

## Engagement Analytics and Employee Retention: Challenges and Opportunities

Meghana V R<sup>1</sup>, Dr. Anitha B<sup>2</sup>

<sup>1</sup>Research Scholar, School of Management, CMR University, Bangalore, India

<sup>2</sup>Associate Professor, School of Management, CMR University, Bangalore, India

**ABSTRACT:** Employee retention is one of the major challenges for organizations, especially in IT sector, where high turnover rates can impact performance and increase costs. This study explores the role of engagement analytics in mediating the relationship between overtime, Job Satisfaction, and employee attrition. Utilizing secondary data from Kaggle and with the help of python's libraries like Numpy, Pandas, Seaborn, Scipy stats, matplotlib and Networkx for analysis and visualizations, the study conducts correlation analysis to determine whether Job Satisfaction affects employee engagement to find that Job satisfaction is positively associated with engagement levels and mediation analysis among Overtime and employee attrition keeping engagement as a mediating variable to find that engagement has a minimal mediating effect on attrition whereas overtime highly positively affect attrition. The study leaves scope for further research governing unexplored factors affecting engagement and retention through primary data. The study also informs about the opportunities and challenges of integrating engagement analytics in driving employee retention.

**KEYWORDS:** Analytics, Employee engagement, Job satisfaction, Mediating effect, Overtime, Retention.

### INTRODUCTION

Employee retention has emerged as a critical challenges for organizations worldwide, particularly in industries with high turnover rates such as IT sector. High attrition rates not only disrupt organizational performance but also incur significant recruitment and training costs. One of the key drivers of employee retention is engagement, which refers to the emotional and psychological commitment of employees to their work and organization. Engaged employees are more likely to be productive, innovative, and committed to the organization, whereas disengaged employees may experience lower motivation and higher turnover intentions. By leveraging data-driven insights, engagement analytics helps organizations measure employee sentiment, identify factors affecting engagement, and implement targeted interventions to enhance retention. This study aims to explore the role of engagement analytics in mediating the relationship between work-related factors such as overtime, Job Satisfaction, and employee attrition in IT companies.

Through a comprehensive analysis of secondary data, this research examines the interplay between job demands (Overtime) and job resources (Job Satisfaction), with engagement acting as a mediator in the relationship between these factors and employee attrition. The study used JD-R model to frame the analysis, providing a theoretical foundation for understanding the dynamic of employee engagement and retention.

### REVIEW OF LITERATURE

A study by **Nomahaza Mahadi and Sathees Basakaran** (Mahadi et al., 2020) employed a conceptual analysis based on existing literature on employee attrition and found that various factors, including basic pay, career advancement, trust in leadership, job security, and Job Satisfaction, with different priorities for different age groups and perspectives influence employee attraction and retention. To focus more on specific factors **Retno Sari Murtiningsih's study** (Murtiningsih, 2020) used a cross-sectional design and collected data through questionnaires and used SEM analysis to test the hypothesis to find that compensation and training & development have a positive effect on job satisfaction. In contrast, organizational culture does not have a positive impact on job satisfaction. Compensation positively impacts employee retention, but training & development and organizational culture do not affect employee retention. A study conducted by **Das R. and Anjana D.** (Das & Anjana, 2020) examines the opportunities and challenges of using HR analytics to reduce attrition rates in organizations. By applying logistic regression to survey responses that



