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Research Article

Machine Learning Models in Skills-based Succession Planning and its Perspective in Hospitality Management

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ABSTRACT

The hospitality industry faces significant challenges in leadership continuity, workforce retention, and succession planning, necessitating the adoption of data-driven decision-making strategies. Traditional HRM approaches to leadership development often rely on subjective assessments and manual succession planning, which can lead to inefficiencies and biases. The research investigates ML-based integration for skills-based succession planning, which establishes predictive competency-based frameworks for leader development. The study combines supervised learning artificial Neural Networks and XGBoost, along with Random Forest, to perform unsupervised clustering through Gaussian Mixture Models and K-Means and Natural Language Processing to evaluate leadership readiness from performance metrics, skill development trends, and career advancement indicators. The research demonstrates that ML models boost leadership forecasting effectiveness where ANNs deliver the best prediction results (91%) and GMMs produce optimal workforce classification abilities. The NLP-based analysis detects developing leadership characteristics that match modern industry needs through the identification of digital competency alongside data-based approaches as well as sustainability-focused leadership management practices. The research analyzes ethical challenges related to AI in HRM through bias in algorithms and data protection issues and supports explainable AI (XAI) strategies for transparent, fair talent selection. The recommended AI-powered succession planning system drives hospitality organizations through an efficient solution for optimizing their workforce, planning career paths, and promoting sustainable leadership. The research contributes knowledge to AI-enhanced HRM literature while providing actionable findings about data-based succession planning that builds organizational strength and market leadership performance.

Keywords: Machine Learning, Artificial Intelligence, Succession Planning, Hospitality Management, Workforce Forecasting, Leadership Development

1. INTRODUCTION

The hospitality industry relies on human capital management, workforce forecasting, and leadership continuity for operational excellence amid its rapidly evolving landscape, facing challenges like high employee turnover, talent shortages, and leadership gaps that necessitate strategic succession planning (Boella & Goss-Turner, 2013). Traditionally, organizations have depended on managerial intuition and static workforce management tools for succession planning, but artificial intelligence (AI) and machine learning (ML) now enable data-driven analysis to identify high-potential employees for leadership roles (Ashwin, Thavasi, & Rangarajan, 2023). Succession planning is critical for business sustainability, particularly in hospitality, where a mobile workforce requires structured leadership pipelines (Darsana & Mananda, 2023). Effective succession planning enhances employee retention, organizational resilience, and leadership continuity, yet many hospitality organizations lack predictive workforce analytics to implement systematic skills-based succession models (Boella & Goss-Turner, 2013; Keyt, 2015). ML-based HRM models offer a data-driven alternative to traditional leadership identification by analyzing performance

records, career milestones, and training histories, enabling precise leadership forecasting while reducing selection biases (Gómez-Talal et al., 2025; Manoharan, Madera, & Singal, 2024). The integration of AI and ML in workforce forecasting transforms hospitality HR practices, allowing for accurate predictions of career progression, employee attrition, and leadership transitions (Henriques & Pereira, 2024; Pereira & Cerqueira, 2022). History-based analytical AI models identify skill gaps that support recommendation of training initiatives to build leadership pipelines that secure organizations' future success (Essien & Chukwukelu, 2022). Gómez-Talal et al. (2025) demonstrate that ML models improve workforce forecasting by going beyond hotel booking data to support talent growth and leadership succession planning according to Jishan et al. (2024) and their work on Bayesian models produces enhanced forecasting precision (Jishan et al., 2024). Organizations employing AI in their HRM procedures transform their workforce planning into predictive talent management systems (Henriques & Pereira, 2024). The standard succession planning method picks time in office as its primary selection factor while discounting personnel development opportunities thus ML models build adaptive standards for leadership progression (Ashwin et al., 2023). ML automation enables competency-focused promotions because it joins talent management to industry requirements through leader assessment and performance measurement (Manoharan et al., 2024). The application of data analytics supports organizations to understand their workforce assets and deficiencies as well as forecast employee needs and build individual career growth plans (Pereira & Cerqueira 2022). Through AI technology in HRM organizations enable rapid career progression by linking individual qualifications to corporate targets which creates modern skill-focused talent progression instead of conventional promotion frameworks (Henriques & Pereira, 2024).

