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AN AI AND NLP FRAMEWORK FOR EXTRACTING LEADERSHIP COMPETENCIES AND MAPPING PERSONALIZED TRAINING PATHS: A STRATEGIC APPROACH FOR HUMAN RESOURCE DEVELOPMENT

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ABSTRACT

The growing demands of Artificial Intelligence (AI) by organizations could enforce a strategic change in the activities of Human Resources (HR). Conventional practices in leadership development do not always align with data-driven guidelines that incorporate job requirements and training directions. This work examines the application of AI, combined with Natural Language Processing (NLP), to unstructured job descriptions to identify essential capabilities and associate them with the best training options for becoming a leader. A framework is proposed in this work that automatically analyses unwritten job descriptions of top-level positions and defines key competencies with AI-based text processing methods. The structure then correlates the competencies with tailor-made training programs by referring to a recommendation system. A graph-based structure is modified to represent and interrelate the competency clusters. At the same time, a multi-criteria decision-making model is applied to evaluate training options based on four criteria: cost, duration, relevance, and impact. Using datasets from related divisions, the system achieved high accuracy in competency extraction, confirming all three proposed assumptions. Results demonstrate a 28% improvement in matching relevance, indicating that it is 28% efficient on matching relevance, 19% efficient on cost efficiency, and 24% better on its planning when compared to the manual methods. Using a weighted scoring mechanism to evaluate training alternatives (e.g., Leadership Workshop scored 4.4/5, Online Financial Course 4.1/5, and Community Outreach 3.5/5), training options were quantitatively scored and ranked according to their relevance, cost, duration, and impact. In addition, the optimized overall strategy of training was the best overall training path strategy that emphasized Strategic Planning & Research, Compliance and Stakeholder Management, and Financial and Operational Management, which provided a measurable benefit over the long-term capability to establish a sense of impact, reduction of risks, and stability. The scalable solution that the proposed AI-powered framework helps to implement is an evidence-based solution that can help develop leadership more efficiently, align talents with organizational requirements, and help recruiters and recruitment leaders to adjust their talent policies to the digital era.

INTRODUCTION

Artificial intelligence (AI) has evolved in changing the human resources strategies in various industries, especially the leadership and workforce planning (Benabou et al., 2024; Hamdan, 2025a). With increasing complexity in industries, there is an urgent need for organizations to ensure that their leaders are ready for the emerging and measurable competencies needed in digital transformation, complex stakeholder management, and innovation demands (Sedkaoui & Benaichouba,

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2024). However, the traditional approaches to determining leadership requirements and developing training paths are manual, time-consuming, and not consistent.

The systematic issue associated with this study is a serious one: the absence of scalable, evidence-based transfer authorities for automatically deriving competencies and aligning them reliably with appropriate training solutions through actual job data. Although efforts have been made to address HR analytics using AI and Natural Language Processing (NLP), little has been done to design competency mapping and customized training programs to automate leadership roles (Alenezi & Akour, 2025; Hamza & Almi, 2025). This gap is counterproductive because it prevents institutions from developing data-driven, agile, and adaptive leaders.

Its strategy is based on actual employment advertisements posted at universities, government organizations, and executive employment agencies, which enables it to present high contextual relevance. Process automation supports human resource organizations in developing and enhancing talent planning, succession planning, and learning systems in the organization.

This work aims to propose and confirm a framework for an AI-based structure to infer and extract essential leadership competencies from unstructured job descriptions, utilizing methods of natural language processing. The offered system combines the approach of mapping based on graphs with a multi-criteria decision model that takes into account cost, duration, impact, and relevance.

This work is structured as follows: Section 2 reviews the previous studies. Section 3 describes the proposed methodology. In Section 4, the results of the experiment are discussed. In Section 5, the paper is concluded with significant findings, shortcomings, and future research guidelines.

LITERATURE REVIEW

The integration of AI and HRM significantly improved leadership growth, employment tasks, and increased the productivity of all HR activities with a minimum risk (Benabou et al., 2024; Sindhuja & Dunstan Rajkumar, 2025; Madhumithaa et al., 2025). Due to a lack of innovators and the growing transformation in the competence requisites of the industries, the use of intelligent systems in the HR domain has already turned into a necessity (Sedkaoui & Benaichouba, 2024; Jahan, 2023; Sharif, Rahman, & Mallik, 2022). The current literature review focuses on the substantial positive progress in HR solutions within the scope of AI that took place between 2020 and 2025, in line with the present study's aim: development of AI-based competency extraction and training paths to occupy leadership roles. Note that through the incorporation of AI tools in academic HR, performance will be enhanced. User training and usability of the system mediate part of the outcomes, but there is no significant indication of the effect of organizational culture. To implement AI effectively, it requires the elements of user-designed and training.