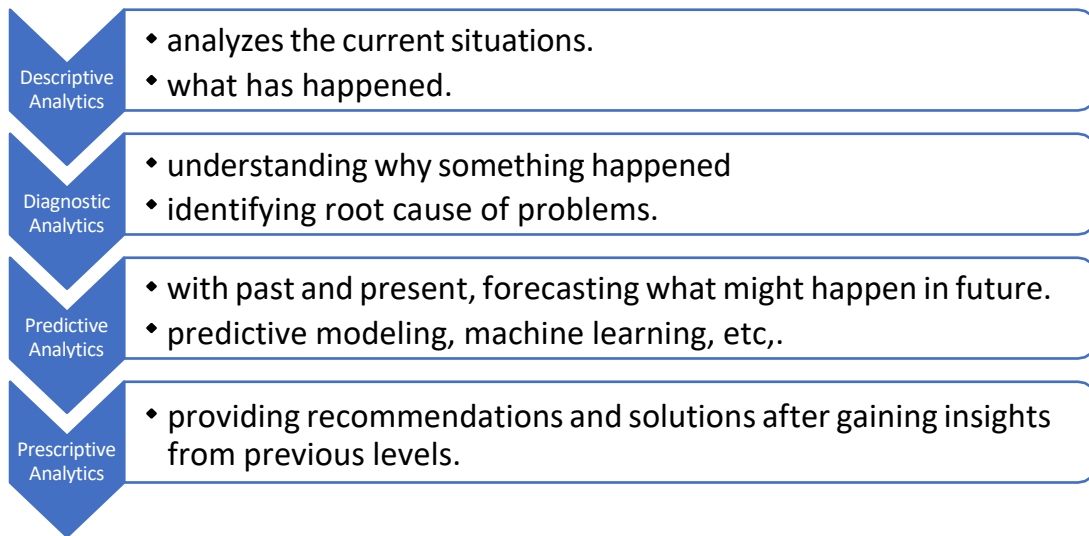
included demographic questions, the researchers highlighted the importance of data mining techniques in predicting attrition patterns. They also emphasized the significant role of organizational culture, job satisfaction, and employee engagement in helping to lower attrition rates. To understand the role of analytics in engagement and retention, a study by **Rao S. and Chitranshi** (Rao et al., 2020) explores the impact of Artificial Intelligence (AI) in Human Resources (HR), specifically regarding employee engagement and retention. The researchers employed factor analysis on survey data to identify factors influencing the adoption of AI in these areas. The study concludes that AI can be a powerful tool for predicting and preventing employee turnover, allowing organizations to identify and address the root causes of employee dissatisfaction. Several studies emphasize the significance of utilizing data-driven insights to understand and address the factors contributing to employee turnover. **Belal H. M., Singh R., and Foropon** (Belal & Foropon, n.d.) focus on the mediating role of Business Data and Predictive Analytics (BDPA) in the relationship between human resource practices and employee retention. This study is grounded in the Resource-Based View theory, arguing that effective HR practices, supported by BDPA capabilities, can help create a sustainable competitive advantage by enhancing employee retention. Employee engagement and retention are major concerns for organizations that encompass multicultural groups. To address these factors, a study conducted by **Alfred Presbitero and Yuka** (Presbitero et al., 2025) examined the relationship between cultural intelligence—in both employees and employers—and employee work engagement and retention within multicultural teams. They used a two-wave, time-lagged design, collecting data from employees in these diverse teams. The study suggests that higher levels of cultural intelligence, both at the individual and supervisory levels, positively influence work engagement and reduce turnover intentions. One effective strategy that HR professionals can use to keep employees motivated and engaged is gamification. In their study, **Dr. Lawande and Rashmita** (Lawande et al., n.d.) explore the impact of gamification on employee engagement, examining both its theoretical foundations and practical applications within the HR field. They employed a mixed-methods approach, which included reviewing existing literature and analyzing survey responses. The study concluded that gamification can be a valuable tool for enhancing employee engagement; however, it requires careful planning and consideration. It emphasizes the need to align gamified systems with organizational objectives and employee needs, while also leaving room for future research in this area. In addition to the IT sector, other industries such as hospitals and banks also experience high attrition rates and struggle with employee engagement. **Ravi Kumar Bommiseti, Shaik, and others** (Ravi Kumar Bommiseti; Shaik Mahaboob Syed; Mrinal Verma; Sirisha Charugulla; A.V.V.S. Subbalakshmi Department of Commerce, 2024) have studied the application of deep learning algorithms and blockchain technology to enhance employee engagement specifically in the banking sector. Their findings indicate that integrating blockchain technology can provide security and transparency in HR initiatives. This integration improves data integrity and reduces the risk of unauthorized access. Additionally, they discovered that deep learning algorithms can predict employee engagement levels using historical data and real-time inputs. Combining HR analytics with employee engagement leads to the concept of engagement analytics. To investigate the role of HR analytics in enhancing employee engagement, **Hemanth Kumar and Naga Kumari** (Hemanth Kumar et al., 2022) studied the moderating effect of KR analytics on the relationship between employee engagement and turnover intentions. Their research explores how data-driven insights can improve the effectiveness of employee engagement initiatives. Through quantitative analysis of their proposed hypotheses, the study concluded that organizations can effectively leverage HR analytics to engage and retain their workforce. This research also opens up opportunities for future studies in this area. The study conducted by **Dr. Animesh and Sigdha** (Enhancing Job Satisfaction and Retention in IT Companies Through HR Analytics-Driven Employee Engagement, n.d.) focuses on improving job satisfaction and retention in IT companies by utilizing HR analytics to enhance employee engagement. The research employed a quantitative survey design, applying both descriptive and inferential statistics to analyze employee perspectives, levels of engagement, and satisfaction within the IT sector. The study concluded that employee engagement and satisfaction are influenced by several factors, with Job Satisfaction, opportunities for career advancement, and recognition being particularly significant. Although progress has been made in understanding and addressing employee engagement and retention in IT companies, there is still considerable room for improvement in implementing effective strategies and fully utilizing HR analytics. The book chapter by **Deepak Kumar Bhattacharya** (Bhattacharyya) provides a comprehensive overview of HR analytics and employee engagement. It clearly explains various statistical tools and analyses used in human resource management, particularly focusing on engagement and retention. Among the tools discussed are linear regression models, meta-analysis, and both parametric and non-parametric tests. The chapter offers detailed explanations of these methodologies, encouraging further research.

