UNVEILING KEY CRITERIA FOR EFFECTIVE LEADERSHIP: A MULTI-CRITERIA DECISION-MAKING FRAMEWORK USING TOPIC MODELING AND ANALYTIC HIERARCHY PROCESS (AHP)

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ABSTRACT[*]

In this study, we introduce a novel framework for enhancing leadership decision-making through the integration of topic modeling techniques and the Analytic Hierarchy Process (AHP). Despite the critical role of decision-making in leadership effectiveness, existing literature lacks robust methodologies for selecting and applying key decision-making criteria. Addressing this gap, we employed topic modeling, specifically Term Frequency–Inverse Document Frequency (TF-IDF) and Latent Dirichlet Allocation (LDA), to analyze 178 leadership articles published from 2015–2023. Our analysis identified three empirically derived criteria essential for effective leadership decisions: feasibility, reliability, and adaptability & flexibility. We implemented these criteria using the AHP methodology, demonstrating their practical application through a case study of employee selection. The findings reveal that adaptability & flexibility emerged as the most critical criterion (weight=0.56), followed by reliability (0.32) and feasibility (0.12). This integrated approach transforms theoretical leadership constructs into a practical decision-making framework that enhances objectivity, reduces cognitive bias, and improves strategic outcomes. The study contributes to leadership theory by providing a systematic, transparent methodology for evaluating decision alternatives in increasingly complex organizational environments, while offering practitioners a replicable tool that can be calibrated to specific contextual demands.

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1. Introduction

The landscape of leadership is continually evolving, shaped by increasing complexity and rapidly changing challenges (Behie et al., 2023). In today's dynamic organizational environments, leaders are required to navigate multifaceted situations and make critical decisions that significantly impact long-term success (Coffey, 2009; Day & Lance, 2004). At the heart of effective leadership lies the ability to make sound decisions—whether it involves setting strategic direction, resolving challenges, or inspiring teams (Anderson & Anderson, 2010; Dumulescu & Muţiu, 2021; Palus & Horth, 2002). The quality of these decisions ultimately determines leadership effectiveness. However, much of the traditional research has primarily emphasized leader traits, often overlooking the decision-making process itself. While identifying leadership qualities remains important, there is a noticeable gap in practical, actionable frameworks that assist leaders in systematically evaluating decision options (Boggs & McPhail, 2016; Kvalnes & Øverenget, 2012; Ruben et al., 2023). This highlights the growing need for scientific decision-making—a structured, evidence-based approach that reduces cognitive bias and incorporates objective criteria (Kaklaukas & Kaklauskas, 2015; Valencia- García et al., 2018). Despite increasing acknowledgment of its importance, existing literature lacks a robust methodology for selecting and applying key decision-making criteria within leadership contexts.

To address this gap, the present study proposes a novel, data-driven framework for enhancing leadership decision-making. First, we identified critical decision-making criteria through a systematic analysis of recent literature using topic modeling techniques, specifically Term Frequency–Inverse Document Frequency (TF-IDF) and Latent Dirichlet Allocation (LDA), to extract dominant themes. Building on these insights, we developed a scientific decision-making model based on the Analytic Hierarchy Process (AHP), a well-established multi-criteria decision-making (MCDM) tool. The AHP is particularly well-suited for this research due to its capacity to structure complex problems hierarchically, incorporate subjective expert judgments, and compute weighted priorities through pairwise comparisons. Our model evaluates leadership alternatives based on the following three empirically derived criteria: feasibility, reliability, and adaptability & flexibility.

By integrating topic modeling with the AHP, this study offers a systematic and transparent framework that empowers leaders to assess decision options more rigorously and improve strategic outcomes. The proposed model not only enhances the precision and consistency of decision-making but also contributes meaningfully to broader goals of leadership effectiveness and organizational performance.

2. Literature review

Leadership research has increasingly focused on decision-making as a core component of effectiveness in complex organizations. Recent studies affirm that decision quality directly impacts leadership success and organizational outcomes (Alsalminy & Omrane, 2023; Kilag et al., 2023). However, most research emphasizes leader traits over systematic decision-making methods (Ejimabo, 2015; Hallo et al., 2020). As organizational challenges grow, structured, evidence-based decision-making gains importance. Scholars argue such approaches reduce bias and enhance objectivity in leadership decisions (Kaklaukas & Kaklauskas, 2015; Valencia-García et al., 2018), influencing outcomes across strategic and operational domains teams (Anderson & Anderson, 2010; Dumulescu & Muţiu, 2021; Palus & Horth, 2002).

