

Employee Attrition: A Statistical Analysis of Key Organizational Factors Influencing Turnover

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Abstract— Reducing employee attrition has become one of the most important challenges that needs to be addressed for any kind of enterprises. High employee attrition can lead to the loss of high skilled employees which in turn can increase operational costs, reduced productivity. This study helps us to evaluate the key parameters that influence employee attrition by analysing both numerical as well as categorical variables taken from an HR dataset. In this particular study two statistical methods were applied which are the independent samples t-test and the Chi-square test of independence. The Chi-square test was employed to examine the association between employee turnover and categorical factors like salary, department and promotion status, while t-test was applied to assess the association between employee attrition and continuous factors like satisfaction level, last evaluation, average working hours in a month. The results obtained in this paper shed light on the key factors that affect employee attrition, which in turn can help organisations to make data-driven strategies that will help to reduce employee attrition.

Keywords— Employee Attrition, Statistical Analysis, HR Analytics, Job Satisfaction, Turnover Prediction

I. INTRODUCTION

Employees form the foundation of each and every organization. Their skills and dedication play a substantial role in the long-term growth of an enterprise. But many companies find it difficult to maintain that dedication and face high employee attrition affecting their growth. A stable workforce is critical for any kind of organization. High employee attrition increases hiring and training cost of a company. At the same time, it hampers the projected growth. When trained personnel leave an organization, the company loses quality human resource in which it has invested time and other resources.

Employee turnover has a great impact on the performance and profit of the organization, and therefore, the needs of employees should be well understood in order to design

effective employee retention strategies that will enhance employee motivation and productivity as well as reduce employee turnover [16]. Recent research using employee turnover information obtained from the online profiles of employees showed that a high level of employee turnover is an indication that the company is likely to perform poorly in the future, and therefore, there is a need for transparency in employee turnover reporting to inform the concerned investors and stakeholders [1]. Additionally, by retaining employees, companies are able to maintain consistency while improving their performance. Thus, it constitutes a central concern for human resource management to figure out what makes employees stay or leave, so that organizations can identify the key factors influencing attrition and develop effective strategies to enhance retention and workforce stability.

Employees may leave for a variety of reasons which include low job satisfaction, lack of career growth, poor management, inadequate pay, and heavy workload. Also, imbalance between professional and personal life and lack of acknowledgement for work may often play a role in them seeking out new opportunities. By identifying these issues, organizations can be able to improve policies, enhance engagement, and reduce turnover.

Several studies have examined employee turnover, satisfaction and retention from psychological, organizational perspectives. Jalagat [2], in his paper, investigated the relationship among job performance, job satisfaction and motivation to understand their interdependence by the means with the help of theoretical models and literatures. Van Scheers and Botha [3] further contributed to this domain through a study aimed at analyzing job satisfaction levels among grocery retail employees in South Africa and determining whether a relationship exists between job satisfaction and motivation in grocery retailers. In addition, several studies have employed statistical modelling to

identify key drivers of employee attrition. For instance, Peng [4] applied a logistic regression model to discover key factors that contribute to employee turnover. Using a mixed-methods approach, Celestin and Vanitha [5] combined survey data from some prominent global firms with qualitative interviews and found that inadequate career growth, mental health concerns and lack of workplace flexibility significantly contribute to turnover while flexible work options and clear advancement paths strongly predict employee retention. Sainju et al. conducted a large-scale analysis of over 680,000 employee reviews with results suggesting that management is an important factor influencing both satisfaction and turnover across industry sectors [8]. A mediation-based study examining burnout, job satisfaction, and turnover intention found out that organizational commitment plays an important intermediary role with burnout and job satisfaction each exerting direct and indirect effects on employees' intention to leave [9]. A study conducted among lecturers in private colleges found low overall job satisfaction especially regarding promotion and compensation, and identified a significant negative relationship between job satisfaction and turnover intention [10]. One study among employees of private hospitals investigated the correlation between job satisfaction and turnover intention, and it was found that there was a positive but weak correlation between the two, suggesting that employees with higher job satisfaction had higher turnover intention, as most employees stated that they would leave their current jobs if they were offered better opportunities elsewhere [11]. On the predictive front, there are several prior studies that have explored machine learning based approaches, including neural networks, to predict employee turnover and identify factors associated with employee retention [6], [7], [12], [13], [14].