**Engagement Analytics** is a strategic approach to understanding and enhancing employee engagement by leveraging data-driven

insights. It involves collecting, analyzing, and interpreting metrics that reflect employees' emotional and psychological commitment to their work, teams, and the organization as a whole. Organizations aim to improve employee satisfaction, productivity, and retention by focusing on engagement, ultimately contributing to long-term business success. **Employee engagement** refers to the enthusiasm and dedication an employee feels towards their job and the organization. Engaged employees are more likely to go beyond their job requirements, exhibit higher levels of creativity and innovation, and remain committed to the organization (Hemanth Kumar et al., 2022). Conversely, disengaged employees may show decreased productivity, lack of motivation, and a higher likelihood of turnover. **Role of Engagement Analytics in 'Retention',** **Engagement analytics** is critical for addressing employee turnover. Organizations can use engagement analytics to gain insights about 1. disengaged employees and understand the root cause of dissatisfaction, 2. design targeted interventions to improve engagement levels, such as personalized career development plans or enhanced Job Satisfaction policies, and 3. evaluate the effectiveness of employee engagement initiatives and refine them based on data-driven evidence. Engagement analytics bridges the gap between employee sentiment and organizational strategy. By leveraging data to measure and improve engagement, organizations can foster a motivated workforce, reduce attrition, and drive sustainable growth. For organizations aiming to enhance employee retention, engagement analytics serves as a vital tool to identify key drivers of satisfaction and commitment while addressing areas of concern proactively.