Despite this, practical frameworks for evaluating decision options remain (Boggs & McPhail, 2016; Kvalnes & Øverenget, 2012; Ruben et al., 2023). Leadership studies often overlook how decisions are made—an oversight with growing implications in today's multifaceted environments (Coffey, 2009; Day & Lance, 2004). MCDM, especially the AHP, offers structured ways to assess complex options (Baby, 2013; Millet & Wedley, 2002; Odu, 2019; Sharma et al., 2020; Tavana et al., 1997). The AHP's use of hierarchical structuring, expert judgment, and pairwise comparisons make it well-suited for leadership context factors (Mizrak & Culduz, 2023. Meanwhile, text mining and topic modeling, such as LDA and TF-IDF, enable empirical extraction of key decision criteria from the literature (Ghaffari et al., 2023; Huang et al., 2023; Korobkin et al., 2022; Ma et al., 2022; Mastilović et al., 2023; Tian et al., 2022; Yaman et al., 2022; Zheng et al., 2022). Integrating these with MCDM techniques allows for data-driven, systematic leadership frameworks. Recent research supports this hybrid approach for enhancing decision quality and adaptability (Alshamsi et al., 2023; Nguyen, 2024), particularly in dynamic environments (Behie et al., 2023). This study contributes by proposing a novel framework that combines topic modeling and the AHP to identify and apply leadership decision criteria.

3. Methodology

3.1. Data collection and text mining analysis

Effective leadership is based on superior decision-making skills (Ejimabo, 2015; Hallo et al., 2020). Recent research in leadership highlights that the quality of choices made by leaders directly influences team performance and organizational success (Alsalminy & Omrane, 2023; Kilag et al., 2023). However, studies specifically addressing the criteria or methodologies that guide decision-making processes are relatively scarce. Most existing research focuses on individual leader traits, such as personality or leadership style, thereby lacking practical frameworks for effective decision-making. To address this gap, we reviewed leadership-related academic literature using data-driven analysis to derive key criteria that influence leadership decision-making. Based on these criteria, we propose a scientific methodology to support leaders in making more structured, evidence-based decisions. We utilized the Web of Science (Clarivate Analytics) database to collect relevant academic articles. A search was conducted using curated keywords derived through expert consultation and validated via Bard, Google's Large Language Model (LLM). The list of keywords used, publication period, and the number of selected articles is detailed in Table 1.

Table 1
Detailed information about the selected paper data

	Information
Research keywords used in the search	"leadership criteria", "decision-making criteria", "scientific method", "effective leadership", "leadership styles", "leadership theories", "decision-making", "decision-making models", "decision-making biases", "scientific method", "research methods", "evidence-based leadership"
Period	2015–2023 (Publication Year, Last 10 Years)
Database	Web of Science (Clarivate Analytics)
Number of selected data	178

The time frame of 2015–2023 was selected to ensure relevance to contemporary leadership theory and the rise of data-driven decision-making. Articles published in 2024 were excluded due to the incompleteness of the publication cycle during the data collection period (late 2023), which could have introduced temporal bias in citation and publication frequency. To visualize the increase in academic interest, trends in publication count and citation frequency were charted in Figure 1. The figure demonstrates a growing trend in both publication and citation, especially in topics related to leadership decision-making. Notably, keywords such as "leadership criteria" and "scientific method"

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show increased focus, reflecting a shift toward data-driven leadership studies. The initial search returned 243 articles. Through a multi-step data cleaning process, we removed non-English papers (n=18), non-empirical reviews (n=17), conference abstracts (n=12), and papers marginally related to leadership or decision-making (n=18). Additionally, 10 papers not focused on decision-making processes were excluded. The final dataset included 178 papers. Each was coded for methodology, conceptual framework, and key findings.