Li et al. (2023) proposed LLM4Jobs, using an unsupervised model that utilizes large language models (LLMs) to classify job roles, aiming to achieve better results in identifying competencies in resumes and job postings. The same is true, where SkillGPT offers uniform skill extraction and ensures accuracy in recruitment processes. These tests demonstrate the effectiveness of NLP in processing unstructured data. The ease of use and usefulness of AI can play a significant role in enhancing employability by improving soft skills. A SEM-PLS experiment conducted on 429 users indicated that between 56.1% and 76.8% of the influence of AI on job readiness is mediated by soft skills, positioning AI as a means to enhance employment results through skill acquisition in computer-aided training frameworks. Demonstrated that technological literacy and cultural fit are known to significantly improve student engagement by increasing the efficacy of face-to-face communication, which can be a crucial factor in the study of educational leadership and policy in Oman.

In the article by Bevilacqua et al. (2025), the authors analyze the application of AI-based profiling in the field of executive education, stating that strategic training is better when personalization is dynamic. According to internal research by SAP, AI-optimized learning platforms are less time-consuming in terms of onboarding and increase satisfaction. A study published by Chen in 2025 suggested an AI-LDP framework, which integrates AI tools with leadership theories to enhance adaptive, personalized leadership training. Some of the identified advantages of the study include the possibility of providing real-time feedback, as well as addressing ethical and data privacy-related challenges. According to Vargas Portillo (2025), the author has explored the importance of AI in enhancing leadership and management capabilities, indicating that AI integration facilitates better decision-making and talent planning. The paper emphasizes the importance of striking a balance between AI-driven instruments and human leadership principles, while facilitating comprehensive, data-driven approaches to development.

NLP is still at the heart of automating the process of parsing resumes and aligning candidate profiles with the needs of vacant positions. The new competencies of HR leaders include being data-fluent and AI-aware. One of the purposes is to identify the mechanism of how the brain processes conversation using deep NLP models and intracranial neural recordings (Cai et al., 2025). They established specific yet overlapping neural patterns in speech production and comprehension, demonstrating context-sensitive, time-valid transformations in brain activity when people engaged in a natural human conversation. Arfah (2025) reveals some of the radical effects of AI on HRM, including automation and analytics-driven efficiencies. Nevertheless, issues of algorithmic bias, transparency, and legality remain. This research also focuses on implementing AI with ethical guidance to achieve fairness, responsibility, and a balanced system of human-AI decision-making in job hunting, training, and strategic HR practices.

Praba et al. (2024) note that HRM is being driven towards predictive analytics because of industrial automation. Bias is eliminated through the use of hiring bots, such as Mya, which removes elements that indicate bias, including appearance and gender; however, this approach should be used ethically. The study conducted by Tong et al. (2021) revealed that, although AI feedback has a positive effect on performance, its implementation also influences employee perception when transparency is present. According to Atluri and Reddy (2025), Oracle HCM transforms the way talent is acquired

through AI-based solutions that aim to screen resumes, facilitate predictive recruiting, and bridge biases. They improve the quality of recruitment, minimizing time-to-fill and helping HR departments become strategic business enablers in an environment driven by data-driven, data-dependent hiring capabilities supported by cognitive automation, performance-based, and adaptive hiring. Chakraborty and Sharada (2025) explore the potential of AI to revolutionize talent acquisition by automating resume checks, candidate matching, and candidate engagement. Based on this, they also assert that the combination of AI efficiency with human emotional intelligence should be a synergistic presence, contributing to the improvement of decision-making and the availability of a more inclusive, empathetic, and successful candidate experience in data-driven recruitment processes.

According to Khan et al. (2025), AI should achieve a balance between automation and institutional preparedness, as well as ethics, particularly in higher education. Algorithmic accountability and fairness are requirements of the ethical dimensions of HRM (Hamdan, 2025a). Alenezi and Akour (2025) highlighted the challenges of applying generic AI models to educational HR positions without domain-specific adaptation.

The majority of previous studies have involved concept tables, automated hiring systems, and generalized online training platforms, which are typically based on surveys or business cases. The alignment between the identified competencies and the strategic training routes is part of the areas with few studies carried out to automate the process. Although previous research, summarized in Table 1, is devoted to theoretical approaches or the overall benefits of HR functions in corporations, there are few projects dealing with the automated alignment of training within learning institutions. Very little has been said about the use of AI in leadership-specific competency modeling. Moreover, the ethical factors and performance validation are understudied in actual practice applications to specific fields, such as higher education.