**Engagement analytics, a part of HR Analytics**

HR Analytics is the process of collecting, analyzing, and interpreting HR data to improve workforce performance, optimize HR processes, and align them with organizational goals. It uses data-driven insights to make better decisions about recruitment, training, employee engagement, and other HR functions (AIHR). Any analytics can be classified into 4 levels as shown in Fig.1



**Fig. 1 (Levels of Analytics)**

Engagement analytics, being a part of HR analytics generally comes in a Descriptive level of analytics, describing the employee engagement levels thus helping the next levels of analytics to make data-driven decisions.

Taking engagement analytics as a core, let us discuss each level of engagement analytics in depth, and see how it impacts HR analytics as a whole. A descriptive level of engagement analytics describes the current engagement levels, diagnostic engagement analytics explores the root cause of disengagement and identifies the factors that affect employee engagement, and predictive engagement analytics forecasts what future engagement might look like with the help of predictive models and Machine Learning (Ali & Bibi, n.d.; Presbitero et al., 2025). and lastly prescriptive engagement analytics provides recommendations and suggestions to keep employees engaged.

Employee engagement analytics is not simply performed, if anything in the organization has to be performed there should be a reason or purpose to serve, as such engagement analytics will be carried out when there is an engagement lack in employees which can be tracked by measuring certain metrics such as productivity, absenteeism, employee turnover, decrease in sales and revenue

(Time doctor), these are situations where engagement analytics has to be chosen.

**Statement of the problem**

Employee retention has become a critical challenge for IT companies in India, where high turnover rates impact organizational performance and increase recruitment costs. Factors such as overtime, poor Job Satisfaction, and low engagement are often cited as contributing to attrition. While engagement analytics can provide actionable insights into retention strategies, there is limited research on its mediating role between Job Satisfaction, overtime, and employee retention. This study aims to bridge this gap by leveraging secondary data to explore these relationships and provide data-driven recommendations.

**Research Gap**

Existing studies have just explored HR analytics as a whole, this study focuses only on Engagement analytics as a part of HR analytics.

**Research Question**

Does engagement mediate the relationship between Overtime, Job Satisfaction, and employee retention?

**Objectives of the study**

- To determine the relationship between Job Resource (Job satisfaction) and employee engagement.
- To analyze the relationship between Job Satisfaction, overtime, and employee engagement in IT companies.
- To understand the opportunities and challenges of integrating engagement analytics with employee retention.

**Hypotheses:**

**H1:** Job Satisfaction is positively associated with engagement levels among employees. **H0:** Job Satisfaction is not positively associated with engagement levels among employees. **H2:** Engagement levels mediate the relationship between overtime and employee retention.

**H0:** Engagement levels do not mediate the relationship between overtime and employee retention.

**THEORETICAL FRAMEWORK**

the theoretical framework serves as the foundation for understanding the dynamics of engagement analytics in employee retention. It provides a structured approach to examine how engagement influences retention, while also identifying challenges and opportunities within the organizational context. This framework integrates the Job Demands-Resources (JD-R) model, which is well-suited for analyzing the interplay between job demands, job resources, and employee engagement, as well as its impact on employee retention.

The core Theoretical foundation is the JD-R model by Bakker and Demerouti (2001), which provides a comprehensive framework to analyze employee well-being, **engagement** and performance. Integrating engagement analytics into the JD-R model, Fig.2. showing the theoretical framework of the study by integrating the JD-R model with engagement analytics with constructs of **Job Demands** (Over Time) and **Job Resources** (Job Satisfaction) as variables, **employee engagement** as a mediating factor, and **employee Retention** as the ultimate dependent variable.