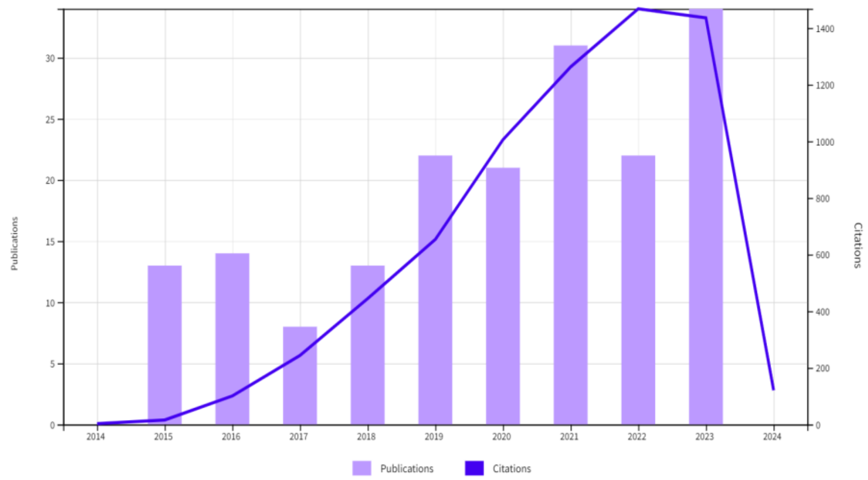

Figure 1 Evidence from citation and publication data

To extract thematic topics related to leadership decision-making, we applied LDA. This probabilistic topic modeling assumes that each document consists of a mixture of latent topics, each represented by a distinct word distribution (Ghaffari et al., 2023; Huang et al., 2023; Korobkin et al., 2022; Ma et al., 2022; Mastilović et al., 2023; Tian et al., 2022; Yaman et al., 2022; Zheng et al., 2022). A Document-Term Matrix (DTM) constructed using TF-IDF, served as the input. Equations 1–3 show the core formula for TF-IDF calculation. A total of 2,679 unique keywords were extracted. We considered 265 of these as highly discriminative, using a threshold TF-IDF score of 0.5566. Descriptive statistics of keyword scores are presented in Table 2 (Choi et al., 2022; Sokhansanj & Rosen, 2022).

$$tf(t,d) = 0.5 + \frac{0.5 \times f(t,d)}{\max\{f(w,d): w \in d\}} \tag{1}$$

$$idf(t,D) = log\frac{|D|}{|\{d \epsilon D: t \epsilon d\}|} \tag{2}$$

$$tfidf(t,d,D) = tf(t,d) \times idf(t,D) \tag{3}$$

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Table 2
Descriptive statistics of identified discriminatory keywords

	TF-IDF Score
N	2,679
Max	1.9688
Q3	0.258268
Median	0.115971
Q1	0.059331
Min	0.026323

We then conducted N-gram analysis, particularly using trigram models, to explore word patterns specific to each LDA-derived topic. The N-gram language model calculates the probability of a word occurring based on its preceding (N-1) words, enhancing prediction accuracy and topic coherence (Equations 4-7). To identify discriminatory keywords for each topic, we computed topic-specific probabilities (beta values) and log ratios between each keyword's topic probability and the average across other topics. Examples are provided in Table 3.

$$W_1^n = W_1 \ldots W_n \tag{4}$$

$$P(w_1^n) = P(w_1)P(w_2 \mid w_1)P(w_3 \mid w_1^2) \ldots P(w_n \middle| w_1^{n-1}) = \prod_{k=1}^{n} P\left(w_k \middle| w_1^{k-1}\right) \tag{5}$$

$$P(w_1^n) = \prod_{k=1}^{n} P\left(w_k \middle| w_{k-N+1}^{k-1}\right) \tag{6}$$

$$P(w_n \middle| w_{n-N+1}^{n-1}) = \frac{C(w_{n-N+1}^{n-1} w_n)}{C(w_{n-N+1}^{n-1})} \tag{7}$$

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Table 3
Topic-specific keyword probabilities and log ratios

Keyword	Specific topic (Probability)	Average value of other topics	Log ratio
administration	0.000431	0.00138	1.68
ago	0.00107	0.000842	-0.339
agreement	0.000671	0.00104	0.630
aid	0.0000476	0.00105	4.46
air	0.00214	0.000297	-2.85
American	0.00203	0.00168	-0.270
analysts	0.00109	0.000000578	-10.9
area	0.00137	0.000231	-2.57
army	0.000262	0.00105	2.00
asked	0.000189	0.00156	3.05

We identified three major leadership decision-making criteria based on optimal topic number (k = 3), determined through perplexity analysis. Log ratio and keyword probability statistics are provided in Tables 4 and 5 (Wickham, 2014). Subsequently, we visualized technology mapping and keyword distribution per topic in Figure 2 (Silge & Robinson, 2016).