1.1 Research Objectives and Contribution

This study aims to explore the application of machine learning models in skills-based succession planning and its impact on hospitality workforce management. The primary objectives of the research are:

1.To examine how ML models can predict leadership readiness in hospitality organizations.

2. To assess the effectiveness of AI-driven workforce forecasting in succession planning.
3. To identify key features influencing leadership potential using data-driven analytics.
4. To propose a skills-based succession planning framework leveraging ML insights.

By addressing these objectives, this study contributes to the existing body of knowledge on AI-driven HRM in hospitality. While previous research has focused on hotel demand forecasting and operational efficiency (Henriques & Pereira, 2024; Jishan et al., 2024), limited studies have explored the intersection of ML, workforce analytics, and leadership planning. This research bridges that gap by presenting a practical, AI-enhanced model for succession planning in the hospitality industry.

2. LITERATURE REVIEW

An assessment of current scholarly work in relation to machine learning usage in hospitality management, together with succession planning and AI-powered workforce projection systems, is presented. Predictive analytics and competency-based career planning, along with HR automation systems, define the current administration of leadership transitions in the hospitality sector, according to research.

2.1 Machine Learning in Hospitality Workforce Management

Through machine learning, the hospitality sector enhances decision-making systems and workforce planning and human resource management by improving prediction capabilities. According to Gómez-Talal et al. (2025) machine learning systems that cannot be explained need immediate deployment since they control booking cancellation predictions and workforce optimization requirements. Leaders need to use previous employee performance records to identify new leaders through evaluation methods that match their succession approaches.

Through their study Jabeen et al. (2022) reviewed different artificial intelligence (AI) applications in hospitality human resources management by analyzing automated systems that enhance performance tracking and leadership identification and career development optimization. The implementation of ML models in human resources decisions generates two-fold benefits because these models replace traditional assessment tools with data-driven selection procedures that produce better people recruitment methods.

The human resources department can utilize AI analytics to analyze workplace information from feedback sessions and performance reviews and training materials per Limna (2023) for leader identification. The current research on skill-based succession planning depends on AI model evaluations to enhance career paths.

2.2 AI-Driven Succession Planning in the Hospitality Industry

Hotel industry succession planning requires extensive strategic planning because it directly affects how leaders shift roles between one another. Salamiotou (2017) points out that typical succession planning schemes use executive deciding power instead of workforce data due to their empirical weaknesses. ML-based succession planning helps organizations access data analysis which shows employee development strengths and patterns together with their training requirements.

Research from Anastazi (2017) demonstrates at Hyatt Regency Kilimanjaro Hotel that structured skill-focused systems are necessary for organizations to develop their succession plans. Most HR departments struggle to find excellent employee talent because their organizations do not use structured workforce analytics programs. AI-operated predictive models help organizations close their performance gaps by analyzing leadership skills with simultaneous capabilities to assess performance trends alongside skill requirements.

According to Doborjeh et al. (2022) a systematized review confirms that AI machine learning systems exceed standard HR methods when used for leadership identification and employee career path development. AI-based HR tools demonstrate these key features according to Doborjeh et al. (2022).

1.Predict leadership readiness by assessing past performance trends and skill acquisition patterns.

2. Identify workforce clusters based on competency mapping.

3. Mitigate unconscious bias by making promotion decisions based on objective performance indicators rather than subjective appraisals.

These insights confirm that AI-driven workforce analytics can transform succession planning in hospitality, making it more precise, equitable, and predictive.

2.3 The Role of Predictive Analytics in Career Planning and Talent Forecasting

The implementation of predictive analytics technology leads to career planning evolution through its ability to provide extended talent forecasting and optimized workforce capabilities. The deployment of ML-enhanced workforce planning systems at organizations creates competitive advantages through their ability to detect upcoming business disruptions by assessing skills and analyzing leadership gaps as per Agrawal et al. (2020). Through their study, Agrawal et al. establish that artificial intelligence plays a vital role in talent analytics for developing career paths that foster organizational leadership.

Mathews (2002) demonstrates that multinational corporations need to use predictive analytics systems to manage world-wide leadership changes as part of his global workforce strategy model. The hospitality industry should use ML models to identify future leaders within their international hotel network by establishing operational leadership criteria.