While these studies provide us with a great deal of information, what is still needed is a combined statistical approach which looks at both categorical and numerical parameters to present a comprehensive view of what is causing an employee to leave. In this particular study we apply samples t-test to analyze the numerical factors like satisfaction level, evaluation score, working time to compare the means between employees that left and those who stayed. For categorical variables like salary, department, promotion history, we have used the Chi-square test. Additionally, we examine which groups of data contribute most to the relationship by the means of standardized residuals. The use of these two approaches provides us with a clear picture of the factors that influence attrition. This will in turn help companies formulate strategies to improve their retention of talent, thus giving them a competitive advantage.

II. METHODOLOGY

A. Research Objectives

This study aims to:

- examine how job satisfaction, performance evaluation and working hours influence employee attrition; and

- analyse the association between employee attrition and categorical factors like salary level, department and promotion history.

B. Data Collection and Description

Due to the sensitive nature of human resource information, it is rather difficult to get information about the actual and projected turnover of employees. Therefore, we resorted to a publicly available dataset from Kaggle [15] for our study. The dataset consists of records about 14,999 employees, and the attributes are generally classified into continuous and categorical variables, and among them, only the variables that fit our objectives were chosen for this study.

C. Statistical Methods

The following statistical tests were performed to point out the factors that shape employee attrition:

1) Independent Samples T-test:

This test has been used to assess mean difference between departing and remaining employees for each continuous variable. The test identifies significant continuous factors by evaluating whether group mean differ significantly.

2) Chi-square Test of Independence:

This test has been used to check the association between the categorical determinants and attrition status to see if there is any significant association. This non-parametric test helps in finding out if there is any significant association between each categorical variable and attrition status.

After the Chi-square test, once a significant relationship was established, Standardized Residual Analysis was used to identify the specific categories in each variable that contributed most to the observed relationship. Residuals beyond ± 2 are considered to have significant influence on employee turnover.

To complement the results obtained from inferential analysis, we use data visualization using bar plots and box plots. Bar plots helped to lay out the rates of attrition over categories such as levels of salary, promotion status, and departments, making it simpler to identify the groups at risk where a higher number of employees had left. On the other hand, box plots of the key continuous variables highlighted the differences in measures of central tendency and dispersion between those who left and those who remained.

III. RESULTS AND ANALYSIS

This section summarizes the statistical outcomes of the study.

A. Samples t-tests results

Samples t-tests were performed to find if statistically significant differences exist between employee who left and those who remained across three key continuous factors:

- satisfaction level,
- last evaluation,
- Average monthly hours

The results are summarized in Table I.

TABLE I. INDEPENDENT SAMPLES T-TEST RESULTS FOR CONTINUOUS VARIABLES

Variable	Mean (left = 1)	Mean (left = 0)	p- value	Significance ($p < 0.001$)
Satisfaction level	0.4401	0.6668	0.0000	Yes
last evaluation	0.7181	0.7155	0.4683	No
Average monthly Hours	207.4192	199.0602	0.0000	Yes

From the above t-test results we observe the following:

1) Satisfaction Level:

A statistically significant difference exists in satisfaction levels between employees who exited the organization and the ones who remained. The very low p-value indicates that employees who left had significantly lower level of satisfaction on average confirming job satisfaction as a primary factor in retention. As illustrated in Fig. 1 below, the boxplot shows that the median satisfaction level is notably lower among those who exited the organization. The independent t-test confirms this observation, with a p-value < 0.001 .

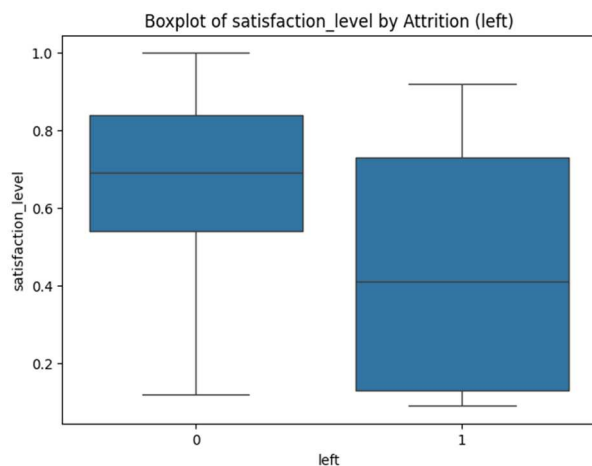


Fig. 1. Boxplot of Satisfaction Level by Attrition

Thus, the level of job satisfaction is seen to be a strong predictor of attrition, suggesting that dissatisfaction at work contributes to employees' decisions to leave.