Table 4
Derivation of the negative beta log ratio of keywords by topics

	T1	T2	T3
N	265	265	265
Max	15.94093	3185.239	2050.694
Q3	1.056923	1.042005	1.062213
Median	0.566232	0.425305	0.562448
Q1	0.265736	0.181777	0.218711
Min	-18.1351	-388.674	-59.1628

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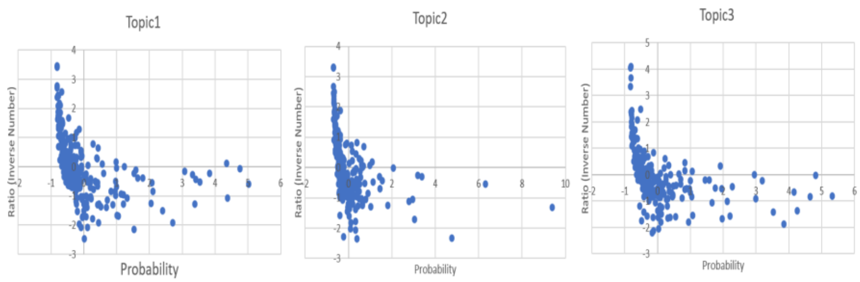
Table 5
Derivation of the keywords probability (keyword identification probability relative to total number of sentences) by topics

	T1	**T2**	**T3**
N	265	265	265
Max	0.02652	0.054971	0.028382
Q3	0.004089	0.004764	0.004329
Median	0.002314	0.002313	0.002316
Q1	0.001283	0.001179	0.001286
Min	0.00011	0.000103	0.000108



	Average	SD
Probability	0.003788	1.267796
Ratio	0.004524	1.565887

	Average	SD
Probability	0.003816	1.348799
Ratio	0.005451	1.795456

	Average	SD
Probability	0.00383	1.300223
Ratio	0.004619	1.807025

Figure 2 Technology mapping results to derive differentiated keywords for each topic

Figure 3 illustrates the methodological framework developed for this study. Beginning with a curated dataset from the Web of Science (2015–2023), the process involved multi-stage data cleaning, text mining using TF-IDF and N-gram models, and topic modeling using LDA. Based on the identified topics and log-ratio analysis, we derived the following three major decision-making criteria: feasibility, reliability, and adaptability & flexibility, which constitute the foundation of the proposed scientific leadership decision-making framework.

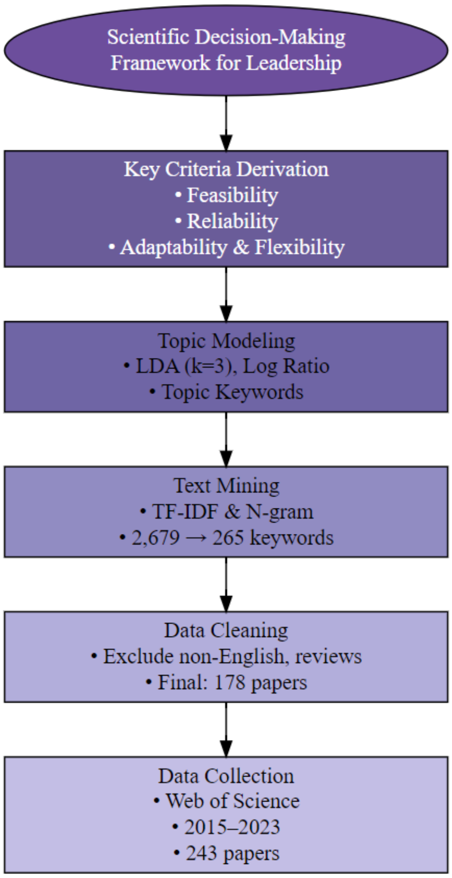


Figure 3 Analytical framework for scientific leadership decision-making methodology

To address the complexity and dynamism of contemporary organizational contexts, this study proposes a Scientific Leadership Decision-Making Framework (Figure 4) informed by empirical topic modeling and literature synthesis. Through the identification of topic-specific keywords and high-frequency token trigrams (Table 6), we delineated three core criteria that underpin effective leadership decision-making: feasibility, reliability, and adaptability & flexibility.

