fully capture deeper contextual meanings or complex socio-cultural dynamics within *pesantren* life. Additionally, the QSPM analysis involved expert judgment in assigning weights and attractiveness scores, which introduces a degree of subjectivity despite its structured framework. Lastly, this study did not include a longitudinal evaluation of the implementation of the proposed strategies; therefore, the long-term effectiveness and sustainability of the recommended management transformation remain untested. Future research is encouraged to involve multiple institutions, employ mixed or longitudinal designs, and explore more advanced analytical approaches to strengthen the robustness and applicability of the findings.

4. Conclusion

The findings of this study successfully address the three research objectives. First, the application of Orange Data Mining to 79 open-ended responses from various *pesantren* stakeholders revealed that the NU identity, the quality of *santri*, and moral development programs constitute the institution's primary strengths, while non-integrated management systems, tuition fee arrears, low teacher welfare, and limited technological infrastructure remain the dominant weaknesses. The outputs generated through word cloud visualization, topic modeling, and sentiment analysis consistently reinforced these patterns, demonstrating the effectiveness of data mining techniques in identifying strategic institutional issues and supporting evidence-based governance in *pesantren* management. Second, the QSPM analysis demonstrated that the strategy of Technology-Based Management Modernization supported by Orange Data Mining achieved the highest Total Attractiveness Score (TAS = 5.95), slightly surpassing the strategy of strengthening cadre development and promotion through NU networks (TAS = 5.85). Based on these findings, the recommended development strategy consists of two implementation phases: the first phase focuses on digitalization of information systems, financial automation, open-source technology laboratories, and intensive training programs, while the second phase emphasizes strengthening alumni and NU networks, expanding collaboration with PCNU, improving language programs, and conducting national branding campaigns. This integrated strategy is projected to reduce tuition arrears, improve institutional transparency, and increase student enrollment, while simultaneously contributing to the development of a more adaptive, transparent, and sustainable model of *pesantren* governance.

Author Contributions

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

Funding

No funding support was received.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/ or publication of this article.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

References

Abdullah, A., Hananto, A. L., Hilabi, S. S., & Priyatna, B. (2025). Analisis klasifikasi pelanggaran santri di pesantren menggunakan algoritma decision tree. *Jurnal Ilmiah Sistem Informasi dan Ilmu Komputer, 5*(1), 322–331. https://doi.org/10.55606/juisik.v5i1.1297

Agneresa, A., Hananto, A. L., Hilabi, S. S., Hananto, A., & Tukino, T. (2022). Strategi promosi penerapan data mining mahasiswa baru dengan metode K-means clustering. *Dirgamaya: Jurnal Manajemen dan Sistem Informasi, 2*(2), 25–34. https://doi.org/10.35969/dirgamaya.v2i2.275

Aini, M. Q. (2020). Peran kepemimpinan kyai dalam manajemen strategi pendidikan pesantren. *Leadership: Jurnal Mahasiswa Manajemen Pendidikan Islam, 1*(2). https://doi.org/10.32478/leadership.v1i2.445

Aji, L. B., & Setyarini, M. D. (2020). Modernisasi pendidikan di Pondok Pesantren Miftahul 'Amal Jiken, Blora. *Journal of Economic Education and Entrepreneurship, 1*(1). https://doi.org/10.31331/jeee.v1i1.1219

Bashori, B. (2017). Modernisasi lembaga pendidikan pesantren. *Jurnal Ilmu Sosial Mamangan, 6*(1). https://doi.org/10.22202/mamangan.1313

Calista, S. A. (2025). Revolutionizing pesantren in the society 5.0 era: The synergy of digitalization, AI, and smart education management. *Proceeding of International Conference on Islamic Boarding School, 2*(1). https://doi.org/10.61159/icop.v2i1.632

Dacholfany, M. I., Ikhwan, A., Budiman, A., & Hutabarat, Z. S. (2024). Model of educational leadership management in boarding schools. *Al-Hayat: Journal of Islamic Education, 8*(1). https://doi.org/10.35723/ajie.v8i1.339

Ghufron, G. (2020). Teori-teori kepemimpinan. *Fenomena, 19*(1). https://doi.org/10.35719/fenomena.v19i1.34

Hamidah, K., & Chasannudin, A. (2021). Mechanization of Islamic moderation da'wah in the Nahdlatul Ulama pesantren tradition. *Jurnal Ilmu Dakwah, 41*(1). https://doi.org/10.21580/jid.v41.1.7134

Hananto, V. R. (2017). Analisis penentuan metode data mining untuk prediksi kelulusan mahasiswa sebagai penunjang angka efisiensi edukasi. *Jurnal Ilmiah SCROLL: Jendela Teknologi Informasi, 5*(1), 1–11.