2) Last Evaluation Score:

The p-value of 0.4683 exceeds 0.001 implying that the null hypothesis cannot be rejected, indicating no statistically significant difference in mean scores between employees who exited the organization and those who remained. Although Fig. 2 suggests that employees who left had slightly higher performance evaluation scores, this visual difference

is not statistically significant according to the t-test. So, the observed difference could be due to random variation and does not provide sufficient statistical evidence to support that performance scores as a significant predictor of employee exit in this particular dataset.

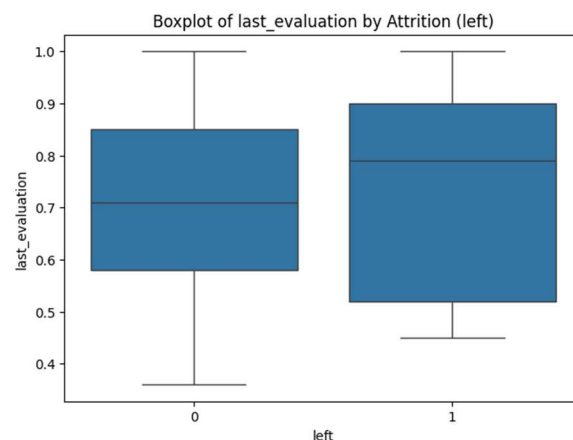


Fig. 2. Boxplot of Last Evaluation Score by Attrition

3) Average Monthly Hours:

This variable shows a significant difference with a p-value < 0.001 , which implies that employees who left worked more hours on average. Fig. 3 illustrates that employees who left tended to have worked longer hours, as indicated by a higher median and wider range of hours. This graphical trend is supported by the results of the t-test, which gives a p-value of < 0.001 , suggesting that the difference in the working hours between the two groups is statistically significant.

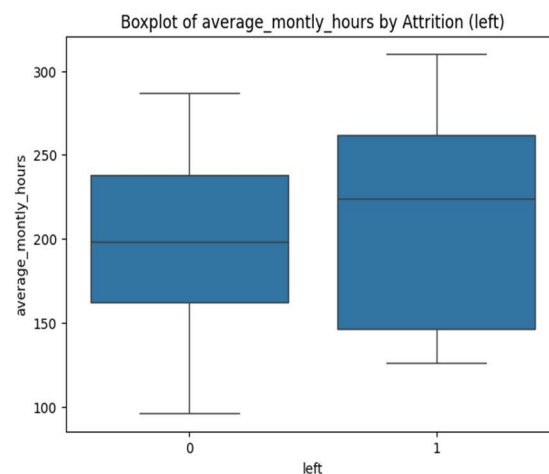


Fig. 3. Boxplot of Average Monthly Hours by Attrition

This difference emphasizes the importance of workload balance by suggesting that extended working hours could result in worker fatigue, disengagement, and ultimately higher turnover.

In conclusion, the sample t-test showed significant differences in the satisfaction level ($p < 0.001$) and the average monthly working hours ($p < 0.001$) between employees who left the organization and those who stayed. Employees who left the organization had lower levels of satisfaction and worked longer hours. However, there was no

significant difference in performance evaluation ($p = 0.468$), which indicates that performance may not be a determinant of employee turnover.

B. Chi-square Test Results

Next, the Chi-square test was performed to examine relations between employee attrition status and categorical factors such as:

- Department,
- Salary,
- Promotion status in the last 5 years,

The results of which are summarized in Table II.

TABLE II. CHI-SQUARE RESULTS FOR CATEGORICAL VARIABLES

Variable	Chi-square statistic	p-value	Significance ($p < 0.001$)
Promotion_last_5_years	56.26	0.0000	Yes
Department	86.83	0.0000	Yes
Salary	381.23	0.0000	Yes

The highly significant chi-square values with $p < 0.001$ provide strong evidence of association between attrition and all the categorical variables tested.

