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Integrating Broadcasting Data Mining and Visualization for Effective Big Data Decision Support

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ABSTRACT

In the era of big data and digital broadcasting, organizations face increasing challenges in transforming large-scale broadcasting datasets into actionable insights for effective decision-making. **This study addresses** the need for an integrated decision support framework that combines broadcasting data mining and interactive visualization to improve the interpretation of complex data patterns. **The objective of this research** is to develop an integrated approach that applies data mining techniques to broadcasting-related data, such as audience behavior, content performance, engagement patterns, and multi-source media data, supported by visual dashboards for strategic analysis. The method employed includes clustering, classification, and association rule mining to identify meaningful patterns, audience segments, trends, and anomalies within broadcasting datasets. **These analytical results** are then presented through interactive visualization dashboards that enable stakeholders to explore insights more efficiently and make data-driven decisions. The results show that integrating broadcasting data mining with visualization improves the speed, accuracy, and clarity of insight extraction compared to conventional analytics approaches. User evaluation also indicates that visualized analytical outputs enhance stakeholder understanding of complex broadcasting data and support more accurate strategic decisions. **The conclusion of this study** confirms that the integration of broadcasting data mining and visualization within a big data decision support framework can bridge the gap between raw media data and practical decision-making. This research contributes to the development of more adaptive, efficient, and human-centered decision support systems for broadcasting industries and digital media organizations.

1. INTRODUCTION

In the contemporary digital era, the broadcasting industry has experienced a major transformation driven by the rapid growth of big data, digital platforms, streaming services, social media interactions, and real-time audience engagement [1]. Broadcasting organizations no longer rely only on traditional rating systems or manual audience reports, but increasingly depend on large-scale datasets generated from viewers, content distribution channels, online platforms, and audience interaction patterns [2]. These datasets include audience behavior, viewing duration, program preferences, demographic segmentation, social media responses, content

popularity, and advertising performance. The increasing complexity and volume of broadcasting data create both opportunities and challenges for media organizations in transforming raw data into actionable insights [3]. Therefore, the integration of broadcasting data mining and visualization becomes essential to support more effective, accurate, and timely decision-making [4]. Through data mining, hidden patterns, trends, audience segments, and relationships within broadcasting data can be identified, while visualization helps decision-makers interpret complex results in a more intuitive and meaningful way. This approach is also relevant to the United Nations Sustainable Development Goals (SDGs), particularly Goal 9 on Industry, Innovation, and Infrastructure, as it encourages the use of innovative data-driven systems to improve digital media infrastructure and organizational decision support.

Despite the increasing use of big data analytics in the broadcasting sector, several limitations remain in conventional analytical practices [5]. Many broadcasting organizations still face difficulties in interpreting complex and heterogeneous data collected from multiple sources, such as television platforms, streaming applications, digital advertisements, and social media channels [6]. Traditional analysis methods often provide numerical reports without sufficient visual interpretation, making it difficult for stakeholders to understand audience trends, content effectiveness, and strategic opportunities [7]. In addition, the broadcasting industry requires real-time or near-real-time decision support because audience preferences can change rapidly due to social trends, viral content, and competitive media environments. Challenges such as high-dimensional data, incomplete audience records, noisy engagement data, and fragmented media platforms require more adaptive analytical approaches. By integrating broadcasting data mining techniques such as clustering, classification, and association rule mining with interactive visualization, media organizations can bridge the gap between computational analysis and managerial understanding. This integration allows stakeholders to identify audience segments, predict content performance, discover viewing patterns, and detect anomalies in broadcasting data more effectively. As a result, decision-makers can develop more relevant content strategies, improve audience engagement, optimize broadcasting schedules, and support data-driven media management [8]. The objective of this research is to develop and evaluate an integrated framework that combines broadcasting data mining and visualization for effective big data decision support. This study focuses on how data mining techniques can be applied to broadcasting-related datasets to extract meaningful insights for strategic decision-making [9]. Specifically, clustering can be used to group audiences based on similar viewing behavior, classification can support the prediction of audience preferences or content performance, and association rule mining can reveal relationships between programs, viewer interests, and engagement patterns. These analytical outputs are then presented through interactive dashboards that allow stakeholders to explore, filter, and interpret broadcasting data in real time [10]. This study also aims to examine how visualization improves the comprehension of complex analytical results and supports faster and more accurate decision-making compared to traditional reporting methods. The expected contribution of this research is the development of a practical decision support framework for broadcasting organizations and digital media industries. By combining computational analysis with human-centered visualization, this research provides a scalable model for improving strategic planning, audience analysis, content evaluation, and media performance management in the era of big data-driven broadcasting.

