

Strategic Human Resource Management and Financial Sustainability in Modern Enterprises

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Abstract.

Strategic human resource management (SHRM) is a vital element for workforce retention and may even help in ensuring the sustainability of the contemporary organizations in the future. The current study analyses the link between the individual variables related to employees and workforce attrition on the basis of IBM HR Analytics Employee Attrition & Performance data set which consists of 1,470 observations with 35 variables. A quantitative research methodology was utilized including descriptive statistics, Welch's t-test, chi-square test, logistic regression analysis and model evaluation. An attrition rate of 16.12% is obtained with significant variation in the attrition rates based on whether the employees work overtime and their job role. The adjusted regression results suggested that working overtime increased attrition probabilities, while job satisfaction, environmental satisfaction, job involvement, work-life balance, and the frequency of training reduced attrition probabilities. A logistic regression classifier was built in addition to the one mentioned above; it resulted in an ROC-AUC of 0.801 for the holdout validation and 0.823 for the five-fold cross-validation. However, the recall on the default classification threshold for this model was low, which is why it is important to assess other metrics of model performance. This project illustrates the power of HR analytics for discovering workforce trends relevant to HR strategies and decision making. However, as the data set lacks any financial indicators, the financial impact of employee retention remains indirect and needs to be explored.

Keywords: Strategic human resource management, employee attrition, workforce stability, HR analytics, employee retention, logistic regression, financial sustainability.

1. Introduction

1.1 Background and rationale

Human resources are now considered more and more a strategic capacity of the organization rather than its purely administrative function. Recruitment, training, compensation, performance appraisal, employee involvement, and job design affect the abilities of employees and could have an impact on such important organizational aspects as productivity, employee well-being, and cost of replacing employees. Strategic human resource management (SHRM) is the attempt of aligning the policies related to human resources with the goals of the organization knowing that the success of these efforts will depend on the way they are implemented and on the organizational context [1].

Financial sustainability is the ability of a firm to ensure its viability and profitability in the long run. Human resource management practices can be instrumental in achieving this goal through building up employees' competencies, enhancing their job satisfaction and minimizing unnecessary turnover rates. On the other hand, recruitment, training, pay and fringe benefits require expenditures for which organizations need to plan properly. As a result, the significance of HRM lies not only in implementing these practices but in justifying their use.

1.2 Problem statement and research gap

While studies in the area of SHRM have looked into the correlation between HRM practices and organizational performance, interpretation of empirical evidence is still hard due to the discrepancies in terms of industry type, institutional environment, methodology of assessment, and the processes linking people management practices to organizational performance. For instance, research into employee retention has shown that compensation,

participation, grievances handling, and job satisfaction can be among the factors that impact an employee's decision to stay within an organization. Yet, the importance of those factors can differ from one group of employees to another and from one organization to another [2].

Another issue is that while many publicly available HR data set provide information about individual employees, they lack information regarding the organizations' financial reports including profitability, operating cash flows, and return on assets. These data sets will help in identifying trends related to employee turnover, yet, they will not provide independent verification of the hypothesis that improvement in retention leads to improved financial performance of the organization.

1.3 Aim, objectives and research questions

The objectives of this research are to determine whether certain indicators of HR and work environment are linked with employee turnover in IBM HR Analytics Employee Attrition & Performance data set.

More specifically, the objectives are to:

1. Describe the prevalence of employee attrition in the data set.
2. Compare employees who have left the firm with those who have stayed with it.
3. Determine links between attrition and certain categorical HR factors.
4. Compute the associations adjusted by employing the logistic regression analysis.
5. Conduct an assessment of an additional classification model of the employee attrition.

The major research question posed is the following: What HR-related factors are associated with employee attrition and what conclusions could be made on this account?

1.4 Contribution and scope

In this research, descriptive, inferential, multivariate models, and predictive analysis have been used to analyze the problem of employee attrition using an HR analytics approach. Recent research on predicting turnover using data-driven methods shows how analytical approaches can be used to uncover hidden trends within the workforce [3].

