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INSTITUTE OF SCIENCE & TECHNOLOGY
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VADAPALANI

International conference on Reinventing Business Practices, Startups and Sustainability (ICRBSS) 2025



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Predicting Employee Attrition Through Engagement Metrics and Machine Learning Algorithms

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Abstract---Employee attrition is a serious challenge for organizations in the stability, productivity, and financial performance. The study aims to effectively harness predictive analytics and machine learning to predict employee turnover while determining key driving engagement factors for this outcome. It also deploys prediction models for attrition patterns using IBM HR Analytics Dataset through logistic regression, random forest, and support vector machine (SVM) models. Out of these models, the one with the best performance was found to be the random forest model in predicting job turnover indicators, with an accuracy of 86.05% while actual work-related factors like job satisfaction, organization commitment, and career development also considered as forms of turnover indicators. By this measure, employee engagement comes out as the very important influencer of retention, where supervisor involvement, work-life balance, as well as recognition are significant in reducing employee turnover. Further, it is found that new employees are quit-prone on average when there is less tenure and age, while higher salaries and better job security have lower attrition rates. Considering this perspective, this study posits that effective HR must take the charge of predictive analytics in the organization's approach towards retention improvement. Thus, data-driven insights can be used and followed by engagement actions for optimizing workforce management and mitigating attrition risks. This goes without saying that future research can revolve around strengthening the predictive models using advanced resampling techniques and qualitative insights that would allow understanding at a holistic level employee turnover.

Keywords---Predictive Analytics, Employee Turnover, Machine Learning, Employee Engagement, Retention Strategies.

1. Introduction

Digital transformation enables organizations to improve upon their internal efficiencies; machine learning and predictive analytics now assume a significant position in the HRM. Employee attrition is one of the most serious issues of the workforce itself and has direct implications for stability, productivity, and even financial health. Conventional methods are declined and reactive in nature. That's why proactive strategies for employee retention are vital for companies. Predictive analytics and machine learning can identify important "engagement factors" i.e. including job satisfaction, organizational commitment, and career growth as possible predictors of attrition risk. Such insights will allow organizations to pinpoint and focus their retention strategies. This research investigates areas intersecting the digital transformation with machine learning and employee engagement in relation to the development of a high-performance attrition prediction model. Supervised machine learning algorithms, such as support vector machines (SVM), logistic regression, and random forests, are being utilized to extract patterns that will facilitate informed decisions in the field of HR. This study is useful in the area of technology-enabled HRM, indicating how the predictive analytics can shape workforce management and employee retention strategies.

2. Literature Review

Predictive Analytics for Employee Turnover

Predictive models are meant to forecast the employees likely to be leaving an organization and determine reasons for their departure (Kudirat, 2024). It is indicative of the employee portal activity and tracking behaviors that could lead to potential attrition. Employee turnover incurs costs on recruitments, training, and productivity loss; thus, analyzing costs becomes pertinent for human resources. The Random Forest model achieved an accuracy count of 90.20% in turnover prediction (Chakraborty, 2021). Attrition tends to demoralize other employees, due to increased workload and job insecurity, thus leading to increased turnover (Nimmagadda, 2024). Employees are retained by an emotional attachment with the organization which shows the importance of affective commitment as reflected in employee retention (Zivkovic, 2024).

3. Employee Engagement

Employee Engagement is the emotional affinity between employees and their organizations, as opposed to the dispassionate characteristic of work engagement (Chaithanya, 2023). This linkage between private aspirations and the bigger vision of the company would increase productivity and performance in SMEs (Samma, 2021). Growth and excel in their engagement (Mounika, 2020). When a supervisor engages an employee, it increases job satisfaction and lowers attrition (John, 2021). Secure and happy workers perform better (Szymon, 2020). Work-life balance fosters engagement and well-being (Samaneh, 2023). Flexible work hours, stress management, and safety policies help employees manage job demands (Paudel, 2024). Organizational commitment is loyalty to the organization, belief in the goals of the organization, and a willingness to contribute (Yandi, 2022). Recognitions and growth opportunities would improve motivation and retention of employees (Marian, 2024). Job satisfaction is motivated through career planning and is a magnet for attracting future talent (Franklin, 2021; Abdullah, 2023).

4. Methodology

The research explains attrition modeling by predictive analyses with a specific interest in employee engagement. Exploratory data analysis (Correlation) and prediction modeling were conducted in Python utilizing IBM HR Analytics data set of 1,470 employees and 35 variables. Logistic regression, random forest, and SVM drove out the main turnover drivers and thereby proved predictive analytics as a strategic HR tool for workforce talent retention.

5. Results

Exploratory Data Analysis (EDA) has come up with some attrition-leading variables. On the other hand, the observed significant negative correlations with age (-0.16), total working years (-0.17), years at the company (-0.13), and years with the current manager (-0.17) suggest that younger employees will tend to leave. The high accuracies of Logistic Regression and SVM (86.73%) could not predict any model accuracies for attrition cases. Random Forest is better at 86.05% accuracy but would be able to identify only 8 out of 39 attrition cases with precision, recall, and F1-score values of 0.44, 0.21, and 0.28, respectively. Of all these methods, Random Forest, albeit with limitations, turned out to be the most effective in terms of addressing the minority class problem during attrition prediction.

6. Conclusion

Predictive analytics are quite useful in analyzing employee turnover. It has carried out logistics regression, random forest, and support vector machine technique in defining attrition factors, out of which random forest performed the

best despite imbalance in datasets. Retention-strategies include job satisfaction, work-life balance, and relationship retention, but pay attention because attrition cannot be ruled out. Obviously, the models could improve since the future work will resample and cost sensitivity learning incorporate qualitative research and continuous monitoring engagement. Predictive analytics allow organizations to instill a strong culture that inevitably makes employees engaged, thus optimizing retention strategies for the workforce to remain stable and perform in the midst of changing environments.

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