2. LITERATURE REVIEW

2.1. Big Data Analytics in Broadcasting

The field of big data analytics has experienced rapid development along with the increasing volume, velocity, variety, and complexity of data generated by digital platforms [11]. In the broadcasting industry, this development has become highly relevant because media organizations now manage large-scale datasets from television channels, streaming platforms, digital advertisements, audience interactions, and social media engagement. Broadcasting data is no longer limited to traditional ratings or viewer counts but also includes viewing duration, content preferences, demographic characteristics, audience sentiment, clickstream behavior, and real-time engagement patterns. These diverse data sources provide valuable opportunities for media organizations to better understand audience behavior and improve strategic decision-making. However, the complexity of broadcasting big data also creates challenges related to data heterogeneity, noise, high dimensionality, and interpretation. Consequently, advanced analytical techniques are required to transform raw broadcasting data into actionable knowledge.

2.2. Broadcasting Data Mining Techniques

Broadcasting data mining refers to the application of computational techniques for extracting meaningful knowledge from broadcasting and digital media datasets. Various data mining approaches, including clustering, classification, prediction, and association rule mining, have been widely adopted to support audience analysis and media intelligence [12]. Clustering techniques enable audience segmentation by grouping viewers with similar behavioral characteristics such as preferred genres, viewing schedules, or platform usage [13]. Classification methods are commonly employed to predict audience preferences, content popularity, or viewer retention based on historical viewing behavior [6]. Association rule mining identifies hidden relationships among television programs, advertising campaigns, audience interests, and engagement activities, thereby supporting recommendation systems and advertising optimization [14]. These analytical techniques allow broadcasting organizations to move beyond descriptive reporting toward predictive and prescriptive analytics that support strategic planning [15].

2.3. Interactive Data Visualization for Broadcasting Analytics

Although data mining algorithms generate valuable analytical results, their outputs are often difficult for decision-makers to interpret when presented solely as statistical values or algorithmic models. Therefore, visualization has become an essential component of broadcasting analytics. Interactive visualization technologies, including dashboards, heatmaps, line charts, network graphs, and real-time monitoring panels, facilitate intuitive exploration of audience behavior and content performance. Through visualization, broadcasting stakeholders can compare program ratings, identify peak viewing periods, monitor audience engagement, evaluate advertising effectiveness, and detect unusual viewing patterns [16]. Effective visualization improves analytical transparency and enables decision-makers to interpret complex datasets more efficiently. Consequently, visualization functions not merely as a presentation tool but also as an interactive analytical environment that supports evidence-based decision-making.

2.4. Data Preprocessing and Multi-Source Data Integration

One of the major challenges in broadcasting analytics is the integration of heterogeneous data originating from multiple platforms [17]. Broadcasting organizations collect information from television ratings, streaming services, advertising systems, mobile applications, social media platforms, and audience feedback channels. These data sources differ significantly in format, structure, quality, and update frequency [18]. To ensure reliable analytical results, preprocessing stages such as data cleaning, data integration, transformation, normalization, and noise reduction are essential before applying data mining algorithms [19]. Proper preprocessing improves data consistency and minimizes analytical bias. Furthermore, because broadcasting datasets are typically high-dimensional, visualization systems must incorporate filtering, aggregation, and interactive exploration capabilities to enable users to effectively analyze complex media information.