2. Literature Review

2.1 Strategic HRM and organizational performance

Strategic Human Resource Management (SHRM) integrates HR activities with organizational goals. The recruitment process, training, performance evaluation, and compensation may altogether enhance employees' abilities and organizational performance. However, their efficiency is contingent upon the organizational context and execution. It has been observed that high-performance work systems may affect organizational outcomes via human capital development [4].

2.2 Human capital, retention and organizational costs

The Human Capital Theory sees the knowledge, skills, and experience of employees as valuable resources for an organization. Training can enhance these abilities, while retention can ensure that knowledge within the institution is retained and costs related to recruitment are minimized. Nevertheless, turnover is not always detrimental since the effects of turnover depend on the nature of the job and the context of the institution. Relational HRM research also emphasizes the significance of relationships at work [5].

2.3 Employee satisfaction, workload and work design

Workload, work-life balance, and the working environment might have an effect on employees' decisions to stay in an organization. Workload and overtime may be signs of insufficient staff or bad work design. The relationship between occupational stress, work-life balance, job satisfaction, and turnover intentions was studied [6].

HR analytics and machine learning may be used for identifying patterns that predict employee attrition. However, the lack of causality is an issue when interpreting the results of the analysis. Current trends focus on the im-

portance of explaining employee attrition predictions [7]. Data privacy, fairness, and interpretation of models are still critical issues.

2.4 Financial sustainability and the evidence gap

Sustainability from a financial perspective implies the ability to maintain viable operation and performance. The HR practices may assist through the development of workforce competency, efficiency, and retention; however, they require implementation costs as well. There is research about the impact of high-performance work systems on firm's outcomes [8]. However, there is no evidence whether the retention of employees can increase the profitability, cash flow, and return on assets without financial information from the company.

2.5 Research gap and hypotheses

The literature identifies the significance of HR activities and employee experience to work-force stability. Nevertheless, due to the lack of financial indicators, it is hard to estimate the effects of such factors on financial sustainability. The present study will address the quantifiable part of this issue by exploring the attrition pattern, adjusted relationship, and the predictive performance based on the IBM HR Analytics Employee Attrition & Performance data set. Explainable predictive approaches prove the necessity of interpreting model outputs, and not only focusing on accuracy [9].

The following hypotheses are tested in this paper:

- H1: There is a relationship between attrition and being in overtime.
- H2: There is a difference in attrition according to the job role.
- H3: High satisfaction and job involvement lead to reduced chances of attrition.
- H4: Training frequency is still related to attrition despite adjustments.
- H5: Logistic regression can predict attrition.

It should be noted that all hypotheses are related to statistical association and predictive performance. The financial implications of this issue are discussed with caution due to the lack of relevant financial indicators in the data set.

3. Methodology

3.1 Research design and dataset

Quantitative cross-sectional research design was adopted. The dataset provided in this research consists of 1,470 records of employees with 35 variables, such as binary variable 'Attrition' and demographic, job-related, pay, satisfaction, and work environment variables. It is an artificial dataset that can be used as a benchmark in HR analytics but cannot be considered a representative sample of any organization.

3.2 Data preparation and variables

Attrition was classified as 1 for "Yes" and 0 for "No". The study evaluated the structure of the data set and analyzed the information that was available for the mentioned variables. The descriptive comparisons were made using the continuous and ordinal variables such as age, monthly income, distance from home, total work experience, tenure, satisfaction, job involvement, work-life balance, and frequency of training.

Table 1. Variable definitions and analytical roles

Role in analysis	Measures	Operational use
Outcome	Attrition (Yes/No)	Binary outcome for comparisons and logistic regression
HR/work-context predictors	Overtime, job role, satisfaction, involvement, work-life balance, training	Potential correlates of workforce stability
Employee characteristics	Age, monthly income, distance from home, tenure, previous employers	Descriptive and adjusted predictors

Model controls	Job role, marital status, stock-option level and other listed predictors	Adjustment for observed differences
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3.3 Statistical procedures

Descriptive statistics were obtained by attrition status. Continuous variables were compared using Welch's independent-samples t-tests in cases where there is an assumption of non-equal group variances. Multiple comparisons among continuous variables were adjusted using Holm procedure to mitigate false positives. Chi-square tests were used to determine relationships between categorical variables and attrition while Cramér's V measured relationship strengths. Tests like t-test and chi-square identify distinctness or dependence of the sample being studied but not causality.