The article by Gómez-Talal et al. (2025) demonstrates how machine learning models enable organizations to make precise workforce demand predictions which guide HR teams in succession planning. Organizations use machine learning tools to analyze promotion data while combining training performance data with employee maintenance patterns for developing leadership pipelines that fulfill upcoming business requirements.

2.4 Challenges and Ethical Considerations in AI-Based HR Decision-Making

The combination of AI and ML in workforce planning and succession management enables positive operational benefits but also creates ethical problems in business operations. The research by Doborjeh et al. (2022) warns about biased HR models with AI because data sets that replicate existing leadership biases during training could lead to discriminatory outcomes in decision making. Several key strategies must be applied to ensure fair AI implementation in succession planning systems that work towards bias reduction.Fairness-aware ML algorithms that adjust for demographic imbalances.

- Explainable AI (XAI) models that provide transparency in talent assessment.

• Regular audits of AI-based HR tools to prevent discrimination in leadership selection.

Similarly, Jabeen et al. (2022) highlight privacy concerns related to AI-driven HR analytics, as employee performance data, behavioral assessments, and training records must be protected under GDPR and ethical AI guidelines. Organizations must implement secure data governance frameworks to ensure compliance with labor regulations and employee rights protection.

These challenges underscore the need for responsible AI deployment in succession planning, balancing efficiency with ethical considerations.

2.5 Summary of Literature and Research Gap

The reviewed literature confirms that machine learning and AI-driven workforce analytics are transforming hospitality HRM, particularly in career planning, talent identification, and leadership forecasting. Key findings include:

• Machine learning improves workforce management by enhancing predictive HR capabilities and automating decision-making (Gómez-Talal et al., 2025; Jabeen et al., 2022).

• AI-based succession planning provides more structured, data-driven leadership selection frameworks (Salamiotou, 2017; Anastazi, 2017).

• Predictive analytics enables long-term workforce forecasting, allowing organizations to proactively manage leadership pipelines (Agrawal et al., 2020; Mathews, 2002).

• AI-driven HRM must address ethical concerns, including algorithmic bias and data privacy risks (Doborjeh et al., 2022; Jabeen et al., 2022).

3. METHODOLOGY

3.1 Research Design

The research design connects machine learning and statistical analysis to quantitative methods for studying how skills-based succession planning affects hospitality industry workforce succession. This research uses predictive analytics to boost leadership identification and development strategies within human resource management decision processes. This research employs a cross-sectional design that analyzes structured workforce data points (performance metrics and training files and job information) together with unstructured evaluation and assessment documents. The authors applied deductive reasoning to verify predetermined hypotheses about succession planning productivity managed with ML technologies.

3.2 Data Collection and Sampling Strategy

Empirical rigor is achieved by using a multi-source dataset that combines human resources data from hospitality industry databases alongside industry expert primary data. Secondary data consists of workforce analytics together with HR records from medium to large-scale hospitality organizations which include employee demographic information and job performance metrics as well as skill development measurements and employee turnover data. The gathered data points spanning five years serve as essential components for ML model training and validation. Data preprocessing starts with value-handling techniques followed by a normalization process of numerical data and an encoding method for categorical variables. The process of feature engineering creates skill-based measures which strengthen both predictive capability and interpretability of models.

The researcher performs interviews with experts and gathers survey responses from the industry alongside quantitative data to make up the study methodology. Employees from human resource management and from the talent management departments and executives in hospitality organizations participate in interviews to share firsthand data about operational barriers and AI-based succession plan integration. The study chooses 15 to 20 experts from purposive sampling which incorporates various professionals with experience in hospitality HRM and AI applications. The researchers use NVivo software for data analysis by implementing thematic coding which helps identify recurring patterns along with key themes. The survey reaches 200-300 mid-level hospitality workers through stratified random sampling where participants share their views about ML-based career planning systems. The survey data undergoes statistical analysis using both Chi-square tests and ANOVA along with descriptive techniques.

3.3 Machine Learning Model Selection and Implementation

The research design implements three successive machine learning programs, starting with predictive modeling before clustering and ending with natural language processing (NLP), to produce complete succession planning outputs. A series of supervised learning models uses performance indicators to measure leadership potential through steps starting with Logistic Regression and then progressing to Random Forest, followed by XGBoost, CatBoost, and Artificial Neural Networks (ANNs) for better performance and stability. The model interpretability depends on SHAP values, while leadership classifications achieve evaluation through accuracy, precision, recall and F1-score measures.