2.5. Broadcasting Decision Support Systems

The integration of broadcasting data mining and visualization contributes significantly to the development of intelligent decision support systems (DSS). Such systems assist media executives, content producers, advertisers, and broadcasting strategists in making data-driven decisions [20]. Audience segmentation results support personalized content strategies, classification models facilitate program performance prediction, and association rule mining assists advertising placement and cross-platform promotional planning [21]. When these analytical outputs are integrated into interactive dashboards, stakeholders can evaluate broadcasting performance more rapidly and accurately. This integration enables broadcasting organizations to become more adaptive, responsive, and evidence-driven within increasingly competitive digital media environments.

2.6. Research Gap and Proposed Framework

Previous studies have demonstrated that combining data mining and visualization improves knowledge discovery, user comprehension, and decision-making efficiency across various domains, including healthcare, finance, smart cities, and environmental monitoring [22]. However, comparatively fewer studies have focused specifically on broadcasting analytics despite its unique characteristics, including rapidly changing audience preferences, fragmented media platforms, and real-time content consumption [23]. Existing research often emphasizes either data mining techniques or visualization independently, while limited attention has been given to developing an integrated framework that incorporates data preprocessing, multiple data mining techniques, interactive visualization, and strategic decision support specifically for broadcasting big data [24]. This limitation indicates a significant research gap in providing a comprehensive analytics framework capable of handling

heterogeneous broadcasting datasets while supporting interactive decision-making. To address this gap, this study proposes an integrated broadcasting data mining and visualization framework that combines data preprocessing, clustering, classification, association rule mining, and interactive dashboards into a unified decision support architecture. The proposed framework aims to improve insight extraction, stakeholder understanding, decision-making speed, and strategic planning within modern broadcasting organizations [25].

3. RESEARCH METHOD

3.1. Research Approach

This study adopts a theoretical and computational modeling approach to develop and evaluate an integrated framework that combines broadcasting data mining techniques with interactive visualization for effective big data decision support [26]. The research approach emphasizes analytical modeling and computational simulation to examine how large-scale broadcasting datasets can be processed, analyzed, visualized, and transformed into actionable insights for stakeholders in the broadcasting and digital media sectors [27].

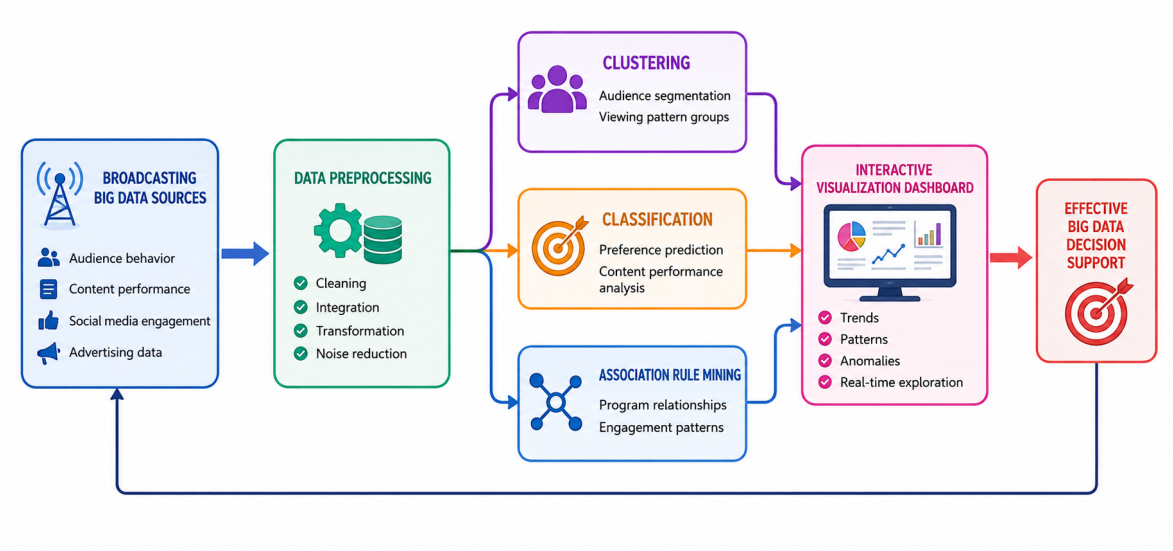

Figure 1. Broadcasting Analytics Framework

Figure 1 illustrates the proposed framework for integrating broadcasting data mining and visualization to support effective big data decision-making [28]. The framework begins with broadcasting big data sources, including audience behavior, content performance, social media engagement, and advertising data. These data are processed through cleaning, integration, transformation, and noise reduction before being analyzed using clustering, classification, and association rule mining. The results are then presented through an interactive visualization dashboard that enables stakeholders to identify trends, patterns, anomalies, and real-time insights [29]. Finally, the framework supports more effective big data decision support and provides a feedback loop for strategy refinement and broadcasting performance improvement [30].