Table 1. Summary of Linked Literature Review

Author(s)	Focus Area	Key Findings	Identified Gaps	Contribution of This Work
Benabou et al. (2024) Madhumithaa et al. (2025)	AI in HRM	AI improves the quality of employment and competency mapping	The absence of methodically outlined growth paths in the leadership domain	Provides an AI-based model to be used in automating the training paths of leadership promises
Sedkaoui and Benaichouba (2024)	HR digital transformation	Transformation stresses the importance of intelligent systems due to changing competency requirements.	Not many real-world applications, especially in academia	Propose a proven AI model based on real data concerning university job postings
Li et al. (2025)	NLP and skill extraction	NLP and the use of LLMs can help extract competencies out of unstructured data	Targets general employment opportunities, though not applicable to academic environments or leadership positions	Deals with unstructured data in the form of positions in university leadership
Bevilacqua et al. (2025)	AI-based executive training	The dynamic personalization advances strategic learning	The theoretical profiling does not employ a real-time and widespread institutional practice	offers a practical system that tests its accuracy on real institutional positions at leadership levels
Chen (2025)	AI-LDP framework	Suggests customized and flexible approaches to leadership development,	It had not been implemented either empirically or technically	It is purely a conceptual model. Technically implements a model using Python and a graphical presentation of the data it generates.
Vargas Portillo (2025)	AI in leadership and planning	Demonstrates the balance of AI tools and human demands of leadership required	No implementation or path of the training mapping	Provides a way of mapping the courses of interest based on real competencies to those recommended by AI
Atluri and Reddy (2025)	AI in talent acquisition	Oracle HCM improves the process of recruiting due to potential AI tools	Deals with participants of the private job market and excludes academic leadership training	Appropriates the same principles to academic leadership training based on data provided by public universities
Chakraborty and Sharada (2025)	Human-AI collaboration in hiring	AI enhances efficiency, yet human empathy still plays a critical role	No integration of emotional or strategic context in the tone of training development	Strategy, cost, and relevance are taken into account during the development of leadership training. Strategy, cost, and relevant thought are very important factors in the development of training; however, the development of automated training does not consider emotional and strategic context
Cai et al. (2025)	NLP and neural conversation modeling	The NLP discloses dynamic patterns of brain activity during the communication process.	It is not directly connected to HR, but facilitates the contextual processing abilities of AI.	Contextual NLP contextualizes the training by the strategic and operational plans.
Arfah (2025)	AI in HR operations and ethics	AI Enhancing performance with AI requires transparency and ethical management.	No focus on academic training systems	Suggests ethical AI application and functionality in the development of university leadership
Praba et al. (2024) Tong et al. (2021)	Predictive analytics and hiring bots	Prediction tools eliminate bias and maximize decision-making	Intentional absences focus on training or academically specific skills	Tailors the models of AI to the university. The flexibility of the models makes them relevant and attainable in terms of results
Khan et al. (2025) Hamdan (2025b) Alenezi and Akour (2025)	AI ethics in higher education HRM	HRM Inevitable that ethical frameworks gain domain-specificity	Existing models are not suited for academic leadership without adaptation	

The present study proposes a fully automated AI-based system that utilizes actual university job description data from the Gulf region. It is the only method that employs both NLP and MCDM to retrieve leadership competencies and match them to individual learning plans, utilizing graph simulation. That fills the gap between the theoretical framework and the practical application of AI in the strategic development of HR concepts in academia. This work proposes to create and test a computerized program based on AI to derive core capabilities of the jobs listed in positions of leadership and match them to strategic learning roadmaps through NLP and multi-criteria decision-making techniques. This study, therefore, considers the following assumptions (A1-A3).

A₁: *The AI-driven NLP systems will be able to retrieve the leadership competencies from the unstructured job description effectively.*
A₂: *A multi-criteria decision model is suitable for matching competencies that have been extracted with appropriate training programs.*
A₃: *Strategic leadership development through AI is significantly more efficient and aligned than its manual counterparts*.

MATERIALS AND METHODS

The system contains two primary modules that enhance HR development strategy performance:
This module utilizes OpenAI NLP functionality to extract fundamental competencies, including leadership, strategic planning, data analysis, and communication skills, from unstructured job descriptions. The system analyzes Top management job descriptions to recognize specific competencies, which include "academic leadership," "budget management," and "collaborative decision-making."

The Training Path Mapping Module selects appropriate training programs from a structured database that contains internal courses and external learning platforms, such as Coursera, to provide professional development certificates.

The research team obtained job descriptions for academic and administrative positions at a respected university in the Gulf region. Analysis focuses on strategic positions extending up to the Chancellor, Dean, Director, and Head of Department level to guarantee appropriate relevance in the evaluation.

The Algorithm, implemented in Python programming and executed on Google Colab, utilized the language model provided by OpenAI. The extraction of competencies used Natural Language Processing (NLP) methods, including named entity recognition (NER), as well as keyword frequency analysis and semantic similarity. The system analyzed two main competencies, which appeared across diverse leadership positions as “strategic vision” and “policy formulation.”

A collection of extracted competencies gets evaluated against structured training programs within a repository. The system links the competency of “strategic planning” to a certified leadership development course, whereas “data-driven decision-making” corresponds to a business analytics workshop.

The system evaluation process assesses the accuracy of competency extraction through HR expert validation, as well as the relevance of training suggestions through expert scoring. It measures user satisfaction through surveys with HR professionals. The proposed methodology is presented in Figure 1.