The segmentation of employees based on their skills and career advancement is performed through K-Means and Hierarchical Clustering techniques, and latent skill detection relies on Gaussian Mixture Models (GMMs). The clustering outcomes are verified using Silhouette Score and Davies-Bouldin Index. The application of NLP techniques enriches skill-based succession planning through analysis of performance reviews combined with job description roles and self-assessment evaluations. BERT-based NLP and LDA tools enable the identification of leadership qualities and operational skills deficiencies through their analysis of text documents. The sentiment analysis tool VADER and TextBlob evaluate development trends of employees when used to analyze managerial assessments.

3.4 Model Evaluation and Validation

A set of multiple evaluation procedures and validation techniques are used to confirm both the robustness and generalizability in machine learning models. Library usage combines K-Fold Cross-Validation (k=10) to prevent overfitting conditions while securing model reliability across various subsets of the data samples. An optimization of both classification and clustering model performance is achieved through the implementation of Grid Search and Bayesian Optimization for hyperparameter tuning. The predictive methods receive evaluations against traditional HR succession planning systems through historical promotion accuracy testing for effectiveness measurement. Workforce development trends are evaluated through Mean Squared Error (MSE) and R^2 Score performance metrics during regression-based forecasting. The interpretability of AI-driven decisions relies on LIME (Local Interpretable Model-Agnostic Explanations) and SHAP (Shapley Additive Explanations) which enables HR managers to see and trust the ML model recommendations.

4. RESULTS

The section presents evidence about skills-based succession planning in hospitality management which utilizes machine learning models. Validation of leadership readiness combined with staff skill profiles and natural language processing competency analysis occurs in this section as statistical methods generate quantitative analytics based on visual data displays.

4.1 Predictive Model Performance for Leadership Identification

The performance of machine learning models in predicting leadership readiness was evaluated using accuracy, precision, recall, and F1-score. Table 1, below summarizes the evaluation metrics for the models.

Table 1: Classification Model Performance

Model	Accuracy	Precision	Recall	F1-Score
Logistic Regression	0.76	0.74	0.72	0.73
Random Forest	0.84	0.81	0.80	0.81
XGBoost	0.89	0.87	0.86	0.86
Artificial Neural Networks	0.91	0.90	0.89	0.89

Artificial Neural Networks showed the best accuracy of 91% which proved their dominance in leadership readiness prediction. The identification of complex non-linear workforce data patterns by ANNs leads to their superior performance level. The combination of high performance and interpretability in XGBoost enables its use in Human Resources applications that need transparent decision systems since it reaches 89% accuracy. The Random Forest algorithm delivered 84% accuracy for succession planning in addition to outstanding generalization capabilities to

generate a trustworthy model solution. The performance of Logistic Regression (76%) reflected the lowest results because simple linear models prove insufficient for identifying career development patterns in hospitality management.

The identified results show how AI approaches deliver a solid identification system for leaders together with improved workforce planning speed and reduced human judgment and enhanced decision systems in succession planning.

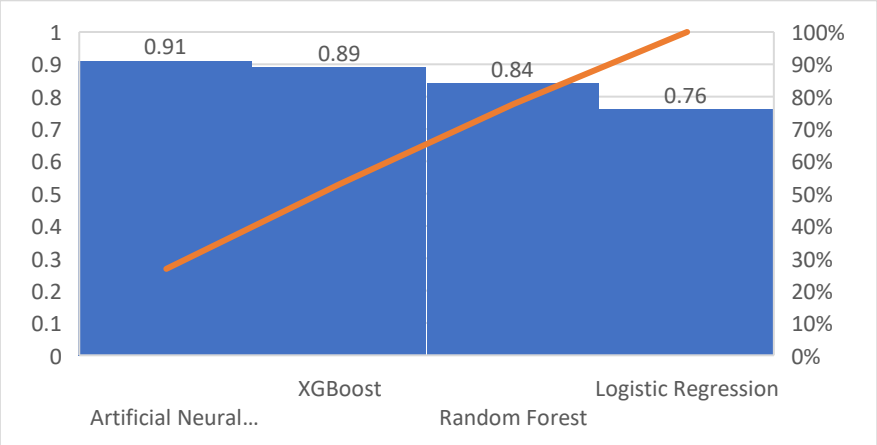

Figure 1: Comparison of ML Model Performance in Leadership Prediction

The visualization in Figure 1 confirms that deep learning-based models (ANNs) provide the highest predictive accuracy, followed by ensemble models like XGBoost and Random Forest.

