



<https://doi.org/10.58225/sw.2026.1-92-100>

A COMPREHENSIVE ANALYSIS OF MACHINE LEARNING-BASED RETENTION OF STAFF MEMBERS

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Abstract. In the hypercompetitive business environment, retaining employees remains a top challenge for companies trying to maintain stability, productivity and lower costs associated with turnover. An attempt to ascertain different factors that influence retention such as corporate culture, employee empowerment, organizational learning, talent development strategies, entrepreneurship education adoption of cultural intelligence and application technology like artificial intelligence and machine learning. This study synthesizes literature review along with empirical evidences. Many predictive modeling approaches including Random Forests, deep learning and Stacking-Based Transfer Learning, and Logistic Regression have a high degree of potential to predict turnover, find critical reasons for attrition, and lead proactive retention strategies. The mediating and moderating roles of job engagement, socialization tactics, organization size, and protean career orientations in predicting retention outcomes are examined across diverse organizational contexts (e.g., banks, startups, global work context). The findings emphasize the importance of integrating data-driven analytics and human-oriented strategies, offering HR practitioners beneficial advice on developing focused interventions to enhance employee satisfaction and sustainable stability in modern, multilingual work settings.

Keywords: Deep learning, Random Forest, Stacking-Based Transfer Learning, Human Resource Management

Cite this article as: M. Yadav, K. Singh, V. H. Abdullayev, F. Moreira, D. D. Barak, R. K. Sharma, S. Kumar, and D. Kumar, "A COMPREHENSIVE ANALYSIS OF MACHINE LEARNING-BASED RETENTION OF STAFF MEMBERS", SW AzUAC, vol. 1, 2026, <https://doi.org/10.58225/sw.2026.1-92-100>

Article history: Received: 20 May 2026 / Revised: 24 June 2026 / Accepted: 04 July 2026

Introduction. Supervisor employee turnover as the bottleneck of human resource management is gradually paid attention [1]. The cycle of employee turnover phenomena has become a chronic phenomenon in modern corporate operations, because of rapid development and increased competition in the market economy [2,3]. Cultural dose as enterprises of competitive base and spiritual appease, having its special value tendency and behavior observing, simultaneously be also



kind of important means to create harmonious environment [4]. Not only is this culture story able to attract talent, it creates job satisfaction which leads to enhanced work engagement and increased belonging in staff so that's not all it is doing a fairly good job of retaining the talent that enter our doors [5]. Employee retention is still a significant concern for HR departments that are trying to maintain organizational stability and reduce the costs associated with high turnover [6]. The forecast accuracy of traditional management approaches is often constrained by their poor ability to effectively incorporate information from multiple databases [7]. Employee satisfaction depends, as is commonly recognized, on more than just financial compensation [8]. A solution is not determined solely by whether one's language has an official status in a given administrative area, but satisfaction also depends on other factors including fair distribution of workloads, respectful treatment, prizes and awards and welfare benefits, or amicable management practices [9,10]. Conversely, motivation, retention, commitment and goal achievement at work are all strongly linked to employee happiness. The present study aims to explore the following: 1) A focus on improving organizational commitment and employee happiness has gained increasing attention. Sexual environment in it, whether sexual harassment occurs, will make a difference in organizational commitment and job satisfaction [11-13]. Level of job satisfaction and organizational commitment due to their increased importance as strategic resources. Satisfaction is also a predictor of employee commitment. For the purpose of this descriptive and empirical study approach purposive sampling technique is employed. Primary data was collected by 75 respondents who completed a structured questionnaire and was analyzed using percentage methods. The results show that staff commitment and management are significantly impacted by employee satisfaction. Contributing factors that can affect motivation and satisfaction include incentives, salary, leave policies, stressors, and rewards. High employee turnover is a deadly problem that managers are grappling with and managers can attest that this is more than just an issue of productivity and the bottom line in terms of morale. The study is focused on more accurate forecast models constructed and analyzed on the basis of data to obtain a better turnover forecasting [14]. Machine learning models are utilized in the search of the key causes that cause attrition by considering employee related data such as demographic, job attribute and performance. The whole aim is to identify the best predicting model that may serve as a guiding tool to produce useful retention policies. On the whole, the findings can be applied to more proactive strategies that can decrease employee turnover and enhance the planning of the work-force [15]. Level of Analysis: Job and Worker __ Random Forest, Logistic Regression Although most of the HR analytic approaches, in the present study, are grounded on the normative tools only, we deploy other types of normative power against the traditional ones. LR is particularly widespread being used as a candidate approach to reveal valuable HR information due to its interpretability. Nonetheless, to make better predictions, we found out that a machine learning model such as Random Forest was in fact highly effective at predicting a complex, non-linear pattern of employee behavior [16]. These models take the place of a useful complement of models to facilitate the design of targeted and data-driven retention interventions on the basis of consistency in prediction quality and more informative understanding of key reasons of attrition. To generate more accurate predictions on likely turnover trends, the proposed method relies on big data analytics for in-depth analysis of the multi-faceted signals like employee behavior, business performance parameters and cultural factors. Given a laboratory validation, the model is more accurate and reliable for predicting retention results to help firms that wish to follow proactive and analytical workforce management approaches in order to be supported for better decisions.