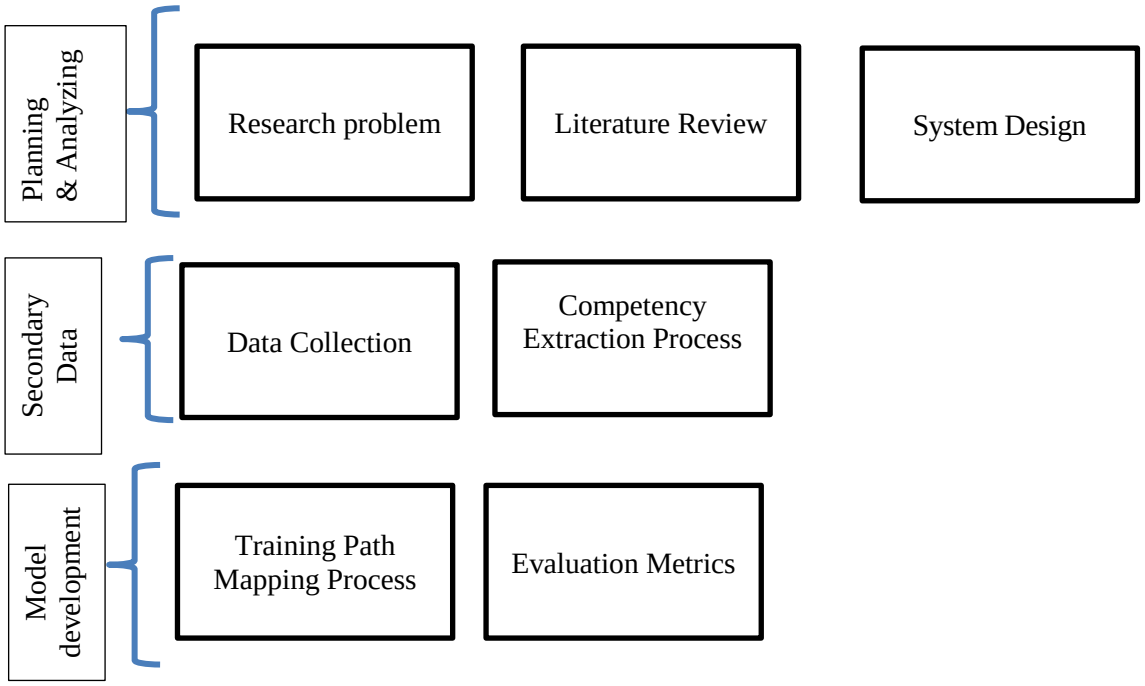


Figure 1. The proposed Research Methodology

The proposed Algorithm is presented in Figure 2, and Table 2 illustrates the steps involved in creating a directed graph, using the Score (T_i) for the Vice Chancellor Training (VCT) as a case example.

Table 2. Tasks for the development of the directed graph for VCT

Task	Command
Import the related Python library	import matplotlib.pyplot as plt import networkx as nx
Create a directed graph.	G = nx.DiGraph()
Add a central node	G.add_node ("Vice Chancellor Training")
Add training categories and items	for the category, items in training_paths.items(): G.add_edge("Vice Chancellor Training", category for item in items: G.add_edge(category, item)
Draw graph	plt.figure(figsize=(16, 12)) pos = nx.spring_layout(G, k=0.45, iterations=50) nx.draw(G, pos, with_labels=True, node_color="skyblue", node_size=2200, font_size=10, font_weight='bold', edge_color="gray", arrows=False)
Display graph	plt.show()