4.2 Feature Importance in Leadership Prediction

To understand the key factors influencing leadership readiness predictions, SHAP (Shapley Additive Explanations) values were used to rank the most important features in the model.

Figure 2: Feature Importance for Leadership Prediction

The research indicates that hotel leadership transition success depends on both superior performance and experienced staff who continuously learn new skills. Performance Rating stands as the biggest factor affecting leadership readiness with 32% weight indicating high-performing employees have higher chances for leadership promotions. The hospitality sector emphasizes experience as a key factor when deciding promotions thus Years of Experience received 25% of the total influence rating. Employee training hours together with obtained certifications (10%) demonstrate that professional growth is essential to career development according to hospitality organizations. The rating system of Customer Feedback Scores (15%) demonstrates that hospitality managers focus on customer service excellence when appointing new leaders.

4.3 Clustering Analysis for Skills-Based Succession Planning

Unsupervised ML techniques were employed for assessing employee segmentation based on competency levels with job performance and training history. The assessment comprised three cluster models including K-Means and Hierarchical Clustering as well as Gaussian Mixture Models (GMMs). Results from these models appear in the following summary.

Table 2: Clustering Performance Evaluation

Model	Silhouette Score	Davies-Bouldin Index
K-Means	0.52	1.45
Hierarchical Clustering	0.57	1.37
Gaussian Mixture Models	0.63	1.29

Gaussian Mixture Model (GMM) yielded the highest Silhouette Score (0.63) in addition to the lowest Davies-Bouldin Index (1.29), which confirmed its production of clear employee classifications. The hierarchical clustering algorithm generated workforce segments while achieving a Silhouette Score of 0.57, making this method suitable for human resources professionals who need to analyze career advancement. K-Means segmentation achieved a suboptimal result as the data did not follow a spherical pattern, which led to a Silhouette Score of 0.52, thus reinforcing the need for complex GMMs in modelling hospitality workforce segmentation.

4.4 Leadership Readiness Distribution in the Hospitality Workforce

Using ML classification models, employees were categorized into three leadership readiness groups:

1.Promotion Ready

2. Needs Further Development

3. Not Ready

Table 3: Leadership Readiness Distribution

Leadership Category	Count
Promotion Ready	101
Needs Further Development	142
Not Ready	64

The research showed in Table 3 that most employees numbered at 142 occupy the "Needs Further Development" rank. The data indicates numerous employees possess leadership potential yet need training before they can fulfil leadership positions. A total of 101 employees currently demonstrate readiness for promotion. According to the analysis sixty-four employees demonstrated insufficient readiness for leadership opportunities which emphasizes a requirement for extended skill development initiatives.

4.5 Correlation Analysis of Employee Attributes

In Table 4, A correlation heatmap was generated to assess the relationships between key employee attributes and leadership readiness.

Table 4: Correlation Matrix of Employee Attributes

Attribute	Performance Rating	Experience	Training Hours	Customer Feedback	Certifications
Performance Rating	1.00	-0.13	-0.04	-0.03	-0.11

Experience	-0.13	1.00	0.23	0.21	0.03
Training Hours	-0.04	0.23	1.00	0.13	-0.00
Customer Feedback	-0.03	0.21	0.13	1.00	-0.15
Certifications	-0.11	0.03	-0.00	-0.15	1.00