Materials and methods. In addition to the Triangle model concentrating on employee retention prediction, we also investigate how deep learning technology can be applied to make use HR strategy as well. The model is a deep feedforward neural network developed from feeding various trends (engagement levels, dozens of job performance measures, demographic information and turnover histories) into a few thousand large companies. In order to ensure scientific rigor, as well as practical relevance of the study, a multimethod design is used providing quantitative predictive modelling and



qualitative input from HR experts and employees. According to results, deep learning can provide substantially higher employee turnover prediction performance than traditional predictive models because it obtains better accuracy, precision, recall and F1- score. All this proves, how deep learning can transform HR analytics and allow corporations to generate more precise predictions at a reduced duration of time which can transform retention strategy into a reactive instead of a proactive approach. There are many ethical implications of such complex algorithms though the most significant of them apply to algorithmic transparency and data privacy. These elements are well represented in the article and the article takes an effort to underscore the fact that companies must be responsible AI-enabled consumers of HR solutions. The policies of big data have impaired the HR analytics of employee retention and talent management. The ability to anticipate hazards at workplaces is central to the minimization of turn over and enhancement of employee performance in the present hyper competitive business environment. The study is about the search of talent, and retention agents of the high potential employees through foresight-based HR analytics. Figure 1 depicts the flowchart of the working model. Figure 2 represents the comprehensive analysis of working model.