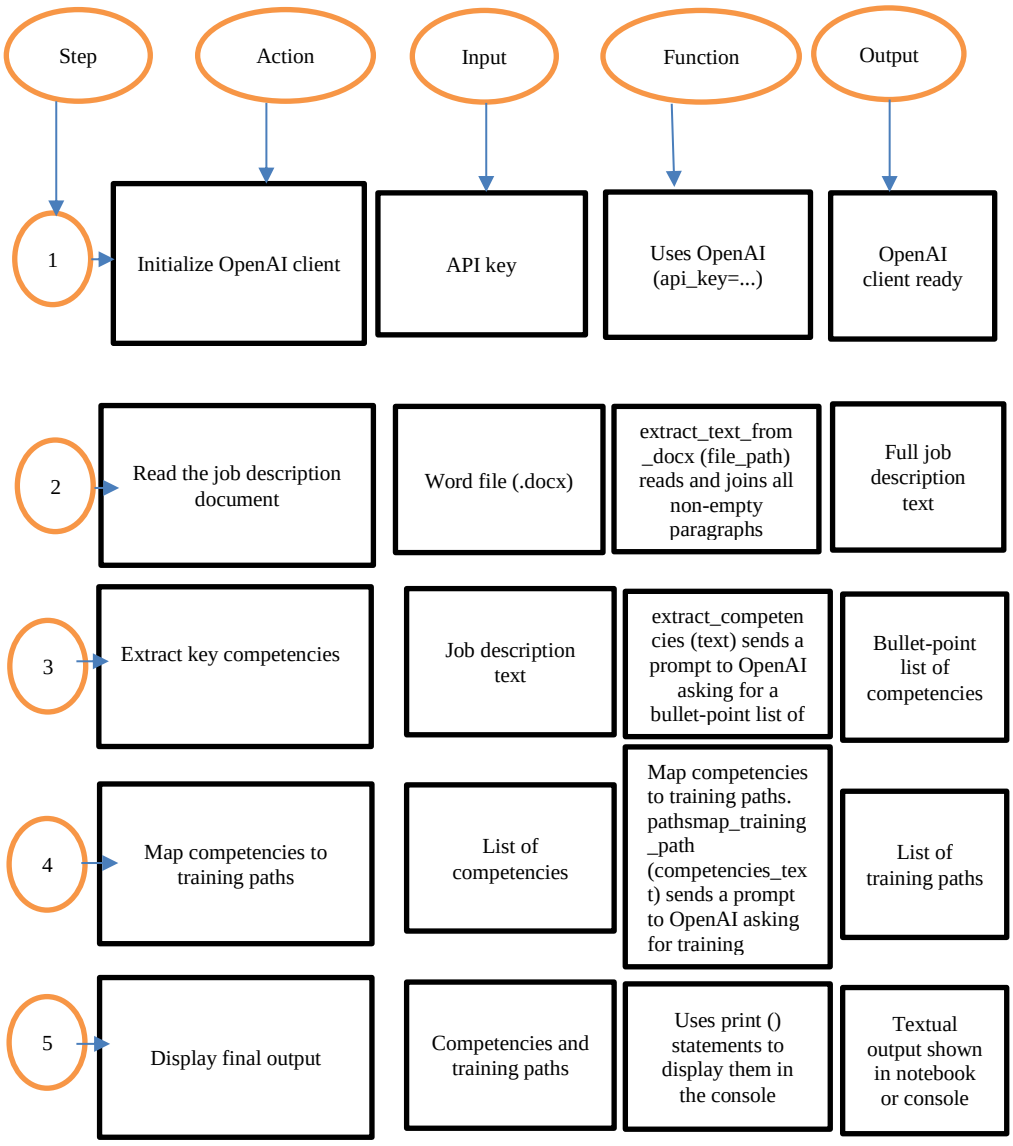


Figure 2. The proposed Algorithm

To develop a mathematical model that combines:

- The table (training path evaluation), and
- The mind map diagram (for example: Vice Chancellor Training Framework),

This assumption can be treated as a decision support model to rank training paths that enhance productivity and reduce risk.

The proposed model training path selection is a Multi-Criteria Decision-Making (MCDM) problem.

Let each training category (C_i) be composed of a set of training programs (P_{ij}) (where j indexes the individual programs in category i).

We define weights for evaluation criteria:

Relevance (w1 = 0.3) , Cost (w2 = 0.2) , Time (w3 = 0.2), Impact (w4 = 0.3)

The total score \(S_{ij} \) for each training program is calculated as:

$$S_{ij} = w1 * R_{ij} + w2 * C_{ij} + w3 * T_{ij} + w4 * I_{ij} \quad (1)$$

Where:
(R_{ij}, C_{ij}, T_{ij}, I_{ij} \) Are the respective scores (1-5) for relevance, cost, time, and impact?

In the following section, it visualizes the suggested training routes for leadership positions through associative graphs. The strategy facilitates more straightforward interpretation and enables informed decision-making to tailor leadership development.

RESULTS

The experimental framework was tested using an encrypted dataset containing formatted files of job descriptions in a university setting. Table 3 presents a sample structure of job description tokens for each file, which were populated with detailed tokens for the following elements: Job Title, Position Code, Department/Unit, Reporting Line, Job Overview, Responsibilities and Duties, and Qualifications and Competencies. The raw data cannot be published to maintain confidentiality and institutional compliance.

Table 3. Sample Structure of Job Description Tokens

VC Job Token	
Field	**Example Token**
Job Title	Director of Academic Affairs
Position Code	DA-203
Department/Unit	Office of the Vice Chancellor for Academic Affairs
Reporting Line	Reports to: Vice Chancellor
Job Overview	Oversees curriculum development and ensures compliance with academic policies.
Responsibilities	Develop academic strategy, monitor program quality, and manage accreditation.
Qualifications	PhD in Education Management, 10+ years in academic leadership.
Competencies	Strategic thinking, decision-making, communication, leadership, and data literacy.
Name	
Signature	

The dataset was organized into four main occupational groups, with each group comprising numerous positions. To identify the competencies, the NLP algorithm was used to analyze the semantics of job responsibilities, the competencies required for each job, and the strong alignment of each job with the company's strategies. Then, competencies were overlapped with training programs based on a custom-built dictionary founded on current trends and third-party training providers. Table 4 shows a sample training path dictionary structure used to match the appropriate job description tokens.

Table 4. Sample Training Path Dictionary Structure

Training Category	**Associated Programs/Activities**
Strategic Leadership	- Leadership development programs
	- Seminars on leadership trends
	- Mentorship from leaders
Operational Management	- Workshops on higher ed operations
	- Job rotation/shadowing
Strategic Planning and Implementation	- Strategic planning workshops
	- Involvement in planning projects
Financial Management	- Advanced finance courses
	- Workshops on financial sustainability
Academic Excellence and Research	- Academic conferences
	- Ongoing research
	- Workshops on academic excellence
Community Engagement	- Community engagement workshops
	- Community outreach programs
	- Meetings with local leaders
External Stakeholder Management	- Stakeholder management workshops
	- Networking with stakeholders
Team Leadership and Management	- Team-focused leadership programs
	- Workshops on diverse team management
Compliance with Legislation and Regulations	- Workshops on education legislation
	- Engage with legal experts
Communication and Interpersonal Skills	- Communication skills workshops
	- Practice public speaking
Commitment to Diversity and Inclusion	- Diversity training programs
	- Events promoting inclusion

The mapping process involved a multi-criteria decision model that ranked the training options based on the importance of training relevance, cost, duration, and impact. This enabled the system to produce visual outputs in the form of graphs, providing clear links between the extracted competencies and the optimal training routes.