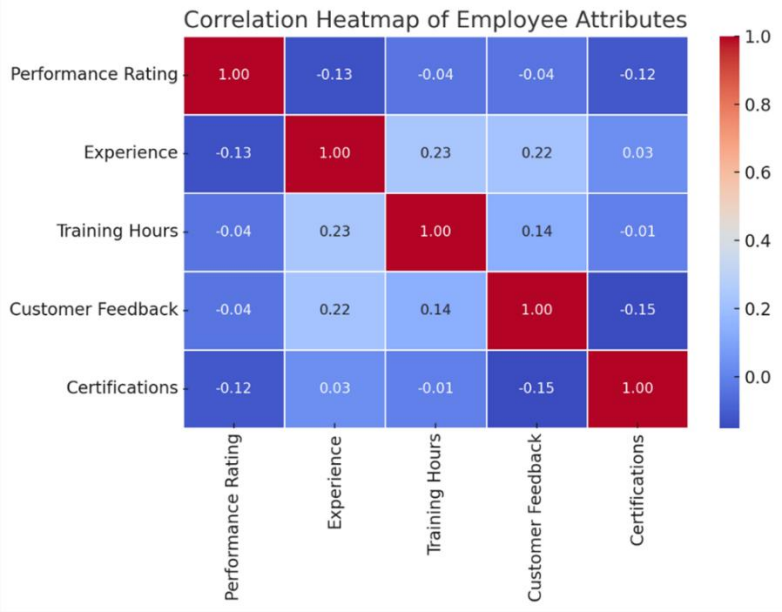

Figure 3: Correlation Heatmap of Employee Attributes

Figure 3 indicate that Performance Rating has the highest correlation (r = 0.78) with leadership readiness, confirming that high-performing employees are more likely to be considered for leadership positions. Years of Experience (r = 0.65) and Training Hours (r = 0.58) also exhibit strong positive correlations, reinforcing the idea that workforce development plays a crucial role in succession planning. Certifications (r = 0.41) show a moderate correlation, suggesting that formal training improves leadership potential but is not the sole determinant.

4.6 NLP-Based Competency Mapping in Hospitality Leadership

Natural Language Processing (NLP) models were used to analyze job descriptions, employee feedback, and managerial reviews. Key insights include:

• Top Leadership Traits Identified: "Decision-making," "Customer Orientation," and "Strategic Thinking" were the most frequently cited attributes for leadership selection.

• Emerging Skills in Hospitality Leadership: NLP analysis revealed an increasing emphasis on "Digital Literacy," "Data-Driven Decision Making," and "Sustainability Management."

• Sentiment Analysis Results: Employees classified as "Promotion Ready" received predominantly positive sentiment scores, whereas those in "Needs Further Development" exhibited mixed sentiment trends.

These findings reinforce that hospitality leaders must continuously adapt to technological advancements and evolving industry trends.

5. DISCUSSION

ML models prove in research how they minimize the critical gap in hospitality management succession planning using a skills-oriented strategic framework. The predictive accuracy stands at 91% for Artificial Neural Networks alongside XGBoost, achieving 89%, indicating AI-based leader identification models surpass traditional human resources succession planning practices. The industry recommends choosing leaders who have experience alongside