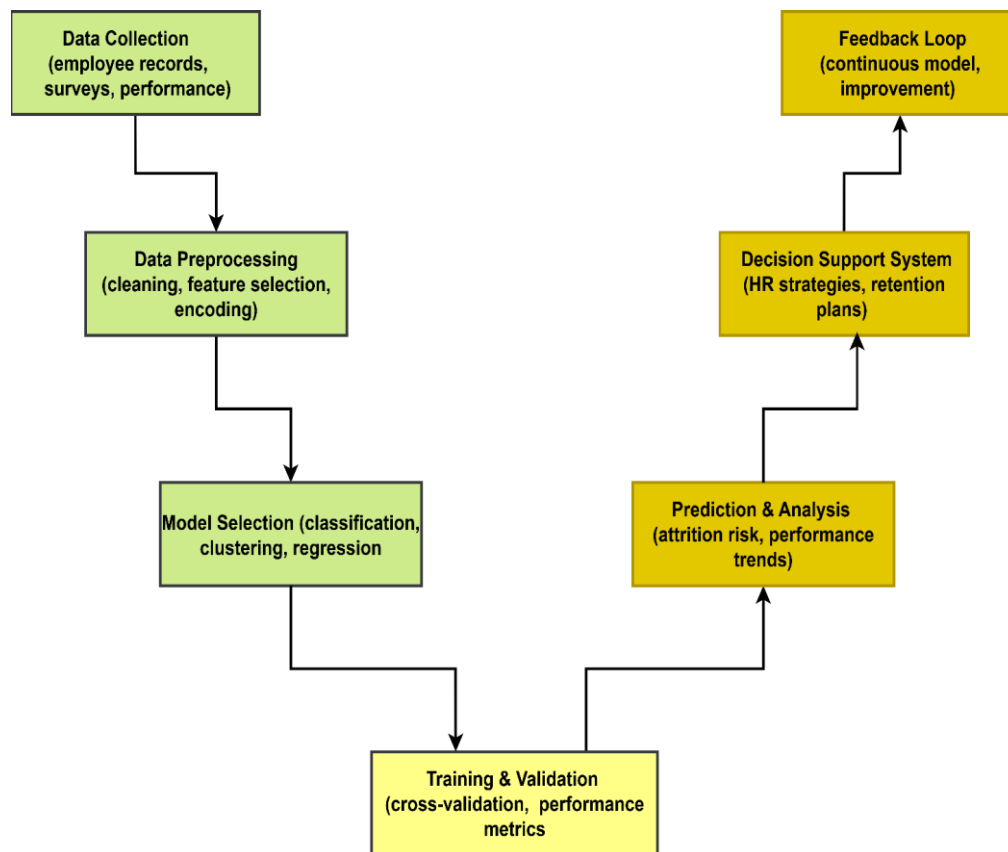


Fig.1. Flowchart of proposed model

There are also predictive models related to staff churn, and for predicting new hires who will be successful if we give them additional help in progressing through their professions. The flavor of the work is about crunching data sets which include demographics, years on job for employees, how people performed and whether they churned (that is left employment). Data collection part collect employee-related data (attendance, questionnaires, and performance indicators). Preprocessing involves cleaning and preparing data for ML models. Model selection part select appropriate machine learning methods (e.g., decision trees for attrition prediction and clustering for staff grouping). Training and validation part validate correctness and train models. Predict and analyze potential

employee turnover, performance trends, and workload difficulties. Decision support part provide HR with practical insights for retention initiatives. Feedback loop part continuously improve models with new data.