Harani, N. H., & Prianto, C. (2019). Analisis data mining menggunakan algoritma fuzzy C-means untuk menentukan strategi promosi Politenik Pos Indonesia. *Jurnal Teknik Informatika, 11*(2), 22–28.

Hozairi, H., Anwari, A., & Alim, S. (2021). Implementasi Orange data mining untuk klasifikasi kelulusan mahasiswa dengan model K-nearest neighbor, decision tree serta naive Bayes. *Network Engineering Research Operation, 6*(2). https://doi.org/10.21107/nero.v6i2.237

Kamal, F. (2018). The transformation of Islamic boarding schools as institutions of the 21st century. *Paramurobi: Jurnal Pendidikan Agama Islam, 1*(2). https://doi.org/10.32699/paramurobi.v1i2.524

Longshore, J. M., & Bass, B. M. (1987). Leadership and performance beyond expectations. *The Academy of Management Review, 12*(4). https://doi.org/10.2307/258081

Maulana, M. Z. (2025). Pendidikan Islam adaptif di era digital: Sinergi AI generatif dan learning analytics. *Insight: Islamic Education and Learning, 1*(2), 80–88. https://journal.literasikhatulistiwa.org/index.php/insight/article/download/266/70

Meyer, J. W., & Rowan, B. (2021). Institutionalized organizations: Formal structure as myth and ceremony. In *The new economic sociology: A reader*. https://doi.org/10.1086/226550

Musaddad, A. (2023). Transformation of Islamic boarding schools as Islamic education institutions in Indonesia. *Journal of Islamic Education Research, 4*(1). https://doi.org/10.35719/jier.v4i1.319

Rahayani, Y. (2017). Restructuring and redesigning the pesantren toward an effective educational institution. *TARBIYA: Journal of Education in Muslim Society, 4*(2). https://doi.org/10.15408/tjems.v4i2.8009

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174

Rizmayanti, A. I., Hidayati, N., Nugraha, F. S., Gata, W., & Mandiri, S. N. (2021). Penerapan data mining untuk memprediksi kompetensi siswa menggunakan metode decision tree: Studi kasus SMK Multicomp Depok. *Jurnal Swabumi, 9*(1), 2021. https://doi.org/10.31294/swabumi.v9i1.8363

Samiya. (2023). Peran kepemimpinan kyai dalam pembinaan kedisiplinan santri di Pondok Nurusibyan Singkawang. *Jurnal LENTERA, 1*. https://ejournal.staika.ac.id/index.php/lentera/article/view/40

Selwyn, N. (2011). *Education and technology: Key issues and debates*. Continuum.

Shulhan, S. (2021). Transformasi modernisasi pesantren salaf. *Jurnal Perspektif, 14*(2). https://doi.org/10.53746/perspektif.v14i2.54

Silvana Nazuah, Shofa Shofia Hilabi, Agustia Hananto, Baenil Huda, & Tukino. (2023). Seleksi penerimaan beasiswa dengan metode K-means clustering menggunakan Orange. *JUSTINDO (Jurnal Sistem dan Teknologi Informasi Indonesia), 8*(1). https://doi.org/10.32528/justindo.v8i1.212

Syafrizal, A. P., Pratama, D. Y., Hasna, N., Fauziah, S., & Sikki, N. (2024). Peranan manajemen sumber daya manusia dalam menghadapi tantangan dunia pendidikan di era Society 5.0 pada Pondok Pesantren Siti Fatimah Kota Cirebon. *Jurnal Manajemen Sistem Informasi, 2*(1). https://doi.org/10.51920/jurminsi.v2i1.198

Teräs, M. (2022). Education and technology: Key issues and debates. *International Review of Education, 68*(4). https://doi.org/10.1007/s11159-022-09971-9

Zuhri, A. M. (2022). *Islam moderat: Konsep dan aktualisasinya dalam dinamika gerakan Islam di Indonesia*. Universitas Nusantara PGRI Kediri.

© 2026 The Author(s)
This is an Open Access article under the Creative Commons Attribution-ShareAlike 4.0 International License
ISSN: 2797-3174