1) Promotion in the last 5 years:

The results show that promotion status significantly affects attrition. Employees who had not received a promotion were more likely to leave the company ($\chi^2 = 56.26$, $p < 0.001$), indicating that providing career advancements opportunity can help reduce employee turnover.

The relationship between promotion status and employee attrition is further illustrated in Fig. 4.

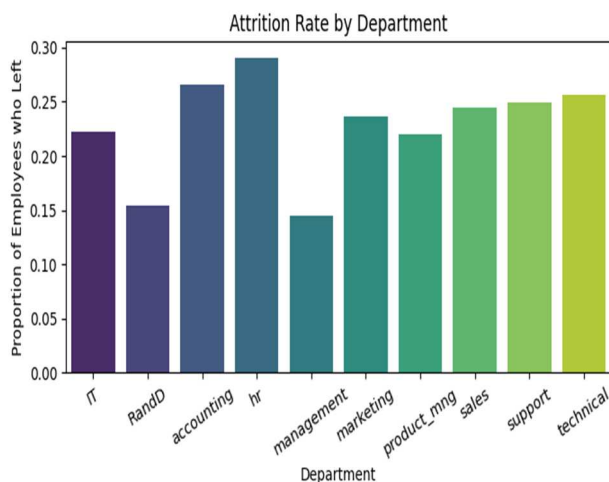


Fig. 4. Bar plot of Attrition Rates across Promotion Status

It clearly shows that employees who did not get a promotion in the last five years had a markedly higher attrition rate compared to those who were promoted.

2) Department:

The Chi-square test showed a statistically significant relationship between department and employee attrition ($\chi^2 = 86.83$, $p < 0.001$).

Next, we proceed with the standardize residual test to identify the factors in each department that influence the attrition outcome. The result is presented in Table III.

TABLE III. STANDARDIZED RESIDUALS FOR DEPARTMENT VS ATTRITION

Department	Left = 0 (Stayed)	Left = 1 (Left)	Significance	Interpretation
RandD	2.71	-4.85	Yes	Lower attrition than expected
HR	-1.65	2.94	Yes	Higher attrition than expected
management	2.69	-4.82	Yes	Lower attrition than expected
accounting,	-0.88	1.58	No	Slightly more left than expected
technical	-1.09	+1.94	No	Nearly significant higher attrition
IT, marketing, product_mng, sales, support	All residuals between -2 and +2 → No significant deviation			

The findings show that the HR department loses staff at a higher rate than expected. R&D and management, on the other hand, lose fewer staff than expected, which points to better retention practices or more agreeable working conditions in those units. Fig. 5 illustrates the share of departures for each department. HR records the largest share of employees who left aligning with the result of the standardized residual analysis.

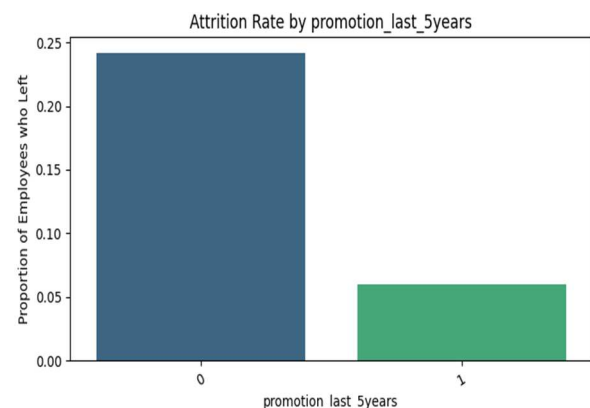


Fig. 5. Bar plot of Attrition Rates across Departments

3) Salary:

A chi-square test revealed significant relation between salary level and attrition, ($\chi^2 = 381.23, p < 0.001$).

Additionally, standardized residuals analysis was performed to determine the contribution of different salary levels to the attrition outcome. The results are summarized in Table IV.

TABLE IV. STANDARDIZED RESIDUALS FOR SALARY VS ATTRITION

Salary	Left = 0 (Stayed)	Left = 1 (Left)	Significance (Left)	Interpretation
High	6.92	-12.38	Yes	Lower attrition than expected
Medium	3.11	-5.56	Yes	Lower attrition than expected
Low	-5.76	10.31	Yes	Higher attrition than expected

The results showed that the low salary category has a significantly higher attrition rate, which stresses the importance of compensation in determining employee attrition. The high and medium salary categories have significantly lower attrition rates, which indicate that competitive compensation is a major factor in retaining employees.