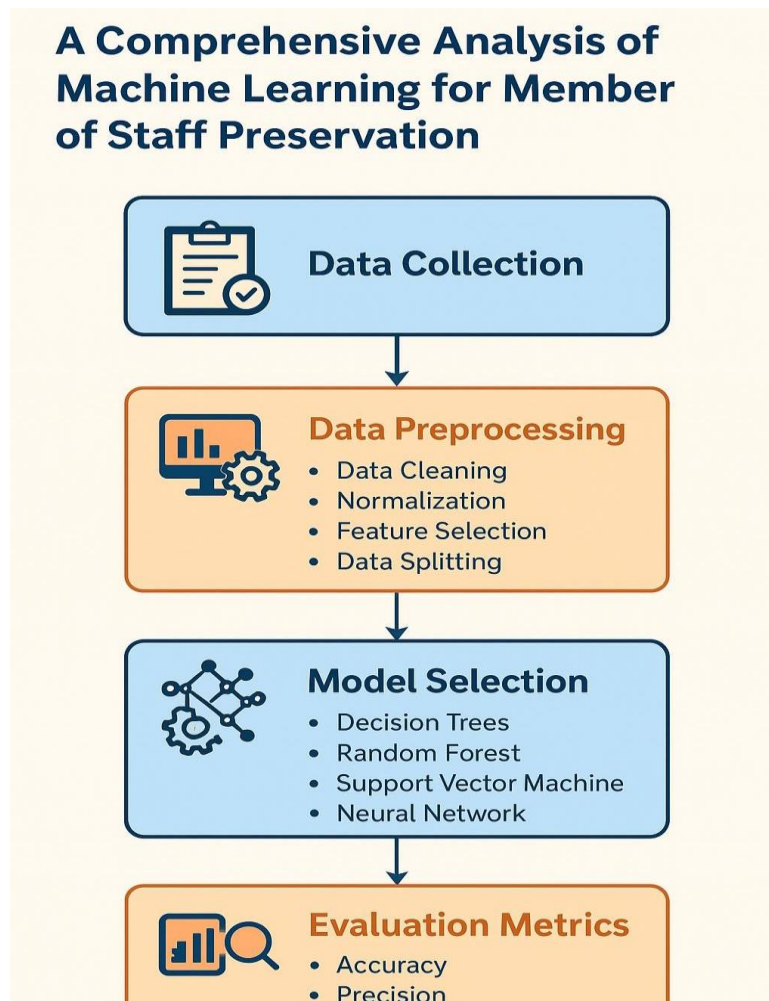


Fig.2. Comprehensive analysis of working model

Random Forests and logistic regression are machine learning methods applied to discover the factors critical to turnovers. To sum up these results indicate that HR predictive analytics can confidently predict employee exits and decisions to leave work by predicting promotion opportunities, receiving recognition reporting and overall satisfaction from the job reporting; all of which may be part of retention improvement efforts. From those numbers, companies can work to reduce turnover costs and retain their high-value employees over the longer-run by building customized retention plans. If there's one fly in the ointment of today's fast-moving workplace, it is keeping employees. Business-level and personal efforts to retain good talent in an organization are cropping up here and there. In this light, studies of EI measurement have never been as important as far as retention strategies are concerned. The purpose of the study is to determine the impact of AI and EI on employee retention. An extensive literature review was conducted to learn about this association. It was estimated that available literature always confirms the relationship between AI and EI, justifies their role to attain improved employee retention outcomes. It would not make you wrong to have an idea of why people leave, in a world where most jobs are cutthroat and insane, if you are a company that wants to retain top talent over a long period of time. The quality and level of



products, services, and workforce is preserved with the help of retention. those garmens are insights into the new people before they even start to work) is important information about the culture and the flow of a company. The proposal suggests a method of testing the significance of Employee turn over variables using IBM HR Analytics Employee Attrition and Performance dataset. The strategy incorporates data visualization, machine-learned attrition predictive models, and SHAP (SHapley Additive exPlanation) feature importance analysis into the workflow to discard major drivers of attrition. In addition, they propose an advice system, where userbased collaborative filtering technique is used to give individualized retention strategy with various risk indicators to each employee. It also develops forward looking measures to avert or be in a better position to anticipate employee turnover in case of prescriptive modeling and reasonable counsel are combined. Retaining employees has proved to be a massive challenge to businesses in the highly competitive business world in the contemporary times. In addition to being a mere issue of maintaining a productive office, loss of star players can also translate to the failure of the company in the long term. In an effort to predict turnover flow behaviour and identify what the main predictors are of absence, scholars have consequently been becoming increasingly interested in machine learning models. There are many factors that contribute to employee retention and analysts frequently face difficulties in making sense of potentially confusing information in personnel data. Feature selection has gained an important role to enhance analytical quality and to identify the most relevant features. The work presents an innovative methodology called the Enriched Employee Retention Analysis System (EERAS), which is a novel framework that combines feature selection and machine learning methods. The two primary objectives of system design are: (1) to find out and rank the critical reasons causing employee attrition, and (2) to propose important factors in retaining staff. Four feature selection methods, including MRMR, Chi-2, ANOVA and Kruskal applied to various classifiers in a large employee dataset empirical study: Decision tree, linear regression, Na\"ive Bayes, Support vector machine, XGBoost source data set that was randomly divided. The results presented in this paper indicate that the feature selection reduces the training time and enhances the classification accuracy. Furthermore, EERAS provides some practical examples of what HR policies could contain to make them more supportive of long-term staff retentions plans. Foreseeing layoffs and finding employees already is a major concern for all businesses and industries, especially those that experience high levels of employee churn or seasona changes in labor needs. The work [8] measures the efficiency of two models XGBoost a supervised classification and KMeans, an unsupervised method of clustering to predict employee retention rate and possibility of laying off staff members. It assesses the model's accuracy, interpretability and predictive power against metrics such as employee tenure, performance reviews and engagement scores. The results demonstrate that in binary classification, XGBoost is better at providing a clear “yes” or “no”. and fairly practical HR decision-making-relevant predictions. KMeans, however, helps in discovering patterns and wine sowing workers into separate clusters also gives insights on traits of the workforce. According to the comparative research, XGBoost with statistical local texture descriptors is the best model for precise layoff prediction, and KMeans can help understand employee clustering and their behavior patterns. These findings illustrate how machine learning could enhance predictive workforce management and offer insight for strategic HR planning and policy formulation.