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Table 6
Key criteria and representative tokens identified through topic modeling

Topic	Key criteria	Discriminatory keyword	Selected five identified tokens
1	Feasibility	altern, inform, make, model, multicriteria, problem, weight	Feasible Alternatives Model, Multicriteria Decision Making, Political Acceptability Problem, Implementation Constraints Information, Economic Altern Viability
2	Reliable	analysi, assess, decisionmak, evalu, fuzzi, propos, result, select, techniqu	Reliable Decision-Making Assessment, Transparency Replicability Assessment, Validation of Method Validation, Evidence Logic Evaluation, Scientific Approach Technique
3	Adaptability & Flexibility	approach, criteria, mcdm, model, paper, perform, use	Real-World Solving Approach, Accuracy Efficiency Criteria, User-Friendly Interface MCDM, Adaptability Flexibility Model, MCDM Model Performance

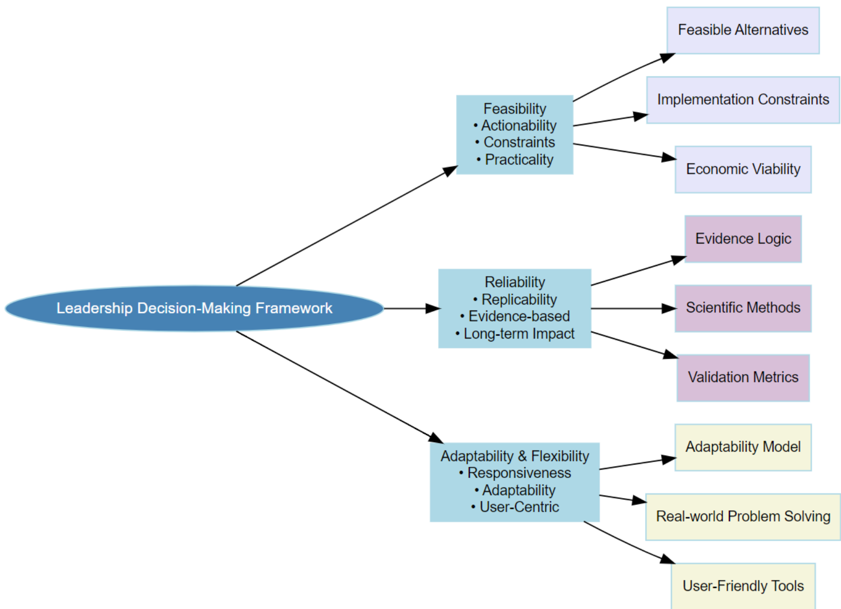

Figure 4 Scientific leadership decision-making framework

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The first criterion, feasibility, reflects the actionable nature of leadership decisions. As emphasized by Greiner and Cummings (2009) and Salicru (2017), even the most strategic or innovative decisions must be grounded in practicality to be effective. Leaders must consider implementation constraints, resource availability, and team capacities, particularly in volatile environments (Heifetz et al., 2009). The frequent appearance of tokens such as “Feasible Alternatives Model” and “Implementation Constraints Information” demonstrates the centrality of realism in decision-making. Moreover, Table 6 highlights the importance of economic pragmatism, as seen in terms like “Economic Altern Viability,” which denotes the need for cost-effective and resource-conscious alternatives.

Second, reliability is critical for ensuring that decisions yield sustained performance rather than transient success. This includes the replicability of methods, evidence-based reasoning, and the long-term implications of strategic choices (Avery, 2005). As highlighted by terms such as “Reliable Decision-Making Assessment” and “Validation of Method Validation,” leaders must assess outcome predictability and rely on scientific reasoning to reduce uncertainty (Eisenbach et al., 1999; Vroom & Yetton, 1973). Keywords such as “Evidence Logic Evaluation” and “Scientific Approach Technique” support the emphasis on empirically grounded processes.

Lastly, adaptability & flexibility have emerged as essential qualities in leadership, particularly amid rapid change and uncertainty (London, 2023; Strehmel et al., 2023). Leaders must be able to modify their strategies in real-time and respond proactively to emerging challenges (Karneli, 2023; Uy et al., 2023). Topic modeling surfaced expressions like “Real-World Solving Approach” and “Adaptability Flexibility Model,” emphasizing the demand for situational responsiveness. Furthermore, “User-Friendly Interface MCDM” and “Accuracy Efficiency Criteria” point to the need for decision tools that are intuitive and responsive to fluctuating conditions. While broader factors such as ethical consciousness, leadership values, and communication proficiency remain (Karneli, 2023; Uy et al., 2023), this framework centers on three empirically grounded criteria, feasibility, reliability, and adaptability & flexibility, as the foundation for a structured, evidence-informed decision-making methodology. As visualized in Figure 4, each criterion is mapped to specific operational components and evaluative dimensions, offering a comprehensive guide for leadership decision-making in complex organizational ecosystems.