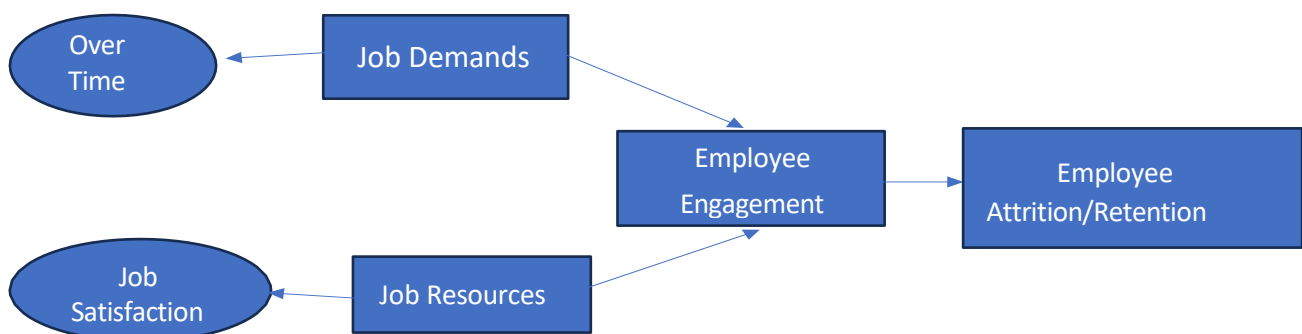


Fig 2. Theoretical Framework for the study.

**Job demands** refer to the physical, psychological, social or organizational aspects of a job that require sustained effort and are associated with physical or psychological costs, this study focuses on **overtime** alone as a Job demand which refers to the cumulative effect of job demand and resources on employees. Long-term exposure to high job demands without sufficient resources can lead to chronic stress, disengagement, and turnover intentions. **Job Resources** refer to aspects of the job that help achieve work goals, reduce job demands, or stimulate personal growth, this study focuses on **Job Satisfaction** alone as a job resource that refers to the equilibrium between personal life and professional responsibilities. It is often influenced by, 1. Flexible work arrangements, 2. organizational policies, and 3. Cultural support. **employee engagement**, characterized by dedication, and absorption, is central to the JD-R model. Engagement acts as a mediator that 1. Translates job resources into positive outcomes such as increased retention, 2. Buffers the negative effect of excessive job demands on retention. As a mediator, engagement analytics bridges the relationship between job demands, job resources, and employee retention. **Employee retention** refers to an organization’s ability to keep its employees over time. It is influenced by, job characteristics, engagement levels, organizational culture, job satisfaction, etc., this study primarily focuses on engagement analytics through job demands and job resources.

The interrelationship between the variables are shown in Fig 3.

