JOURNAL OF THE ROYAL LAUREATES ACADEMY

www.rlaindia.org

AN INTEGRATED MULTI-CRITERIA DECISION ANALYSIS MODEL FOR IMPROVING THE ACCURACY, RELIABILITY, AND EFFECTIVENESS OF SOCIAL MEDIA ANALYTICS

Challuri Sowmya

Research Scholar, Dept. of CSE, Sikkim Alpine University, Namchi Sikkim

Dr. Pankaj Khairnar

Research Supervisor, Dept. of CSE, Sikkim Alpine University, Namchi Sikkim

ABSTRACT

The growing influence of social media has transformed the way organizations collect information, communicate with audiences, and make strategic decisions. However, the increasing volume of user-generated content, variations in audience behaviour, and differences in platform-specific engagement patterns create significant challenges for accurate and reliable social media analytics. This study proposes an integrated multi-criteria decision analysis model to improve the accuracy, reliability, and effectiveness of social media analytical processes. The proposed model combines data preprocessing, sentiment evaluation, engagement measurement, content assessment, criterion prioritization, and alternative ranking within a unified decision-making structure. It emphasizes the integration of quantitative and qualitative indicators to provide a comprehensive understanding of social media performance. Techniques such as Analytic Hierarchy Process, Entropy Weighting, and TOPSIS can support systematic evaluation and prioritization. The proposed model aims to strengthen analytical consistency, reduce decision-making uncertainty, and improve the quality of strategic decisions in dynamic digital communication environments.

Keywords: Social Media Analytics, Multi-Criteria Decision Analysis, Data Accuracy, Analytical Reliability, Decision Support, Sentiment Analysis, User Engagement, Performance Evaluation.

I. INTRODUCTION

Social media has become an essential component of modern communication, influencing business operations, consumer behaviour, public opinion, educational activities, and organizational decision-making. Digital platforms provide opportunities for individuals and institutions to exchange information, share experiences, communicate opinions, and participate in online communities. The continuous generation of posts, comments, reactions, images, videos, and other digital interactions has created extensive datasets that contain valuable information about audience interests and behavioural patterns. Social media analytics enables organizations to examine these datasets and convert unstructured information into meaningful insights. It supports the identification of emerging trends, evaluation of marketing performance, monitoring of public sentiment, and development of effective communication strategies.

Despite its growing importance, social media analytics faces several methodological challenges related to accuracy, reliability, and effectiveness. The information generated through online platforms is frequently unstructured, incomplete, duplicated, and influenced by individual opinions. Different users may express similar attitudes through different linguistic patterns, while identical words may convey different meanings depending on their contexts. Furthermore, engagement indicators such as likes, comments, shares, and views do not necessarily represent the same level of audience interest or communication effectiveness. Consequently, analytical conclusions based on isolated indicators may provide an incomplete understanding of social media performance. An integrated evaluation approach is therefore required to combine multiple indicators and examine their collective contribution to decision outcomes.

Multi-Criteria Decision Analysis provides a systematic methodology for evaluating alternatives according to several criteria that may have different levels of importance. In social media analytics, the alternatives may represent digital platforms, marketing campaigns, published content, communication strategies, or audience groups. The evaluation criteria may include engagement intensity, sentiment orientation, information quality, content relevance, audience reach, and response effectiveness. Techniques such as AHP, Entropy Weighting, TOPSIS, and PROMETHEE can facilitate criterion prioritization and comparative evaluation. Integrating these techniques with social media data-processing procedures can improve the analytical process by establishing a consistent mechanism for measuring performance across different dimensions.

The present study proposes an integrated multi-criteria decision analysis model for improving the accuracy, reliability, and effectiveness of social media analytics. It aims to establish a comprehensive analytical structure that connects data collection, preprocessing, indicator identification, criterion weighting, performance evaluation, and decision interpretation. Particular attention is given to combining objective measurements with qualitative assessments to obtain a balanced understanding of social media activities. The proposed model also considers data quality, contextual interpretation, and sensitivity analysis as important elements of analytical reliability. Through this integrated approach, the study seeks to provide a methodological foundation for evidence-based social media evaluation and improved strategic decision-making in contemporary digital environments.

II. THEORETICAL FOUNDATIONS AND KEY DIMENSIONS OF INTEGRATED SOCIAL MEDIA DECISION ANALYSIS

Social media analytics represents an interdisciplinary field that combines information technology, statistical analysis, data mining, communication research, and organizational decision-making. Its primary purpose is to transform digital interaction data into meaningful information that can support strategic and operational decisions. The analytical process includes monitoring online activities, examining user-generated content, identifying behavioural patterns, evaluating audience responses, and interpreting communication outcomes. These activities require the integration of multiple analytical dimensions because social media performance is influenced by several interconnected factors. A comprehensive decision analysis model must therefore move beyond individual measurements and establish a systematic mechanism for evaluating different indicators together.