Results and discussion. In [9] a Stacking Based Transfer Learning (TL) is presented in order to reduce the risk of employee retention. We construct a hierarchical stacking ensemble of deep learning models where we combine the domain specific data and pre-trained representations (BERT for textual, ResNet for numerical). The algorithm is exploited to offer retention estimates by fusing number values and textual data. Experimental results based on a publicly employee retention dataset verify the effectiveness of our proposed strategy. The use of Stacking-Based TL framework outperforms the offthe-shelf models such as Random Forest (88.3%) and Support Vector Machine (85.7%), which achieves an accuracy of 92.5%. Also, 17% of prediction error is decreased by the



model when compared to baseline methods. Generative AI (or GAI, a type of artificial intelligence) is one of the most rapidly expanding innovators in talent and HR technology. The review [10] addresses the utilization of GAI in talent management, particularly with regard to its role in employee engagement and retention initiatives. It also considers the wider implications of costs and benefits on implementing the GAI into practice. A literature overview on usage and applications in performance evaluation, as well as hiring/ training & talent identification discovery is provided. The findings indicate that the benefits of using GAI in HR practices can be seen as a number of direct and significant positive effects, such as efficiency, individuality of employee experiences, improved quality decision-making based on data-driven action reports, and so on. However, also implementing GAI provides serious doubts, whether in terms of ethical decision-making and algorithmic biases, or privacy threats and accelerated change that HR professionals will be forced to adapt to with these systems. It is a curious insight into the revolutionary nature of GAI, in regard to retention, employee engagement and HR administration, in the current digital environment that is rapidly evolving. Considering the increased globalization and the incessant connectivity, there has been a trend nowadays with many businesses around the world attempting to establish methods of effectively attracting and retaining multicultural talent in their workforce due to emerging diversity. This paper examines interactions between the cultural intelligence (CQ) of a supervisor and subordinate and job engagement as well as intention to stay in multicultural workgroups. After this call, we carried out two empirical studies, which were based on leader member exchange (LMX) theory and engagement with work. Like in Study 1 (m170 matched), supervisor CQ moderates an employee CQ that leads to job engagement. Study 2 (matching data 161) confirmed the findings and also indicates the importance of job engagement on the intentions of the employees to remain. A 2CQ CQ study, whereby the dual gain approach is employed to enhance the supervisor and the TC-workers CQ, would be added to theory and practice of retention/performance in multicultural work groups. The research article under discussion contributes to the existing body of knowledge by assuming that the organizational learning and employee empowerment are the mediating variables between employee retention intentions and talent development strategies. The findings provide useful management implications to the banking sector in Bangladesh, indicating that the development of organizational learning potential and employee empowerment could benefit the retention performance.. A questionnaire on 5-points Likert scale was distributed to 378 employees of private banks. Replies were analyzed using SmartPLS software and the proposed links were tested. This study's findings indicated that the link between talent development strategies and employees' retention intention is mediated by organizational learning and employee empowerment processes. Effects of University-Based Entrepreneurship Education 85 The study investigates time the extent to which university-based entrepreneurship education influences employee retention in Chinese start-up businesses. University-level entrepreneurship education may, however, help shape students' omporting people's professional attitudes and behaviour, which will influence their entire career over time. This is grounded in the attraction, selection and attrition model and social learning theory. To investigate A two-stage web-based and onsite survey was conducted among employees from startups in three entrepreneurial incubators in China. The hierarchical multiple regression and bootstrapping (n = 274) was conducted with the final sample. The results indicate that entrepreneurship education substantially enlarges employees' willingness to remain in the firm and protean career attitudes have a mediating role between the two. Further, this mediating relationship was found to be reinforced by socializing tactics. These findings provide long-term yet salient benefits of how entrepreneurship education at university contributes to the graduates' employment and thus useful lessons for the design of university's entrepreneurship curriculum and people management in startups. Focusing on influences that impact workers' propensity to stay and commitment, the study investigates employee retention in SMEs and large corporations. Size of the firm doesn't matter; retention is highly influenced by such factors as nature of work, benefits, relationships with co-workers, normative