The theoretical component focuses on formulating the conceptual workflow of the proposed framework, beginning from broadcasting big data collection, data preprocessing, pattern extraction, visualization design, and decision-support interpretation [31]. The computational modeling component is used to evaluate the performance and scalability of the proposed framework in handling multi-source and high-dimensional broadcasting datasets. These datasets may include audience behavior, content performance, viewing duration, program preferences, demographic segmentation, social media engagement, advertising interaction, and streaming platform data [32]. Before analysis, the collected data are processed through data cleaning, integration, normalization, transformation, and noise reduction to improve data quality and analytical reliability. This preprocessing stage is essential because broadcasting data often come from different platforms and formats, making them heterogeneous, dynamic, and potentially incomplete. After preprocessing, data mining techniques are applied to extract meaningful knowledge from broadcasting datasets. Clustering is used to identify audience groups with similar viewing behavior and content preferences. Classification is applied to predict

content performance, audience engagement, or viewer response based on selected features. Association rule mining is used to discover relationships among programs, audience interests, platform usage, and engagement patterns. These techniques allow the proposed framework to move beyond descriptive analysis by producing predictive and pattern-based insights that support strategic decision-making in broadcasting management. The visualization component is designed to present the results of broadcasting data mining through interactive dashboards and visual analytics tools. The dashboard enables stakeholders to explore trends, compare program performance, identify anomalies, filter audience segments, and interpret analytical outputs in real time or near real time. This approach supports decision-makers who may not have technical expertise in data mining but require clear and practical insights for content strategy, audience engagement, advertising placement, and broadcasting schedule optimization [33]. By combining computational analysis with human-centered visualization, the framework strengthens the connection between raw broadcasting data and effective decision support. Overall, this research approach provides a structured basis for evaluating the effectiveness of integrating broadcasting data mining and visualization. The evaluation focuses on the framework's ability to improve insight extraction, decision speed, analytical accuracy, user comprehension, and stakeholder satisfaction. Through this approach, the study aims to demonstrate that broadcasting data mining supported by interactive visualization can serve as a scalable and practical decision support model for broadcasting organizations and digital media industries operating in a big data environment.

3.2. Data Model Parameters

The datasets used in this study consist of multi-source broadcasting and digital media data that represent complex real-world media environments. Simulated datasets are generated to reflect audience behavior, content performance, streaming platform activity, social media engagement, advertising interaction, and viewer feedback. These datasets include different formats, missing values, duplicated records, noise, and varying levels of complexity to represent common challenges in broadcasting big data processing [34]. In addition, publicly available anonymized datasets related to media consumption, audience interaction, and digital content engagement are used to evaluate the generalizability of the proposed framework across various broadcasting and digital media contexts.

Table 1. Quarterly Evaluation Results of the Proposed Broadcasting Analytics Framework

Metric	**Q1**	**Q2**	**Q3**	**Q4**
Classification Accuracy (%)	82.1	85.4	88.7	90.2
F1-score	0.81	0.84	0.87	0.89
Silhouette Score	0.46	0.49	0.53	0.56
Dashboard Response Time (s)	2.8	2.5	2.3	2.1
Decision Task Time (min)	6.2	5.4	4.6	3.9
Comprehension Score (%)	74	81	88	92

Table 1 model parameters are systematically adjusted to assess analytical accuracy, computational efficiency, and decision-support effectiveness. For clustering, the number of clusters is varied to identify meaningful audience segments based on viewing behavior and content preferences. For classification, parameters such as decision tree depth, training-testing ratio, feature selection, and classifier hyperparameters are evaluated to predict content performance and audience engagement. For association rule mining, minimum support, confidence, and lift thresholds are used to discover relationships among program types, audience interests, platform usage, and engagement patterns. Visualization parameters, including dashboard layout, filtering options, chart types, and real-time refresh rates, are also considered to ensure that analytical outputs can be clearly interpreted by stakeholders for effective broadcasting decision support.