Multivariate logistic regression analysis provided adjusted associations with attrition status. Covariates in the analysis include age, monthly income, distance from home, job satisfaction, environmental satisfaction, work life balance, job involvement, training frequency, years with company, number of companies with which the person has worked, overtime, job role, marriage status, and stock option status. The results are presented as odds ratios (ORs) with 95% confidence intervals. ORs less than one represent lower odds associating with one unit increase or stated category than the reference category, controlling for other variables in the model.

3.4 Predictive experiment and validation

Another logistic regression classifier was trained through a stratified 75%/25% training/test split with fixed random seed value. Standardization of numeric predictors and one-hot encoding of categorical predictors was applied in the preprocessing pipeline. Accuracy, precision, recall, F1 score, and ROC-AUC scores were calculated for the test dataset. ROC-AUC stability was estimated using five-fold stratified cross-validation. In order to take into account that attrition is a minority class, accuracy was not considered as a sufficient metric.

3.5 Ethics, reproducibility and limitations of design

However, the provided benchmark has no direct outcome for the financial performance of any company. As such, it is suitable for demonstration purposes only, and not for generalization to real-life companies without any validation of results externally. Any individual-level decision-making based on these results would not be justified. Furthermore, cross-sectional observational data cannot provide temporal sequencing or causality.

4. Research Methodology

4.1 Sample profile and attrition prevalence

Out of a total of 1,470 observations, 237 individuals have been classified as attriters and 1,233 as stayers, resulting in a total percentage of attrition of 16.12%. The rest 83.88% have been classified as stayers. This disparity is important because any model predicting "stayers" for all the observations can achieve an accuracy of 83.88%.

Table 2. Sample profile and attrition prevalence

Indicator	Stayed (n=1,233)	Left (n=237)
Mean age (years)	37.56	33.61
Mean monthly income	6,832.74	4,787.09
Mean total working years	11.86	8.24
Mean years at company	7.37	5.13
Mean job satisfaction (1–4)	2.78	2.47
Mean environment satisfaction (1–4)	2.77	2.46
Mean job involvement (1–4)	2.77	2.52
Mean training times last year	2.83	2.62
Mean distance from home	8.92	10.63

The findings from the descriptive analysis indicate that the employees who left work tend to be younger, earn less monthly, have less tenure, have less job and environmental satisfaction, and higher mean distance from home. This is a difference between groups and might correlate with factors like role, experience, or work history.

4.2 Overtime and attrition

Attrition rate for those who were recorded as working overtime was 30.53%, while for those not recorded as working overtime, it was 10.44%. This difference is certainly important and reflects the fact that work load can be a retention problem. The chi-square test resulted in a statistically significant relationship between overtime and attrition ($\chi^2(1) = 87.56$, $p < .001$; Cramér's $V = 0.244$).

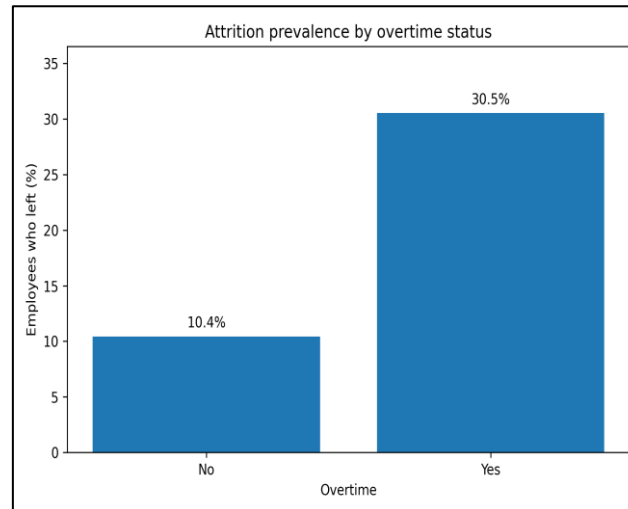


Figure 1. Attrition prevalence by overtime status.