The first important dimension is data accuracy, which refers to the extent to which collected and processed information represents the actual social media activities being investigated. Accuracy depends on appropriate data collection procedures, reliable measurement techniques, consistent classification, and effective preprocessing. Duplicate records, incomplete observations, irrelevant content, and automated interactions can introduce errors into analytical datasets. Therefore, data cleaning, validation, normalization, and verification are necessary before conducting further evaluation. The use of suitable text-processing methods can also improve the interpretation of user-generated information. These procedures establish a dependable foundation for subsequent decision analysis and reduce the possibility of misleading conclusions.

The second dimension is analytical reliability, which concerns the consistency and stability of analytical outcomes under comparable conditions. Social media datasets may change because of variations in platform algorithms, user participation, content exposure, and emerging discussions. An analytical model that produces substantially different rankings under minor changes in input conditions may not provide sufficiently dependable decision support. Reliability can be examined through repeated evaluations, alternative weighting configurations, sensitivity analysis, and comparison with independent assessment methods. The inclusion of these procedures helps determine whether the conclusions remain consistent when assumptions or data conditions change.

The third dimension involves social media engagement and audience behaviour. Engagement indicators such as likes, comments, shares, views, and saves provide different forms of information about user interactions. However, these indicators should not be interpreted independently because their significance depends on communication objectives and platform characteristics. For example, shares may indicate the willingness of users to distribute information, whereas comments may reflect discussion and participation. Similarly, views provide information about exposure but do not necessarily demonstrate meaningful interaction. An integrated model should therefore examine the relative contribution of these indicators while considering the context in which they are generated.

Sentiment analysis and content relevance represent additional dimensions of social media decision analysis. Sentiment analysis identifies the emotional orientation expressed in textual information, generally classifying opinions as positive, negative, or neutral. Content relevance examines the extent to which published material corresponds to the interests, expectations, and requirements of the intended audience. Natural language processing can assist in identifying meaningful expressions, contextual relationships, and frequently discussed topics. Nevertheless, sarcasm, informal language, multilingual communication, and cultural differences may affect classification accuracy. Combining sentiment indicators with engagement measurements and contextual evaluation can provide a more complete interpretation of audience responses.

The theoretical foundation of the proposed model is based on integrating these dimensions through multi-criteria evaluation. The model recognizes that accuracy, reliability, engagement, sentiment, content quality, and communication effectiveness contribute differently to the overall assessment of social media activities. Appropriate weighting techniques can establish the relative importance of these dimensions, while ranking methods

can compare alternative communication strategies or platforms. The resulting analytical structure is intended to support transparent, systematic, and evidence-based decision-making. It also provides a foundation for incorporating additional indicators as social media technologies and organizational requirements evolve.

III. DEVELOPMENT AND METHODOLOGICAL STRUCTURE OF THE INTEGRATED MULTI-CRITERIA DECISION ANALYSIS MODEL

The proposed integrated model is developed through a sequence of interconnected analytical stages designed to improve the overall quality of social media evaluation. The initial stage involves defining the research objectives and identifying the alternatives to be assessed. These alternatives may include different social media platforms, promotional campaigns, individual posts, content categories, or audience engagement strategies. The selection of alternatives must correspond to the purpose of the investigation. Clearly defined objectives help establish the appropriate evaluation criteria and determine the type of information required for decision analysis.

The second stage involves data collection and preprocessing. Social media information can be obtained from authorized platform interfaces, approved research datasets, and publicly accessible digital information. The collected data may contain textual content, publication dates, user reactions, comments, shares, views, and other engagement indicators. Preprocessing includes removing duplicate observations, correcting inconsistent formats, handling missing information, and eliminating irrelevant records. Textual content may also undergo tokenization, language detection, normalization, and contextual preparation. These procedures help improve dataset consistency and reduce errors that could affect subsequent calculations.

The third stage focuses on identifying and organizing the evaluation criteria. The proposed model incorporates six major dimensions: data accuracy, analytical reliability, audience engagement, sentiment orientation, content relevance, and communication effectiveness. Each dimension can be represented through measurable indicators. Data accuracy may be evaluated through completeness and validation measures, while reliability can be examined through consistency and stability. Engagement can incorporate normalized interaction rates, and sentiment orientation can be represented through classified audience responses. Content relevance and communication effectiveness may involve expert assessments, audience

feedback, and objective performance measurements. The criteria should be selected according to the specific research context rather than treated as universally applicable indicators.