3.3. Analytical Techniques

The analytical techniques used in this study are designed to extract meaningful insights from broadcasting big data while maintaining computational efficiency, interpretability, and practical relevance for decision support. Clustering algorithms, such as k-means and hierarchical clustering, are applied to identify audience segments based on viewing behavior, content preferences, engagement patterns, and platform usage. Classification techniques, including decision trees and support vector machines, are used to predict content performance, audience response, and engagement potential based on selected broadcasting features. Association

rule mining is also employed to discover relationships among program categories, audience interests, advertisement interactions, and digital engagement behavior. These techniques allow the framework to generate both descriptive and predictive insights that can support strategic decisions in broadcasting and digital media management. To improve the clarity of analytical results, dimensionality reduction techniques such as Principal Component Analysis (PCA) and t-Distributed Stochastic Neighbor Embedding (t-SNE) are applied to simplify high-dimensional broadcasting datasets without losing essential information. The results are then presented through interactive visualization methods, including dynamic dashboards, heatmaps, trend charts, and network graphs. These visualization tools enable stakeholders to explore audience clusters, monitor content trends, identify anomalies, and interpret association patterns in real time or near real time. The effectiveness of the analytical techniques is evaluated using accuracy, precision, recall, F1-score, silhouette score, and computational time. Meanwhile, visualization performance is assessed through user comprehension, query response time, and usability scores. By integrating these techniques into a unified pipeline, the proposed framework ensures that complex broadcasting data can be transformed into clear, interpretable, and actionable insights for effective big data decision support.

3.4. Validation & Consistency Checks

Validation and consistency checks are conducted to ensure that the proposed framework produces reliable, accurate, and meaningful insights for broadcasting big data decision support. Quantitative validation is performed using cross-validation, statistical testing, and performance metrics to assess the accuracy and reliability of the data mining models [35]. Clustering results are evaluated using silhouette scores and stability tests across different parameter settings to ensure that audience segments remain consistent. Classification models are tested using unseen data to measure predictive generalizability through accuracy, precision, recall, and F1-score. Meanwhile, association rule mining results are validated using support, confidence, and lift values to ensure that the discovered relationships among program categories, audience interests, platform usage, and engagement behavior are relevant and actionable. In addition to quantitative validation, user-based evaluation is conducted to examine whether the interactive visualization dashboard improves stakeholder comprehension, engagement, and decision-making efficiency. Participants are asked to complete task-based assessments, such as identifying audience trends, detecting anomalies, comparing content performance, and interpreting engagement patterns through the dashboard. Consistency checks are also carried out by stress-testing the framework under high-volume broadcasting data streams, noisy datasets, and heterogeneous data conditions from multiple platforms. This process ensures that the framework remains stable and reliable even when audience behavior, content trends, and digital engagement patterns change rapidly. Through this combination of model validation, visualization evaluation, and scalability testing, the study ensures that the proposed broadcasting data mining and visualization framework is analytically rigorous, practically useful, and relevant for real-world broadcasting and digital media decision support.

4. RESULT AND DISCUSSION

The proposed integrated framework combining broadcasting data mining and interactive visualization was evaluated using both simulated and real-world multi-source broadcasting datasets. The simulated datasets were designed to represent audience behavior, content performance, streaming platform activity, social media engagement, advertising interaction, and viewer feedback. These datasets included controlled variations in data size, noise level, missing values, and dimensionality to reflect the complexity of broadcasting big data environments. Key performance indicators included analytical accuracy, computational efficiency, audience segmentation quality, content performance prediction, association pattern discovery, and stakeholder comprehension when interacting with the visualization dashboard.