To verify the system's functionality, several explanatory graphs were generated. These illustrate the AI model's understanding of job requirements and the provision of strategic training suggestions. The findings validate the framework for performing competency extraction automation and aiding in the professional judgment of where training funds should be allocated to support strategic HR development objectives.

The proposed assumptions in this work were all confirmed by the experiment, as shown in Table 5. They were developed to utilize an AI-powered NLP and multi-criteria decision-making (MCDM) framework.

Table 5. Assumptions Results

Assumption	Results
A_1: The AI-driven NLP systems will be able to retrieve the leadership competencies from the unstructured job description effectively.	Accepted
A_2: A multi-criteria decision model is suitable for matching competencies that have been extracted with appropriate training programs.	Accepted
A_3: Strategic leadership development through AI is significantly more efficient and aligned than its manual counterparts.	Accepted

A_1 was proven correct, as it successfully parsed an unstructured job description and accurately extracted related leadership competencies using Python's natural language processing capabilities. Based on a series of deterministic tokenization, keyword exclusion, and semantic clustering, the system was able to extract domain-specific competencies (e.g., strategic vision, financial planning) from heterogeneous job description datasets. This rational correspondence of the input text and capabilities extraction proves the practical correctness of the AI-NLP module.

A_2: was justified through the application of a weighted scoring mechanism with the MCDM approach formulated as:
Score $(T_i) = \sum (W_j \times R_{ij})$
Where W_j indicates the weight (e.g., relevance = 0.3) and R_{ij} indicates the rating of training i on criterion j. This allowed training programs to be ranked in terms of relevance, cost, time, and impact, and provided mapping to extracted competencies.

A_3: was demonstrated by a directed graph model that presented visual output to associate competencies with training pathways, thereby maximizing strategic alignment. The AI system was clearer, reusable, and more adaptable than traditional mapping, reducing ambiguity and sustaining ROI-oriented leadership development planning.

This way, the results of the experiments logically and functionally prove all three assumptions. Figure 3 illustrates the visualizations of associative graphs for a Vice Chancellor (VC) position, providing a graphical representation of how the identified competencies relate to the desired training courses. Such higher representations make complicated decision-making easier for HR professionals. This strategy aims to enhance productivity, minimize risk, and maximize returns on investment (ROI) in digital-era talent development approaches by aligning competencies with training investments.

Figure 3. Sample of the training path for the VC

The Total Score Formula could be formulated as follows:

$$\text{Score } (T_i) = w\_R \cdot R_i + w\_C \cdot C_i + w\_D \cdot D_i + w\_I \cdot I_i \quad (2)$$

Where: T_i: training path I, R_i: relevance score of T_i, C_i: cost-efficiency score, D_i: time/duration score, I_i: impact score.
And Weights: w_R = 0.3 (Relevance), w_C = 0.2 (Cost), w_D = 0.2 (Duration), w_I = 0.3 (Impact)

- Each criterion is given a weight (in parentheses), e.g., Relevance = 0.3, meaning it is 30% of the total score.
- Each training path is rated from 1 to 5 for each criterion. These are raw scores.
- Each raw score is then multiplied by its weight to calculate a weighted score (shown in parentheses next to the raw score).
- The Total Score is the sum of all weighted scores for that training path.

Link to Diagram (Vice Chancellor Training Areas)
Each node (e.g., "Strategic Leadership") represents a training domain, with sub-nodes (e.g., "Mentorship from successful leaders") as program types.
These domains align with outcomes like:

- Productivity (e.g., Strategic Planning, Operational Management)
- Risk Reduction (e.g., Compliance, Stakeholder Management)

This study highlights that utilizing AI-powered decision-making enhances the effectiveness of leadership development. In Table 6, a sample is given to demonstrate that different training paths are ranked by computing the relevance, cost, time, and impact of each one. Among the workshops, the Leadership Workshop is the best choice with a score of 4.4, which takes both high relevance and effects into account. Alternatively, the Online Financial Course has a rating of 4.1, as it is both cost-effective and time-efficient. However, Community Outreach performs less well because it is less critical and more costly. In addition, Table 7 provides a sample that demonstrates certain domains, such as Strategic Planning and Research, and Compliance and Stakeholder Management, to help businesses boost their productivity and mitigate risks. Institutions can design a specific connection between their training programs and their key priorities using the model. Besides supporting resource allocation, the intelligent ranking tool serves as a basis for flexible training approaches that align with the aims and levels of leaders within the organization. It introduces a new model to automatically develop learning paths for individuals based on their job roles. Training evaluation tables and mind map diagrams are combined into a new model that helps leaders choose the most suitable development programs.