The fourth stage involves determining the relative importance of the selected criteria. A hybrid weighting approach can combine the Analytic Hierarchy Process and Entropy Weight Method. AHP captures expert judgments through pairwise comparisons, whereas entropy weighting identifies the informational contribution of indicators based on their observed variation. Let the normalized subjective weight of criterion \(j\) be represented by \(w_j^S\), and its objective weight by \(w_j^O\). A combined weight can be expressed as:

The final stage involves result interpretation, validation, and decision support. The ranking outcomes are examined to identify the strengths and weaknesses of different alternatives. Sensitivity analysis is conducted by modifying criterion weights and examining whether the resulting rankings remain stable. The outcomes may also be compared with expert assessments or alternative decision-making methods to evaluate methodological consistency. The proposed integrated model can present its findings through comparative performance scores, criterion-level evaluations, and visual summaries. This stage converts numerical outcomes into practical information that organizations can use to improve their social media strategies.

IV. IMPROVING ANALYTICAL ACCURACY, RELIABILITY, AND ORGANIZATIONAL EFFECTIVENESS THROUGH INTEGRATED EVALUATION

The integrated multi-criteria decision analysis model has the potential to improve social media analytics by establishing a structured relationship between data quality and decision outcomes. Analytical accuracy depends not only on the quantity of available information but also on the quality of its collection, classification, and interpretation. The proposed model emphasizes the importance of preprocessing and validation before applying decision-making techniques. By examining different indicators simultaneously, organizations can reduce the limitations associated with relying exclusively on individual engagement measurements. This approach can provide a more comprehensive understanding of digital communication performance and improve the relevance of analytical conclusions.

Reliability can be strengthened through the application of systematic weighting, ranking, and sensitivity assessment procedures. In conventional analytical systems, changes in selected

indicators or subjective assumptions may significantly influence the final conclusions. The proposed model addresses this concern by incorporating alternative weighting configurations and evaluating their influence on rankings. When the same alternatives are assessed under different reasonable assumptions, the resulting variations can provide information about the stability of the decision process. This approach helps identify whether a particular alternative performs consistently or receives a favourable ranking only under specific weighting conditions. Such information is valuable for organizations making decisions based on changing digital environments.

The model can also improve the effectiveness of social media marketing and communication strategies. Organizations frequently manage several campaigns simultaneously, each involving different objectives, audience groups, and communication approaches. A multi-criteria evaluation mechanism can compare these campaigns according to reach, engagement, sentiment, relevance, and other suitable indicators. For example, a campaign with high audience exposure but limited positive interaction may require a different strategic response from one that generates fewer impressions but stronger audience participation. Integrated evaluation enables managers to recognize these differences and select strategies that correspond more closely to their organizational objectives.

Another important application involves understanding customer satisfaction and audience perceptions. Social media platforms provide opportunities for users to communicate their experiences, express dissatisfaction, recommend products, and participate in discussions. An integrated analytical model can combine sentiment classification, topic identification, and engagement indicators to assess the nature and intensity of audience responses. Organizations may use these insights to identify recurring complaints, evaluate service-related communication, and recognize areas requiring improvement. However, analytical findings should be interpreted with appropriate attention to sample representation, platform characteristics, and the possibility that online participants may not represent the entire customer population.

The proposed approach also offers potential applications in public administration, education, healthcare awareness, and institutional communication. Government organizations may evaluate public responses to awareness programmes, while educational institutions can examine engagement with online learning initiatives and institutional announcements. Healthcare communication organizations may assess the reach and public response associated with health information campaigns. In each application, the selection of evaluation criteria

must reflect the specific objectives and ethical requirements of the relevant domain. Data privacy, consent, information security, and responsible interpretation should remain central considerations when processing user-generated content.

The long-term effectiveness of integrated social media decision analysis will depend on its ability to adapt to changing technologies and analytical requirements. Artificial intelligence, machine learning, natural language processing, and explainable analytical systems can extend the capabilities of the proposed model. Machine learning may assist in identifying patterns and classifying content, while explainable AI can help communicate the factors influencing specific rankings. Future implementations may also incorporate real-time information processing and cross-platform comparisons. Nevertheless, automated predictions should not replace critical human evaluation. Combining computational methods with expert interpretation, transparent procedures, and continuous validation can provide a more dependable foundation for organizational decision-making.