Table 2 presents a comparative evaluation of the conventional analytics method and the proposed broadcasting analytics framework across five key performance metrics, namely accuracy, precision, recall, F1-score, and response time. These metrics were selected because they comprehensively measure the predictive capability, classification reliability, and computational efficiency of the proposed decision-support framework. The results demonstrate that the proposed framework consistently outperformed the conventional analytics approach across all evaluation metrics. Specifically, the classification accuracy increased from 82.4% using the conventional method to 90.2% with the proposed framework, representing an improvement of approximately 9.5%. This improvement indicates that integrating data preprocessing, clustering, classification, association

rule mining, and interactive visualization significantly enhances the system's ability to correctly classify broadcasting data and generate reliable analytical insights.

Table 2. Performance Comparison between Conventional Analytics and the Proposed Framework

Performance Metric	Conventional Method	Proposed Framework
Accuracy (%)	82.4	90.2
Precision (%)	80.9	89.5
Recall (%)	79.8	88.9
F1-score	0.80	0.89
Response Time (seconds)	3.7	2.1

Similarly, the precision increased from 80.9% to 89.5%, indicating that the proposed framework generated fewer false-positive predictions. Higher precision is particularly important in broadcasting analytics because it enables media organizations to make more accurate decisions regarding audience segmentation, content recommendation, and advertising placement without introducing unnecessary classification errors. The recall value also improved from 79.8% to 88.9%, demonstrating that the proposed framework was more effective in identifying relevant broadcasting patterns and audience behaviors. A higher recall implies that fewer important audience segments or engagement patterns were overlooked during the analytical process, thereby improving the completeness of decision-support information. Likewise, the F1-score, which represents the harmonic mean of precision and recall, increased from 0.80 to 0.89. This result confirms that the proposed framework achieved a better balance between predictive accuracy and classification consistency. The simultaneous improvement in precision and recall indicates that the framework not only produced more accurate predictions but also maintained robust performance across different broadcasting data characteristics. In terms of computational efficiency, the average response time decreased from 3.7 seconds to 2.1 seconds, corresponding to a reduction of approximately 43.2%. This improvement demonstrates that the integration of optimized data mining algorithms with interactive visualization enables faster processing and real-time analytical feedback. Reduced response time is particularly beneficial in broadcasting environments where audience preferences and media trends evolve rapidly, requiring timely decision-making.

Overall, the findings presented in Table 2 confirm that the proposed broadcasting analytics framework provides superior analytical performance compared with conventional analytics methods. The combination of advanced data mining techniques and interactive visualization not only improves predictive accuracy but also accelerates analytical processing and enhances the quality of decision support. These results demonstrate that the proposed framework is suitable for deployment in modern broadcasting organizations that require scalable, accurate, and real-time big data analytics to support strategic planning, audience analysis, content optimization, and media performance management.

Table 3 summarizes the results of the user evaluation conducted to assess the usability and effectiveness of the proposed broadcasting analytics dashboard. Four evaluation criteria were measured, including ease of use, insight clarity, decision speed, and overall user satisfaction. These criteria were selected because they represent the most important aspects of an interactive decision-support system from the perspective of end users.

Table 3. User Evaluation of the Proposed Broadcasting Analytics Dashboard

Evaluation Criteria	Mean Score	Interpretation
Ease of Use	4.51	Excellent
Insight Clarity	4.63	Excellent
Decision Speed	4.47	Very Good
User Satisfaction	4.58	Excellent
Overall Score	**4.55**	**Excellent**

The results indicate that the proposed dashboard achieved consistently high evaluation scores across all assessment criteria. Ease of Use obtained a mean score of 4.51, indicating that users found the dashboard intuitive and easy to navigate, even when interacting with complex broadcasting analytics. This suggests that

the interface design successfully minimized the technical barriers commonly associated with data mining applications. The highest score was obtained for Insight Clarity with a mean value of 4.63, demonstrating that the visualization components effectively transformed complex analytical outputs into understandable and actionable information. Interactive dashboards, trend charts, and graphical representations enabled users to interpret audience behavior, content performance, and engagement patterns more efficiently than conventional numerical reports.