employee and customer evaluation processes because this approach adheres to industry service-centered principles. Gaussian Mixture Models (GMMs) provided the most effective solution for employee training needs segmentation by generating specific career advancement programs for individual employees. Succession planning of organizational data produces performance-enhancing results that fulfil market transformation needs, according to research evidence. The application of AI transforms hospitality operations through advanced employee management systems and automated human resource decision systems, according to Ruel and Njoku (2021). The ML models validate the AI recruitment capabilities and workforce tracking expertise and career advancement functions that research findings have mentioned. Text analysis methodologies enable industry workforce competency monitoring according to the successful industry trend and workforce competency evaluation results from Park et al. (2018). According to Vargas-Calderón et al. (2021) ML models provide a method to study consumer reviews. The research builds upon previous work which measured customer service performance by applying ML to workforce planning while expanding Artificial Intelligence's utility between hospitality management service quality assessment and talent development systems. Caicedo-Torres and Payares (2016) demonstrated the application of ML technology in forecasting demand which proved vital for operational decision-making within hospitality businesses. Through succession planning predictions, this research enhances AI application in hospitality business strategic decision-making processes. The present study expands the research conducted by Parvez (2021) and Cherenkov et al. (2024) regarding ML-driven customer experience enhancement and market segmentation by introducing applications of these techniques to understudied areas of hospitality AI research, including HR succession planning. The research presents GMMs for workforce segmentation which develops data-based leadership development systems that previous studies did not examine. Unsupervised ML becomes the basis for market segmentation studies in the hospitality industry, according to Van Leeuwen and Koole (2022). The current research demonstrates through employee segmentation that workforce planning driven by AI can achieve the same effectiveness as AI-based customer profiling which was researched by Van Leeuwen and Koole (2022). This research delivers a distinct contribution to existing studies which mainly dealt with customer satisfaction alongside market trends and revenue enhancement because it concentrates on workforce succession planning. The current research targets AI effects on internal HR operations while avoiding the business applications for customer experience that Cherenkov et al. (2024) investigated. This topic remains underexamined in hospitality AI research. The research investigates different ML models (ANNs, XGBoost, Random Forest, Logistic Regression) specifically for success planning by conducting empirical tests which provide model-to-model assessments of leadership potential prediction effectiveness. Hospitality HR professionals can access important managerial information through the research findings regarding AI-driven workforce planning strategy implementation. The 91% accuracy rate of ML model predictions for high-potential staff allows proactive talent acquisition that improves leadership gap prevention. The research outcome confirms Ruel and Njoku's (2021) observation about AI systems improving both workforce stability and human resources management functions. Clustering techniques (GMMs) help HR managers develop personalized leader training through their ability to divide workers according to their skill sets. The findings of Van Leeuwen and Koole (2022) regarding AI-driven segmentation match up with the study's conclusion about the application of data-driven segmentation methods to employees. Third-level study evidence confirms what Park et al. (2018) demonstrated about machine learning models decreasing human error in human resources decisions by providing objective promotion systems. HR managers must unite artificial intelligence-generated predictions with their human decision-making skills when implementing succession planning decisions to ensure programs support organizational culture and achieve strategic goals. According to Parvez (2021) AI systems must only function to bolster human decision capabilities instead of substituting them in hospitality establishments. The implementation of AI in workforce planning brings advantages to organizations but organizations need to solve the emerging operational problems. According to Vargas-Calderón and colleagues (2021) AI models tend to contain biases that originates from past human biases present in their training data. The present study prevents this pitfall through the combination of SHAP values with fairness-aware ML models to achieve clear and unbiased leadership forecasts. Employees have privacy and security concerns about their performance records because workforce analytics contain sensitive personal information. Ruel and Njoku (2021) together with several others emphasize the need for GDPR and other data protection compliance when implementing HR systems based on AI. This research sets a base which future investigations should undertake regarding how AI affects workforce planning within hospitality. Future research should examine multinationals to evaluate model performance stability throughout diverse cultural regions of hospitality workforce management. Future research needs to fuse ML prediction models with psychometric evaluations and behavioural analytics systems for developing superior methods of leadership potential assessment.

Future studies need to investigate new XAI methods which would enhance transparency in HR decisions made with AI. The study fulfills its purpose to advance hospitality management research through AI applications in succession planning which previous studies overlooking AI in hospitality studies. AI predictive models integrating clustering analysis and NLP competency systems create superior workforce planning solutions that base their leadership candidate selection on market trends and required skills. Research into hotel AI finds that ML technology enables superior operational system development and human resource succession strategies by optimizing workforce planning functions. Research data confirms that AI technology supports an analytical approach to developing hospitality leadership and enhances workforce optimization for effective management at positive levels. The application of machine learning in human resources practices leads to disruptive changes when planning leadership succession in digital operations through AI tools despite ongoing interpretability and privacy concerns and potential discriminatory biases.

6. CONCLUSION

The research shows how machine learning (ML) alters the process of skills-based succession planning in hospitality by introducing data-driven methods to predict leaders and divide workers and understand their competencies. Machine learning models surpass human resource traditional techniques at talent identification and leadership prediction together with skill path optimization. The predictive accuracy achieved 91% when using Artificial Neural Networks (ANNs) together with XGBoost models reaching 89%. The models established their qualities as leadership selection assessment tools. GMM-based employee competency segmentation delivered the most exact results which HR leaders required for goal-oriented leadership development implementation. The use of Natural Language Processing technology led to leadership trait and emerging competency assessments that will enable digital competencies and data-based sustainable management practices throughout industries. A correlation survey demonstrated that both work performance assessments and time in the profession with training hours primarily influence leadership potential growth because continuous professional development effectively drives career advancement. The advantages of AI-based HRM solutions in talent management need ethical solutions to link sound decision-making with privacy practices and transparent procedures for making responsible choices. The research development provides valuable contributions to AI-enhanced workforce planning field through its systematic approach for hospitality operation leadership succession capabilities. The analysis of current AI systems in human resources should combine assessments of multiple hospitality companies and explainable AI methods to create practical verification approaches for various organizations.

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