The adjusted logistic regression shows that overtime is positively linked to attrition (OR = 5.70, 95% CI [4.02, 8.08], $p < .001$). This number is substantial even when adjusting for the variables included in the model, but the relationship should not be assumed to be causal or apply generally to all other organizations as a multiplier. Overtime can serve as a proxy for many other variables.

4.3 Differences across job roles

Table 3. Employee attrition by job role

Job role	Employees	Employees who left	Attrition rate
Sales Representative	83	33	39.76%
Laboratory Technician	259	62	23.94%
Human Resources	52	12	23.08%
Sales Executive	326	57	17.48%
Research Scientist	292	47	16.10%
Manufacturing Director	145	10	6.90%
Healthcare Representative	131	9	6.87%
Manager	102	5	4.90%
Research Director	80	2	2.50%

The chi-square statistic showed that there were differences in attrition according to different job roles, $\chi^2(8) = 86.19$, $p < .001$, Cramér's $V = 0.242$. Sales Representatives had the highest observed rate of attrition, and Research Directors had the lowest. This pattern at the level of role might be due to salary structure, stress levels, career paths, travel, and market conditions. These rates must be interpreted with care since the groups are of different sizes and compositions.

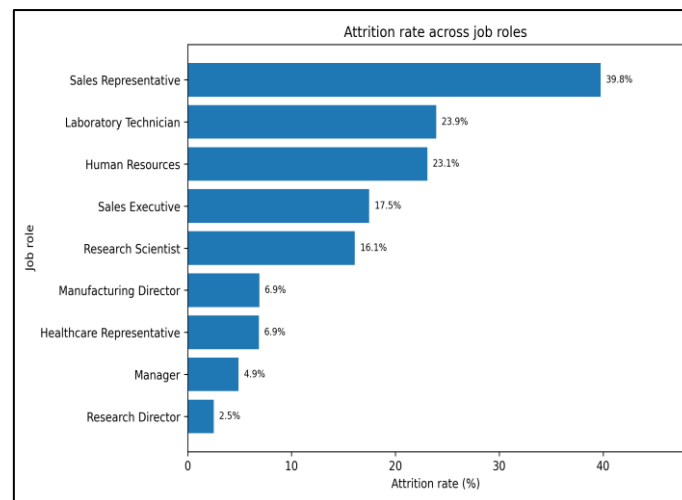


Figure 2. Attrition rates across job roles.

4.4 Satisfaction and involvement

For job satisfaction levels of 1, 2, 3, and 4, the percentages of attrition were 22.84%, 16.43%, 16.52%, and 11.33% respectively. The trend does not fully reflect a monotonic relation between attrition rate and job satisfaction level but does suggest higher attrition rates among employees who are less satisfied with their jobs. There was found a statistical relationship between job satisfaction and attrition ($\chi^2(3) = 17.51$, $p < .001$, Cramér's $V = 0.109$).

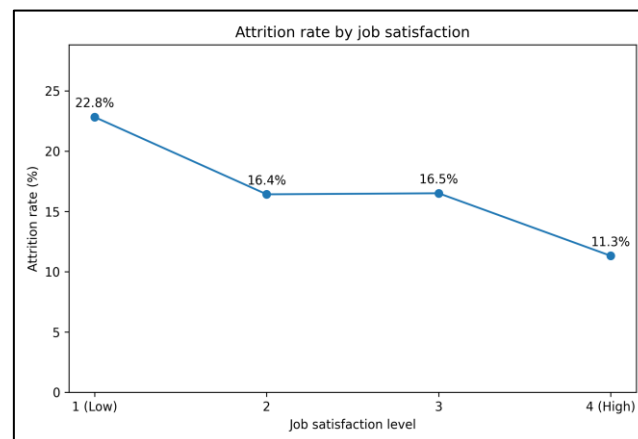


Figure 3. Attrition prevalence by job satisfaction level.