The graphical trend indicated by Fig. 6 supports the fact that employees belonging to the low salary category have the highest attrition rate, while those belonging to the medium and high salary categories have a higher tendency to remain in the organization, which indicates better job satisfaction, security, and commitment. The graph indicates that salary is an important factor in retaining employees, and increasing the salary of low-paid employees can help in reducing employee attrition.

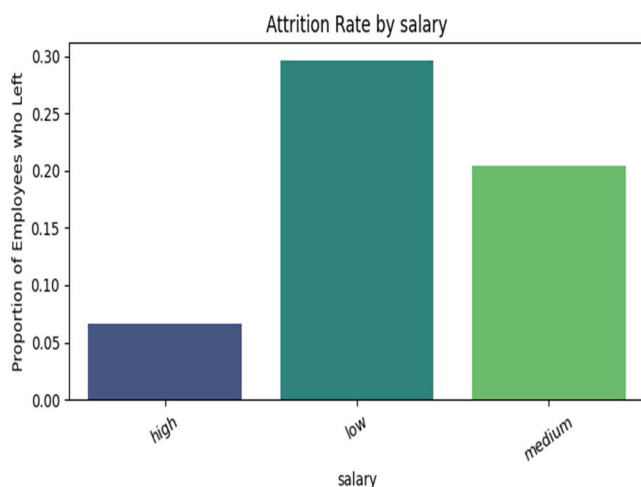


Fig. 6. Bar plot of Attrition Rates across Salary Levels

IV. DISCUSSION

The current study offers an overall understanding of the variables that are linked to employee turnover by considering both numerical and categorical variables in the same organizational dataset. The results are in line with what has been previously suggested by earlier studies on employee turnover, but they also provide some quantitative and meaningful insights that are derived from the current dataset. The results suggest that employee turnover is not caused by a single variable but a combination of variables related to work experiences.

Job satisfaction was seen to be significantly different for employees who left the organization and those who stayed, and it was observed that employees who left the organization had lower levels of job satisfaction on average, thus reiterating the fact that negative experiences at the workplace can have a gradual effect on the employee's intention to leave the organization. Additionally, average monthly working hours were also seen to be significantly different for employees who left the organization and those who stayed. Employees who left the organization had higher or irregular working hours, thus implying that work pressure can lead to burnout and eventual departure from the organization. Finally, last performance evaluation was seen to have no statistically significant difference for employees who stayed and those who left the organization. This implies that attrition in the organization is not significantly affected by performance appraisal.

The categorical variables also played critical role for in-depth analysis of employee attrition. First, compensation played a significant role in employee attrition. Low-salaried employees have a higher attrition rate than those employees who fall in the medium and high salary brackets. Promotion history was also an important factor. Individuals, who were promoted recently, were more likely to stay in the organization. This highlights the significance of career growth prospects. Departmental variations were also seen, with employees from HR and technical departments more likely to leave than those from R&D or management departments.

In conclusion, the discussion above demonstrates that employee turnover is a complex phenomenon that is influenced by both individual and organizational considerations. The findings of the study clearly highlight that retaining employees is not only about evaluating their performance but should also focus on their workload management, improving their satisfaction, ensuring that they are paid fairly, and providing them with good career opportunities.

V. CONCLUSION

The above study indicates that there are different factors which influence employee turnover. Dissatisfaction at work, excessive stress at the workplace, poor remuneration and benefits, lack of growth opportunities are some of them. Most employees that were less satisfied with their job, worked longer hours, have been at the same organization longer

would therefore quit, while those satisfied with their compensation and have recently been promoted are less likely to quit. Another cause of employee turnover was the discrepancy between departments.

The findings are quite useful for businesses that are planning to enhance employee retention strategies. In other words, organizations must take care of employees by creating an overall environment in which employees feel cared for and appreciated, well-compensated, and given more opportunities. The management of vacancies and loads must also be well done per department. The studies show that we cannot analyse employee turnover in isolation with the help of traditional HR parameters such as performance appraisal alone. Attrition is a reflection of what employees actually experience in work.

In other words, those organizations which shall be able to successfully engrain all such elements, such as fair remuneration, appropriate opportunities for advancement and correct culture will be at a better position to enjoy longer loyalty.

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