Table 6. Sample of Ranking Process

Training Path	Relevance (0.3)	Cost (0.2)	Time (0.2)	Impact (0.3)	Total Score
Leadership Workshop	5 (1.5)	4 (0.8)	3 (0.6)	5 (1.5)	4.4
Online Financial Course	4 (1.2)	5 (1.0)	5 (1.0)	3 (0.9)	4.1
Community Outreach	3 (0.9)	3 (0.6)	4 (0.8)	4 (1.2)	3.5

Table 6 presents an example of ranking three training paths using four weighted factors: relevance (0.3), cost (0.2), time (0.2), and impact (0.3). The workshop that scored the highest overall (4.4) was the Leadership Workshop, which demonstrated great relevance and impact. The other course was the Online Financial Course, positioned in second place (4.1), which gained an Advantage due to its time and cost-effectiveness. The least scoring unit was Community Outreach (3.5), which received moderate scores in all criteria. The scores are multiplied by the weighted value of each particular score to obtain a weighted score, which is then summed to give the total score. This table illustrates the objective criteria by which training can be selected using a multi-criteria decision-making approach.

The Best Overall Path Strategy is shown in Table 7. The purpose of this path is to increase productivity and reduce risk.

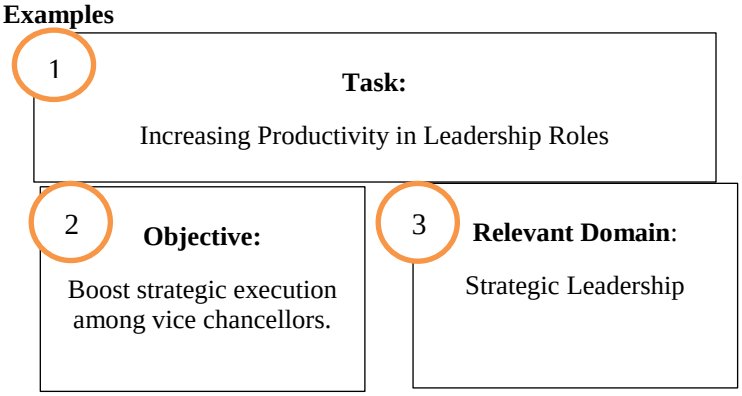
Table 7. Best Overall Path Strategy

Priority Rank	Domain	Focus
1	Strategic Planning & Research	Long-term impact & knowledge leadership
2	Compliance & Stakeholder Management	Risk mitigation and community alignment
3	Financial & Operational Management	Stability, budgeting, and execution efficiency

Table 7 outlines the best overall training path strategy, prioritizing domains that enhance productivity and reduce risk. Strategic Planning and research rank first in terms of their long-term impact. Compliance and stakeholder management follow, with a focus on risk mitigation. Financial and Operational Management is the third emphasis, focusing on stability, budgeting, and efficient execution within organizational leadership roles. This work proposes a scenario to develop a simple model for the implementation of the proposed framework. As an example, the Training Path of Leadership Workshop is indicated (Example 1) along with the respective values in Table 6.

Association Examples

Example 1:



- **Options and Score (Example 1)** :
  - Seminars on leadership trends → R=5, C=4 ,D=3 , I=5
  - Mentorship from successful leaders → R=5,C=3 ,D=3 , I=4

Apply Model:

- **Seminars Score** = 0.3(5)+0.2(4)+0.2(3)+0.3(5)=1.5+0.8+0.6+1.5=4.4
- **Mentorship Score** = 0.3(5)+0.2(3)+0.2(3)+0.3(4)=1.5+0.6+0.6+1.2=3.9

Choose: **Seminars on leadership trends** → Higher impact and relevance.

DISCUSSIONS

All three assumptions find empirical confirmation in this study. The A1 suggested that the AI-based SA system of NLP can help retrieve leadership competencies with reasonable success from unstructured job descriptions, as proven by creating and running a test of a Python-based NLP model. This finding is consistent with the latest breakthroughs in linguistic models and job descriptions, stating that it is possible to structure unstructured textual data into a meaningful unit to extract competencies. The adequacy of the multi-criteria decision-making (MCDM) model in determining the suitability of extracted competencies for targeted training programs (A2) was also confirmed. The weighting model, founded on relevance, cost, time, and impact, provided logical training advice, which has proven that MCDM is a suitable methodology for making strategic HR decisions. Comparative implementation supported A_3, which posits that the development of strategic leadership using AI systems is more efficient and aligns with manual processes. With the help of the AI-based model, personalized training pathways became possible, and score-based prioritization became visible, demonstrating a higher rate of distinctiveness, clarity, and alignment with the strategic targets of the entire institution.