In the adjusted analysis, an increase of one point on the job satisfaction scale was linked to a decrease in the odds of attrition (OR = 0.71, 95% CI [0.62, 0.83], $p < .001$). Environmental satisfaction (OR = 0.72, 95% CI [0.62, 0.83], $p < .001$) and job involvement (OR = 0.60, 95% CI [0.48, 0.75], $p < .001$) were likewise associated with a reduction in the odds. Work-life balance was also statistically significant (OR = 0.71, 95% CI [0.57, 0.90], $p = .004$).

4.5 Other adjusted associations

Table 4. Other adjusted associations with employee attrition

Predictor	Adjusted OR (95% CI)	p-value
Age (per year)	0.96 (0.94–0.98)	< .001
Distance from home (per unit)	1.04 (1.02–1.06)	< .001
Number of companies worked (per additional company)	1.15 (1.07–1.23)	< .001
Training times last year (per additional time)	0.85 (0.75–0.98)	0.025
Stock-option level 1 vs reference level 0	0.37 (0.21–0.66)	< .001
Stock-option level 2 vs reference level 0	0.33 (0.15–0.74)	0.007

Age and the stock options held were linked to reduced probability of leaving, while the distance between the worker's residence and his job place and the number of previous employers were related to increased probabilities. The relationship between training frequency and departure probability was statistically significant even after controls, but its impact was weaker than the one for working overtime. Training frequency does not take into account the quality, usefulness or the transfer of know-how achieved through the training program, so one cannot interpret the result to mean that merely increasing trainings prevents departures. Income per month was lower for those employees who departed, but it did not show up as statistically significant after controls.

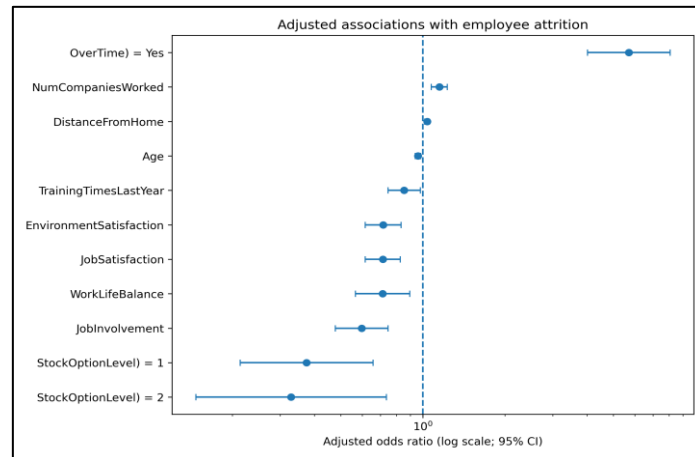


Figure 4. Selected adjusted odds ratios and 95% confidence intervals. Values below 1 indicate lower attrition odds.

4.6 Model fit and predictive performance

The logistic regression model with multiple predictors was statistically significant compared to the null model, likelihood ratio $\chi^2(24) = 351.37$, $p < .001$. McFadden's pseudo- R^2 was 0.271. It is a likelihood-based statistic and should not be confused with the amount of variance accounted for like in the R^2 of ordinary least squares.

Table 5. Predictive model evaluation

Evaluation metric	Observed result
Held-out test observations	368
Accuracy	86.96%
Precision	67.74%
Recall	35.59%
F1-score	46.67%
Holdout ROC-AUC	0.801
Five-fold cross-validated ROC-AUC	0.823 ± 0.020

An ROC-AUC of 0.801 demonstrates effective ranking capability: A randomly chosen leaving worker should be likely to receive a higher predicted score compared to a randomly chosen worker who does not leave the company. The 35.59% value of recall at 0.5 default threshold signifies that the vast majority of departures were not detected by this model. The achieved accuracy rate of 86.96% is slightly greater than the 83.88% baseline of staying workers alone.