commitment and organizational commitment based on a partial least squares structural equation modeling analysis of 511 employee responses. While the models certainly succeed in highlighting organizational differences, a more focused examination is needed for homogeneous groups of employees. The findings suggest that companies need to focus less on bringing in new subscription services or take-out food and more on improving workplace connections, perks and job happiness if they want a high number of people to stay. By adopting the moderating role of organization size and using a holistic point of view, this study helps in better understanding employee retention, as well as the joint influences of multiple constructs. The research is on how corporate intrapreneurship influences employee retention in Nigerian banks with emphasis on characteristics such as initiative, innovation, decision making, strategic change and company growth. The data was obtained purposively from the eight (8) banks on Nigeria Stock Exchange. Results: The results demonstrate that corporate intrapreneurship has a significant influence on employee retention, resulting in a positive and statistically significant effect in initiative, company growth, decision-making, and creativity. Among them, initiative was the most important factor (coefficient = 0.557077, p-value < 0.05), followed by decision-making (coefficient = 0.1632493, p-value < 0.05), business development (co-efficient = 0.4497637, p-value < 0.05) and creativity (co-efficient = 0.1185839, p-value < 0.05). In the other hand, there was no significant difference due to strategic change (p-value = 0.090). The study reveals that Corporate intrapreneurship is a very strong predictor of employee retention in Nigerian banks, especially as they prompt novel initiative and expansion oriented strategy. To encourage a spirit of risk taking, proactive decision making and utilization of competitive opportunities and reduce turnover - HR Director It is the quality of employees and managers that it recommends organizations focus on developing, by working to build an organizational culture that embraces risk, encourages proactive decision making and leverages competitive opportunities. The findings add to knowledge by introducing intrapreneurial strategies as a strategic tool for achieving workforce stability in the banking industry. The HRM practices of South Indian self-financed institutions were also investigated in the study. Topics reviewed included recruitment and selection, initial training, supervision, training and career development. Data were procured from faculty through surveying. The results indicate that satisfaction with prospects for career advancement, and satisfaction with the quality of work life were not high while feeling valued by management was high among faculty members. What they did also find, though, were unusually high stress levels and rather low job security.

Conclusions. The fact that employee retention management is the catchphrase of any organization in the industry, is simply because an ordinary person would desire a workforce that is stable and thus will result in high productivity and low turnover-cost. The paper highlights the multi-dimensional aspect of retention in its correlation between human aspect variables like corporate culture, employee empowerment, organizational learning, talent development protean career attitudes and cultural intelligence and information technology methods such as AI, machine learning, and predictive analytics. These also have impacts on the intention to remain by workers as it is affected by underlying EM and MM such as empowerment, socialization strategies or organisational size. The findings indicate that a mixture of traditional HR approaches and advanced analytics and specifically designed retention program enhances the quality of the predictions and, therefore, allows a proactive design of the staffing strategies. It offers applied views that are a blend of structure, human and technical aspects.



Author Contributions. All authors contributed to the conception and design of the study, literature review, methodology, data collection and analysis, manuscript preparation, revision, and approval of the final version of the manuscript.

Funding. The authors received no specific financial support from any funding agency, commercial organization, or not-for-profit institution for the research, authorship, and/or publication of this article.

Data Availability. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Conflict of Interest. The authors declare that they have no competing interests or conflicts of interest related to this work.

Ethical Approval. This article does not involve studies with human participants or animals. Therefore, ethical approval was not required.

Informed Consent. Not applicable.

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