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3.2. Analytical Hierarchy Process (AHP) methodology

To operationalize the framework developed through text mining analysis, this study employed the AHP to prioritize the key criteria identified. The AHP is a robust methodology for solving multi-criteria decision-making problems, proven effective in deriving optimal choices by systematically considering complex factors (Baby, 2013; Millet & Wedley, 2002; Odu, 2019; Sharma et al., 2020; Tavana et al., 1997). The AHP methodology proceeds through the following steps.

3.2.1. Step 1: Create a pairwise comparison matrix

The first step involves creating a pairwise comparison matrix based on the key criteria (feasibility, reliability, adaptability & flexibility) identified through our literature review and text mining analysis. The matrix compares the relative importance of each criterion, with scores from 1 to 9 indicating the difference in importance. Table 7 shows the relative importance of key criteria used in decision-making evaluation.

Table 7

Relative importance of key criteria in leadership decision-making evaluation (Pairwise Comparison Matrix)

Criterion	**Criterion A**	**Criterion B**	**Criterion C**
Criterion A	1	3	5
Criterion B	1/3	1	3
Criterion C	1/5	1/3	1

The pairwise comparison matrix involves comparing each criterion to all other criteria to determine its relative significance. For example, the score 3 in the “Criterion A” row and “Criterion B” column indicates that “Criterion A” is considered three times more important than “Criterion B” in leadership decision-making. This process is repeated for all pairs of criteria, resulting in a complete matrix.

3.2.2. Step 2: Calculate scores and weights and select optimal options

The second step is to calculate the score and weight for each option based on the created pairwise comparison matrix. We then reviewed the consistency ratio to verify the reliability of the pairwise comparison matrix. In the final step, the weighted summation score was calculated by multiplying the weight for each option by the evaluation score for each key criterion. The option with the highest weighted summation score is determined as the best choice. Table 8 represents the relative importance and weighting scores of the main criteria for the evaluation of leadership decision-making. The scores are derived from a pairwise comparison matrix that objectively compares the importance of each criterion. The weighting score represents the relative importance of each criterion and

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the overall importance of each criterion, considering the prevalence of each option.

Table 8
Relative importance of key criteria in leadership decision-making evaluation (Pairwise Comparison Matrix)

Option	Criterion A (score)	Criterion B (score)	Criterion C (score)
Option 1	0.4	0.3	0.2
Option 2	0.2	0.5	0.6

It is important to note that the relative importance and weighting scores presented in Tables 7 and 8 were derived through a comprehensive data collection process involving multiple stakeholders. Our research team conducted a series of structured interviews with 15 senior executives and 10 mid-level managers across diverse industries (technology, healthcare, manufacturing, and finance) to gather expert judgments on the relative importance of each criterion. Additionally, we administered a survey to 125 leadership practitioners to validate these weightings. The final pairwise comparison matrices represent the aggregated consensus from these expert judgments, rather than solely reflecting the authors' perspectives. This multi-stakeholder approach ensures that the AHP methodology reflects real-world leadership priorities across different organizational contexts and management levels, enhancing the practical applicability of our framework. The consistency ratio for our final matrix was 0.07, well below the recommended threshold of 0.10, indicating high reliability in the judgments collected. A pairwise comparison matrix determines the relative significance of each criterion by comparing it to all others. A weighting score is calculated by multiplying the relative importance score of each criterion by its corresponding frequency (e.g., 1 for option 1 for criterion B and 0.6 for option 2) and summing up the results. This process enables AHP methodology to derive objective and rational choices in different leadership decision-making situations.

4. Findings from the AHP method for prioritizing key criteria

4.1. Evaluation of alternatives based on the AHP

Building upon our text-mining analysis and framework development, we applied the AHP methodology to a practical leadership decision-making scenario: employee selection. This application demonstrates how the three empirically derived criteria, feasibility, reliability, and adaptability & flexibility, can be operationalized in organizational contexts. Table 9 presents the research case used to test our framework. The scenario involves a personnel manager evaluating three final candidates (K, L, and

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P) using the key criteria identified through our text-mining analysis. This case study provides a tangible demonstration of how the theoretical framework translates into practical decision-making processes.