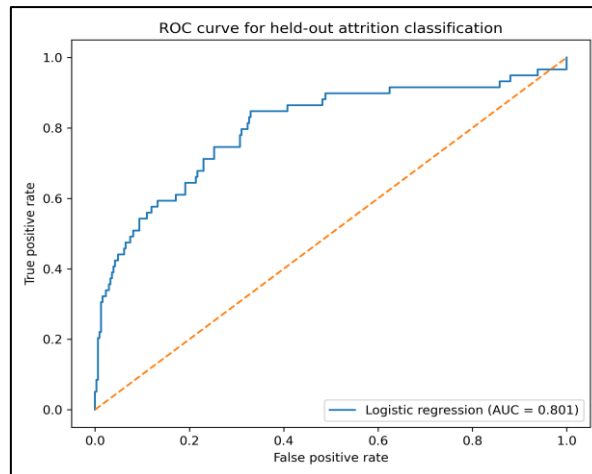


Figure 5. ROC curve for the held-out attrition-classification experiment.

4.7 Integrated interpretation for strategic HRM

Combined, the results highlight overtime, occupation, satisfaction, involvement, work-life balance, tenure-related factors, and training frequency as important correlates of attrition in this data set. The findings indicate several potential hypotheses for human resource management practice: analyze the overtime and workload structure; examine retention problems in occupations with high attrition rates; improve listening skills of employees and support of managers; and assess training practices in the context of career development and skill use. Such suggestions must be validated locally instead of being implemented in a general fashion.

The link with financial sustainability is indirect. Not causing unnecessary turnover could help to retain organization's knowledge and avoid costs related to recruiting, hiring, and vacancy, but the current analysis fails to quantify such savings. It also does not demonstrate the link between any particular HR practice and profitability, cash flow, and return on assets.

5. The Conclusion and Future Scope

5.1 Conclusion

Attrition among employees was analyzed in this research, and a sample size of 1,470 was selected from the IBM HR Analytics Employee Attrition & Performance dataset. The total percentage of attrition was 16.12%. Employees who attrited were younger in age, had lower salaries, had lower tenure, lower job satisfaction, lower environmental satisfaction, and job involvement, and higher distance from home. There were significant differences in attrition according to overtime status and job position. In logistic regression analysis, overtime status increased attrition probability greatly, whereas other variables reduced attrition probability.

Results from the predictive experiment included a holdout ROC-AUC value of 0.801 and a cross-validated ROC-AUC value of 0.823; however, the recall on the default threshold was poor. These results illustrate how HR analytics can be used to uncover trends that should be investigated by the organization. However, these results neither prove causation nor include any information about financial sustainability as the synthetic dataset is being used here. The most appropriate conclusion that can be made is that employee retention is an important HR metric that may lead to sustainability.

5.2 Managerial implications

The results should be considered as a stimulus to diagnosis rather than as some sort of automatic prescription by managers. The issue of overtime needs to be viewed in combination with the adequacy of staffing, preferences of employees, safety, and workload issues. High turnover jobs need to be examined with an interview approach as well as analysis of the pay, goals, training, and managerial practices involved. Employee satisfaction and involvement results should lead to regular listening to employees and improvements in the job design.

5.3 Limitations

The dataset is artificial and cross-sectional; there are no financial performance measures for the companies, and the data might not reflect the actual distribution of HR practices in modern firms. There may be correlation between the predictors, and some factors unaccounted for—the quality of management, regional labour market situation, and changes in the organization, for instance—could affect the HR practices and attrition. The classification criteria will vary depending on how the split and threshold were selected.

5.4 Future scope

Future research would use employee-level HR data and firm-year financial data collected from multiple organizations and years. The possible results are operating margin, return on assets, cash-flow variability, sales per employee, and costs of employees as reported. Longitudinal panel analysis may be performed to test whether the change in retention is followed by changes in financial performance, taking into consideration industry effects, firm size, leverage, and year effects. Future re-search could estimate the cost of attrition directly, as well as compare it with the cost of interventions for cost-benefit analysis.

Nonlinear effects, overtime effects by roles, exit-time survival models, and calibrated prediction models could be tested in future re-search. Evaluation would cover precision-recall curves, calibration, sub-group error rates, and external validation. Interviews could shed light on attrition of different roles. An overall sustainability framework should cover employee well-being, productivity, financial resilience, and responsible work force management.

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