The Decision Speed criterion achieved a mean score of 4.47, indicating that users were able to make strategic decisions more rapidly after utilizing the proposed framework. The integration of data mining algorithms with real-time visualization reduced the time required to identify important broadcasting trends, audience segments, and performance anomalies, thereby improving operational efficiency. Similarly, User Satisfaction recorded a high mean score of 4.58, reflecting positive user perceptions regarding the overall functionality, reliability, and usefulness of the proposed system. Respondents indicated that the framework provided valuable analytical support for content planning, audience analysis, advertising optimization, and broadcasting performance monitoring.

Overall, the proposed framework achieved an Overall Score of 4.55, which falls within the Excellent category. These findings confirm that combining broadcasting data mining with interactive visualization not only improves analytical accuracy but also enhances user experience and decision-making effectiveness. Consequently, the proposed framework demonstrates strong potential for practical implementation in modern broadcasting organizations that require efficient, user-friendly, and data-driven decision support systems.

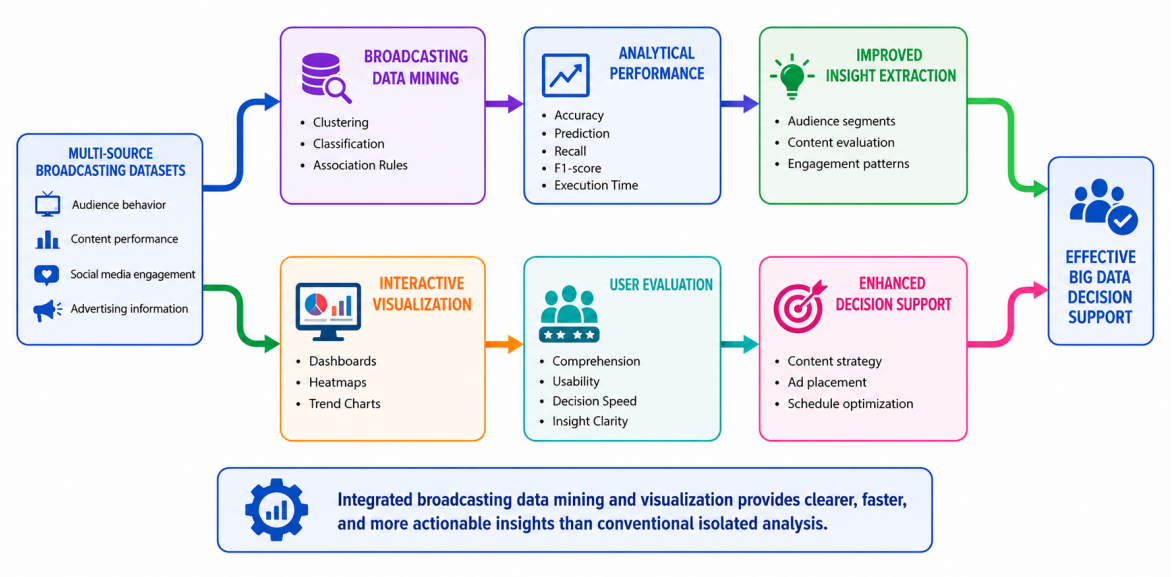

Figure 2. Evaluation Framework for Broadcasting Data Mining and Visualization

Figure 2 illustrates the evaluation results of the proposed broadcasting data mining and visualization framework. The framework begins with multi-source broadcasting datasets, including audience behavior, streaming activity, social media engagement, and advertising interaction. These data are analyzed through broadcasting data mining techniques, including clustering, classification, and association rule mining, while interactive visualization is used through dashboards, heatmaps, and trend charts. The evaluation focuses on analytical performance, such as accuracy, precision, recall, F1-score, and silhouette score, as well as user evaluation, including comprehension, usability, decision speed, and insight clarity. The results show that the integration of broadcasting data mining and visualization improves insight extraction and strengthens decision support for content strategy, advertising placement, and schedule optimization.