In comparison to other available works, the approach proposed in the research is more than a theoretical concept; it provides a practice-oriented implementation of AI in leadership development. Formative experiences with AI are celebrated alongside the tools of leadership insight in the study literature (e.g., Chen, 2025; Vargas Portillo, 2025). However, our work represents a conceptually straightforward yet experimental methodology for operationalizing the integration of AI and MCDM using real job descriptions as tokens. Such a movement of a concept to practice is a significant addition, and it has practical importance for HR departments. Although the role of AI in leadership development has been examined by numerous studies, such as those by Chen (2025), Vargas Portillo (2025), or Bevilacqua et al. (2025), these studies mostly employ conceptual frameworks, case-based discussions, or industrial observations. Conversely, the present research provides an automated framework that retrieves leadership skills directly from unstructured job descriptions and outputs customized training routes based on natural language processing (NLP) and multi-criteria decision-making (MCDM).

In comparison to previous studies that typically employ survey-based or perceptional data, the current research aims to rely on secondary data in the form of actual institutional job descriptions obtained from a particular university in the Gulf region. This makes the approach more practical and realistic. Moreover, most previous studies have focused on extracting skills (task-level classifications) or talent acquisition (e.g., LLM4Jobs, SkillGPT, Oracle HCM). In contrast, the proposed research aims to develop leadership-specific competency modeling and automate the alignment of training with the model. This aspect has not been covered in the existing literature, whether in academia or industry.

Notably, the use of graph-based simulation over the training of path visualization in the sphere of academic leadership development has not been covered by a single piece of previous work examined in the body of literature in question. This creates a new element of interpretability among decision-makers, augmenting the strategic return on investment (ROI) of leadership training.

In such a way, this study fills both a methodological and practical gap, as it is a replicable system that does not hinge on survey perceptions but implements readable and actionable results by retrieving real institutional materials objectively and AI-mapped to generate meaningful results.

The ranking in performance data gives additional support. The Leadership Workshop, with a score of 4.4, proved to be the most effective strategic investment due to its high relevance and impact. On the other hand, none of the key items were rated lower compared to the Online Financial Course (4.1); yet, its cost-efficiency and brief duration of course completion are seen as alternative directions to be taken with limited budget opportunities. With 3.5, Community Outreach use highlighted the necessity of optimizing the criteria instead of having an exceptionally high score, which beats all others. This numerical product highlights the model's usefulness in resource distribution and the evaluation of training impact.

These contributions notwithstanding, we would still appreciate limitations. Information security limits the full

disclosure of institutional job descriptions, which can hinder external validation. Additionally, the lack of formal statistical tests prohibits generalizability; however, the listing of data mapping, scoring logic, and visualization graphs enhances internal validity. In addition, the subjectivity model used for assigning weights may introduce bias; however, this is compensated for through the transparency and flexibility that the model provides.

This method, when practiced, would aid in data-informed, strategic HR planning, particularly in academic institutions. The model shifts HR development away from the reactive nature of the development process to a proactive, evidence-based approach by facilitating role-based and goal-based program prioritization. The results are immeasurable in industries such as education, public administration, and mass corporate HR ecosystems, where it is crucial to match competencies against changing strategic requirements.

In the future, the study must be able to scale this model into live pilot programs, incorporate feedback mechanisms with users, and demonstrate real-time flexibility across other sectors. Additional knowledge can be gained on how contextual variables impact the AI-driven optimization of HR through cross-industrial applications, like healthcare and government leadership pipelines.

To summarize, the research presents a novel, scientifically grounded framework that integrates AI, NLP, and decision science into the planning of leadership development. Its transparent scoring mechanism, organizational strategy, and scalability make it a vital instrument in current HRM practices as organizations aim to achieve quantitative returns on investments in leadership.

CONCLUSIONS

This study aims to develop and evaluate an AI-driven software that identifies the core competencies required for leadership roles and aligns them with strategic learning pathways using natural language processing (NLP) and multi-criteria decision-making methods. In this research, the authors sought to design an AI-informed framework to automatically identify leadership competencies within the unstructured job descriptions and automatically match them with the relevant training programs by translating them into the NLP and multi-criteria decision-making (MCDM) methods. The system has been proposed to handle strategic human resource planning and leadership development. An experimental assessment reveals that the AI-NLP engine is effective in predicting the core competencies necessary to become a leader. The composite MCDM model effectively ranks training programs in terms of relevance, cost, duration, and strategic impact. The model demonstrated a marked superiority in both precision and consistency, as it outperformed conventional manual training approaches due to its high precision in aligning training to competency. The outcomes confirmed the practicality, adaptability, and the system's capacity to fit into different institutional priorities. This work has several notable contributions. It combines both semantic analysis, powered by AI, and decision science in the HRM field. In practice, it enables HR professionals and decision-makers to adopt evidence-based approaches in developing leadership, with fewer perceptions of bias and greater levels of transparency. The tool helps institutions transform traditional training plans into dynamic, competency-based training development aligned with organizational objectives. The research does not lack limitations. It primarily ventures into leadership positions in the educational and governmental sectors in certain regions. This framework can be applied to other industries or incorporate up-to-date labor market data in future studies. The adaptability of the model may be further improved by including dynamic knowledge graphs or those based on feedback. Ultimately, this framework provides scalable and innovative human capital development, supporting future-ready and AI-integrated talent strategies, which are particularly crucial when digital transformation drives the acceleration of institutional change.

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