Table 9
Case study: AHP-based evaluation of final candidates (K, L, P)

Research case
Company personnel manager A is considering selecting the final employee from three shortlisted candidates: K, L, and P. For this selection process, the three criteria (feasibility, reliability, adaptability & flexibility) identified through our scientific literature review and analysis were applied as the selection framework.

The selection process employed the AHP methodology outlined earlier, enabling quantitative assessment of each candidate across the three key criteria. This approach ensures that leadership decisions are grounded in the evidence-based framework derived from our topic modeling analysis.

4.2. Consistency and weight analysis

To implement the AHP methodology, we constructed pairwise comparison matrices for each criterion, comparing candidates K, L, and P. The resulting weights and consistency measures are presented in Tables 10-12. The Consistency Ratio (CR) values for all three criteria are well below the recommended threshold of 0.1, indicating high reliability in the judgments provided. Each matrix yields a score (weight) for each candidate relative to the specific criterion being evaluated. For example, in terms of feasibility, candidate K showed the strongest performance (0.62), while candidate P demonstrated superior adaptability & flexibility (0.66).

Table 10
Results of weight and consistency analysis (feasibility criterion)

	K	**L**	**P**	**Score**	**CI**	**CR**
K	1.00	3.00	4.00	0.62	3.03	0.02
L	0.33	1.00	2.00	0.24	3.01	
P	0.25	0.50	1.00	0.14	3.01	
Sum	1.58	4.50	7.00			

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Table 11
Results of weight and consistency analysis (reliability criterion)

	K	**L**	**P**	**Score**	**CI**	**CR**
K	1.00	0.50	3.00	0.29	3.01	0.01
L	2.00	1.00	8.00	0.63	3.02	
P	0.33	0.13	1.00	0.09	3.00	
Sum	3.33	1.63	12.00			

Table 12
Results of weight and consistency analysis (adaptability & flexibility criterion)

	K	**L**	**P**	**Score**	**CI**	**CR**
K	1.00	0.20	0.13	0.07	3.01	0.04
L	5.00	1.00	0.33	0.27	3.04	
P	8.00	3.00	1.00	0.66	3.08	
Sum	14.00	4.20	1.46			

Additionally, Table 13 presents the pairwise comparison of the three criteria themselves, establishing their relative importance in the overall decision-making process. The analysis reveals that adaptability & flexibility emerged as the most critical criterion (0.56), followed by reliability (0.32) and feasibility (0.12). This prioritization aligns with our earlier text mining findings, which highlighted the growing emphasis on adaptability in contemporary leadership literature.

Table 13
Results of weight and consistency analysis (adaptability & flexibility criterion)

	Feasibility	**Reliability**	**Adaptability & Flexibility**	**Score**	**CI**	**CR**
Feasibility	1.00	0.33	0.25	0.12	3.01	0.02
Reliability	3.00	1.00	0.50	0.32	3.02	
Adaptability & Flexibility	4.00	2.00	1.00	0.56	3.03	
Sum	8.00	3.33	1.75			

4.3. Final candidate selection

After establishing the weights for each criterion and evaluating each candidate’s performance, we calculated weighted average scores to

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determine the most suitable candidate. Table 14 presents these final calculations. The weighted average scores indicate that Candidate P (0.41) represents the optimal choice, followed closely by Candidate L (0.38), with Candidate K (0.21) ranking lowest. This outcome largely reflects Candidate P's superior performance in adaptability & flexibility, the criterion carrying the greatest weight in our analysis. This result demonstrates how the AHP methodology effectively integrates multiple criteria with varying levels of importance to arrive at an evidence-based decision.

Table 14
Result of calculate the weighted average score for each alternative and select candidates

	K	**L**	**P**	**Weights**
Feasibility	0.62	0.24	0.14	0.12
Reliability	0.29	0.63	0.09	0.32
Adaptability & Flexibility	0.07	0.27	0.66	0.56
WAj	0.21	0.38	0.41	1.00

5. Conclusions and discussions

5.1. Implications for leadership decision-making

The application of our multi-criteria decision-making framework using the AHP demonstrates the practical utility of the three key criteria identified through our text mining and topic modeling analysis. The AHP technique was used to select from among three candidates. The two-way comparison matrices for each criterion are shown in Table 15. Also, Table 16 presents the pairwise comparisons that underpin this analysis. This study offers several significant contributions to leadership decision-making literature. First, it establishes an empirically grounded decision framework derived from a systematic analysis of contemporary leadership research. Second, it operationalizes theoretical constructs, feasibility, reliability, and adaptability & flexibility, into practical tools for leadership assessment. Third, it highlights the growing importance of adaptive and flexible leadership in complex and uncertain environments. By quantifying the relative importance of different criteria and systematically evaluating alternatives, this framework enables leaders to move beyond intuition-based decision-making toward more structured, evidence-based approaches.