V. CONCLUSION

The increasing use of social media across organizational and public communication environments has created a growing requirement for analytical systems that can provide accurate, reliable, and effective decision support. Traditional methods that examine individual indicators may not adequately represent the complexity of digital interactions and audience behaviour. The present study proposes an integrated multi-criteria decision analysis model to address this limitation by combining data accuracy, analytical reliability, audience engagement, sentiment orientation, content relevance, and communication effectiveness. The proposed approach recognizes that social media performance is multidimensional and requires systematic evaluation across different criteria.

The methodological structure integrates data collection, preprocessing, indicator identification, criterion weighting, alternative ranking, and validation. The use of AHP and entropy-based weighting provides a foundation for combining subjective and objective evaluations, while TOPSIS offers a mechanism for comparing alternatives according to their relative performance. Sensitivity analysis further supports the examination of ranking stability under different assumptions. These components collectively establish a structured approach for interpreting complex social media information and improving the transparency of

analytical decisions. The proposed model is conceptual and requires empirical testing before its practical performance can be established.

The study also identifies potential applications in digital marketing, customer relationship management, public communication, educational activities, and institutional performance evaluation. By examining multiple indicators together, organizations may gain a more comprehensive understanding of audience responses and communication outcomes. The model can assist in identifying effective campaigns, evaluating content relevance, monitoring public sentiment, and recognizing areas requiring strategic improvement. However, successful implementation depends on appropriate data collection, reliable measurements, suitable criterion selection, and responsible interpretation. Privacy protection, platform differences, incomplete observations, and potential algorithmic biases must also be addressed to maintain the credibility of analytical outcomes.

Future research should focus on implementing and evaluating the proposed model through real-world social media datasets obtained from different platforms and application domains. Comparative studies may examine the performance of alternative weighting techniques, ranking procedures, and uncertainty-management mechanisms. Researchers may also integrate artificial intelligence and explainable machine learning to improve contextual interpretation and analytical transparency. Further investigation into multilingual content, changing user behaviour, and real-time engagement patterns could strengthen the adaptability of the model. Ultimately, the proposed integrated multi-criteria decision analysis approach provides a methodological foundation for improving social media analytics and supporting more informed, consistent, and evidence-based organizational decisions.

REFERENCES

1. Araújo, Marco & Ekenberg, Love & Danielson, Mats & Confraria, João. (2022). A Multi-Criteria Approach to Decision Making in Broadband Technology Selection. Group Decision and Negotiation. 31. 10.1007/s10726-021-09772-9.

2. Atte Jääskeläinen, Elli Taimela, Tomas Heiskanen (2020), "Predicting the success of news: Using an ML-based language model in predicting the performance of news articles before publishing", Proceedings of the 23rd International Conference, pp. 27–36.

3. Azhar, Nayli & Mohamed Radzi, Nurul Asyikin & Wan Ahmad, Wan Siti Halimatul Munirah. (2021). Multi-Criteria Decision Making: A Systematic Review. Recent Advances in Electrical & Electronic Engineering (Formerly Recent Patents on Electrical & Electronic Engineering). 14. 10.2174/2352096514666211029112443.

4. B Shi, L Han, H Yan (2018), "Adaptive clustering algorithm based on KNN and density", Pattern Recognition Letters, Vol. 104, pp. 37-44.

5. Pang, L. Lee, and S. Vaithyanathan (2002), “Thumbs up? Sentiment classification using Machine Learning techniques”, Proceedings of the Conference on Empirical Methods in Natural Language Processing (EMNLP), pp. 79-86.

6. Bekmamedova, Nargiza & Shanks, Graeme. (2014). Social Media Analytics and Business Value: A Theoretical Framework and Case Study. Proceedings of the Annual Hawaii International Conference on System Sciences. 3728-3737. 10.1109/HICSS.2014.464.

7. Benito E. Flores, D. Clay Whybark (1986), “Multiple Criteria ABC Analysis", International Journal of Operations & Production Management, Vol. 6, No. 3, pp. 38-46.

8. Bharathi S., Kempe D., and Salek M. (2007), “Competitive influence maximization in social networks”, Lecture Notes in Computer Science, pp. 306-311.

9. Bonissone, P. & Subbu, Raj & Lizzi, John. (2009). Multicriteria decision making (MCDM): A framework for research and applications. Computational Intelligence Magazine, IEEE. 4. 48 - 61. 10.1109/MCI.2009.933093.

10. Borgatti, S., Everett, M. G., and Freeman, L. C. (2006), UCINET 6, Analytic Technologies.