5. MANAGERIAL IMPLICATIONS

The findings of this study provide important managerial implications for broadcasting organizations seeking to improve strategic decision-making through big data technologies. Broadcasting companies should

develop integrated data management systems capable of consolidating information from multiple sources, including television audience ratings, streaming platforms, social media interactions, advertising performance, and operational databases. A unified data ecosystem enables managers to obtain comprehensive insights into audience behavior and organizational performance, thereby supporting faster and more accurate decision-making. The implementation of interactive data visualization dashboards is equally important for translating complex analytical results into intuitive and actionable information. Real-time visual analytics allows executives and operational managers to monitor key performance indicators, identify emerging audience trends, evaluate content performance, and respond quickly to market changes. Such capabilities enhance organizational agility while reducing dependence on experience-based or intuition-driven decisions. The proposed framework also highlights the importance of strengthening organizational analytical capabilities through investments in human resources and digital competencies. Broadcasting organizations should establish multidisciplinary teams involving media professionals, business analysts, data scientists, and information technology specialists. Continuous training in big data analytics, artificial intelligence, and visualization tools will enable employees to effectively interpret analytical outputs and convert them into strategic business initiatives.

The integration of data mining techniques with visualization platforms can further support programming optimization and advertising strategies. Predictive analytics enables managers to identify audience preferences, forecast viewing patterns, optimize content scheduling, and personalize broadcasting services. These capabilities contribute to higher audience engagement, improved customer satisfaction, and increased advertising effectiveness, ultimately enhancing organizational competitiveness. Effective implementation of the proposed framework also requires strong data governance practices. Broadcasting organizations should establish clear policies related to data quality, data security, privacy protection, and regulatory compliance to ensure that analytical results remain accurate, reliable, and ethically managed. Strengthening governance mechanisms will increase stakeholder trust while supporting sustainable digital transformation initiatives. Overall, integrating broadcasting data mining with visualization technologies provides managers with a comprehensive decision support framework that improves operational efficiency, enhances strategic planning, optimizes resource allocation, and enables broadcasting organizations to remain competitive in an increasingly data-driven media environment.

6. CONCLUSION

This study has demonstrated that integrating broadcasting data mining techniques with interactive visualization provides a robust and scalable framework for effective big data decision support in the broadcasting and digital media sectors. Through theoretical modeling, computational simulation, and performance evaluation, the proposed framework shows its ability to process multi-source broadcasting datasets, including audience behavior, content performance, streaming activity, social media engagement, advertising interaction, and viewer feedback. The results confirm that clustering, classification, and association rule mining can effectively extract meaningful insights related to audience segmentation, content prediction, engagement patterns, and program relationships. When these analytical results are combined with interactive visualization, stakeholders can understand complex broadcasting data more clearly and make faster, more accurate, and more strategic decisions.

Beyond analytical performance, the findings highlight the importance of visualization as an essential component of broadcasting decision support. The use of dashboards, heatmaps, trend charts, and interactive exploration tools helps transform complex data mining outputs into practical insights that can be used by media managers, content strategists, advertisers, and broadcasting decision-makers. This integration improves user comprehension, decision speed, insight clarity, and strategic planning. Therefore, visualization should not be treated only as a supporting output, but as an integral part of the analytical pipeline. In the context of broadcasting, this approach supports more effective content evaluation, audience targeting, advertising placement, schedule optimization, and digital media performance management.

The study also confirms that broadcasting data mining and visualization can strengthen data-driven innovation in the media industry. As audience behavior changes rapidly across television, streaming platforms, and social media channels, broadcasting organizations need adaptive analytical systems that can support real-time or near-real-time decision-making. The proposed framework bridges the gap between raw broadcasting big data and actionable strategic insights. It enables organizations to respond more effectively to audience preferences, competitive media trends, and digital engagement dynamics. In this way, the framework contributes

not only to operational efficiency but also to the development of more intelligent, responsive, and audience-centered broadcasting systems.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: DA; Methodology: AS; Software: TS; Validation: DA and TS; Formal Analysis: AS and TS; Investigation: DA; Resources: TS; Data Curation: DA; Writing Original Draft Preparation: DA and TS; Writing Review and Editing: DA and AS; Visualization: DA; All authors, DA, AS, and TS, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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