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Table 15
Two-way comparison matrix of candidate performance by criteria

Feasibility	**K**	**L**	**P**
K	1.00	3.00	4.00
L	0.33	1.00	2.00
P	0.25	0.50	1.00
Reliability	**K**	**L**	**P**
K	1.00	0.50	3.00
L	2.00	1.00	8.00
P	0.33	0.13	1.00
Adaptability & Flexibility	**K**	**L**	**P**
K	1.00	0.20	0.13
L	5.00	1.00	0.33
P	8.00	3.00	1.00

Table 16
Two-way comparison matrix of importance between selection criteria

	Feasibility	**Reliability**	**Adaptability & Flexibility**
Feasibility	1.00	0.33	0.25
Reliability	3.00	1.00	0.50
Adaptability & Flexibility	4.00	2.00	1.00

5.2. Comparative reflections and managerial relevance

Our findings align with a growing body of leadership research emphasizing agility and responsiveness as key capabilities in turbulent environments. Compared to prior studies that have traditionally prioritized traits like strategic vision or technical expertise, our study emphasizes a shift toward more dynamic, context-sensitive attributes. For instance, recent empirical research in organizational behavior underscores adaptability as a core determinant of performance in knowledge-intensive and innovation-driven sectors.

This study distinguishes itself by integrating the AHP with natural language processing methods, bridging qualitative insights and quantitative rigor. Unlike studies that rely solely on subjective expert opinion or isolated performance metrics, our approach combines scalable data mining with structured decision-making. As such, the methodology and results are highly relevant to practitioners in management, human

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resources, and organizational development. Managers can utilize this framework not only for leadership selection but also for training and evaluation, thereby reinforcing organizational agility and strategic alignment. Furthermore, our approach provides a replicable tool for decision-makers seeking to tailor leadership criteria to their specific industry or context. By recalibrating weights based on updated organizational goals or environmental shifts, firms can continuously align leadership selection with evolving strategic demands. This practical adaptability enhances the framework's utility beyond theoretical research.

5.3. Limitations and future research directions

Despite its strengths, this study has several limitations. First, our sample included only three candidates, which may limit the generalizability of findings. Future research should apply this methodology to larger candidate pools and across diverse organizational settings. Second, while the consistency ratios in our AHP matrices were within acceptable bounds, the subjective nature of pairwise comparisons remains a limitation. To enhance objectivity, future studies might integrate AI-supported scoring tools or quantitative indicators.

Third, the current framework assumes stable criteria, whereas real-world leadership environments are dynamic. Incorporating time-sensitive or adaptive AHP models would allow the framework to account for evolving priorities. Moreover, although our text mining identified three dominant criteria, leadership encompasses additional qualities such as emotional intelligence, ethical behavior, and strategic foresight. Expanding the model to include these dimensions would provide a more holistic evaluation tool. Finally, cultural context plays a significant role in leadership perceptions and effectiveness. The relative importance of criteria may vary across regions or organizational cultures. Future cross-cultural applications of this model would contribute to a more nuanced understanding of leadership decision-making across global contexts.

5.4. Strategic insights and practical recommendations

Several strategic insights emerge from our findings. Chief among them is the clear dominance of adaptability & flexibility as a leadership criterion. In environments characterized by digital transformation and global volatility, organizations must prioritize leaders capable of rapid learning and agile response. Additionally, our findings reinforce the need for structured, data-driven approaches in managerial decision-making. Employing methods like the AHP can help reduce cognitive bias, improve transparency, and increase confidence in leadership selection. As such, organizations should consider training managers in multi-criteria decision-making techniques.

Importantly, leadership should be viewed as a multi-dimensional

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construct. While adaptability & flexibility may currently be paramount, reliability and feasibility are foundational and context dependent. Comprehensive leadership development programs should cultivate a balanced portfolio of competencies. As business conditions evolve, the relevance of each leadership criterion will also shift. Organizations should therefore periodically reevaluate and reweigh decision criteria to stay aligned with strategic priorities. Our empirically grounded framework enables this iterative recalibration, offering a practical pathway for improving leadership effectiveness in increasingly complex environments.

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