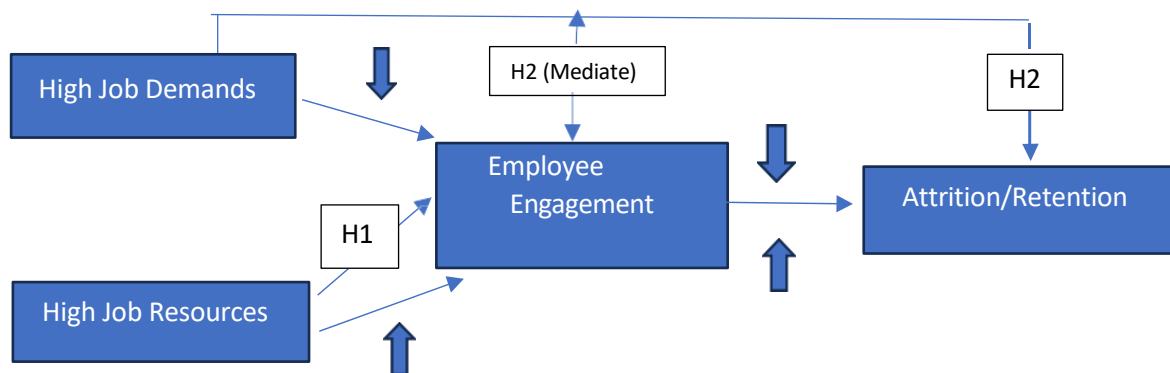


Fig 3. Shows the interrelationship between the variables in the study

**METHODOLOGY**

This study adopts a quantitative research design to examine the relationship between overtime, Job Satisfaction, engagement levels, and employee retention. Secondary data sourced from Kaggle datasets (<https://www.kaggle.com/datasets/adityaghuse/employee-attribution-and-engagement>) is used to test the proposed hypotheses, the dataset originally contained 1,400 records. After cleaning the data to remove incomplete or irrelevant data entries, the final sample size was 1230. The sample size is sufficient for statistical analysis and ensures robust findings. Considering Overtime(Yes/No), and Job Satisfaction(scale of 1-5), Engagement data was not directly available in the dataset. Instead, job involvement and job satisfaction were used as proxies to measure engagement, as both are established components of employee engagement in the study. And employee retention data with binary variables whether the employee stayed or left the organization. Descriptive statistics is used to summarize the data, including mean, standard deviation, and frequency distributions for key variables. Correlation analysis was used to test the relationship between Job Satisfaction and engagement levels(H1), and mediation analysis to assess whether engagement levels mediate the relationship between overtime and employee retention(H2). Statistical tools, Excel, and Python(Numpy, Pandas, matplotlib, seaborn, scipy stats, and networkx ) are used for statistical analysis and visualizations.



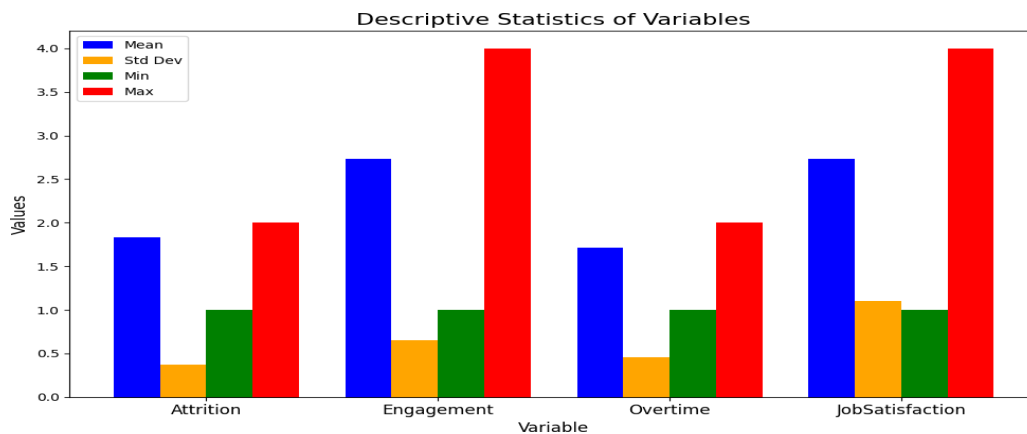


**DATA ANALYSIS**

**Descriptive Statistics of key Variables**

**Table 1**

	Attrition	Engagement	Overtime	Job Satisfaction
<b>Count</b>	1230.000	1230.000	1230.000	1230.000
<b>Mean</b>	1.835772	2.734553	1.713008	2.736585
<b>Std</b>	0.370633	0.649893	0.452542	1.102056
<b>Min</b>	1.000	1.000	1.000	1.000
<b>Max</b>	2.000	4.000	2.000	4.000



**Fig. 4 (descriptive statistics plot)**

The dataset comprises 1,230 observations. **Table 1** Key variables analyzed include attrition, engagement, overtime, and Job Satisfaction. The descriptive statistics for these variables are:

The mean attrition value is 1.08 with a standard deviation of 0.37. the minimum and maximum values are 1 and 2, respectively, indicating a binary variable for attrition status. The mean engagement score is 2.73 with a standard deviation of 0.65 on a scale of 1 to 4, suggesting moderate employee engagement levels—the quartile range between 2,5 and 3. The mean overtime value is 1.71 with a standard deviation of 0.45, indicating that most employees fall between low and moderate levels of overtime. Indicating a binary variable for overtime status. The mean Job satisfaction score is 2.73 with a standard deviation of 1.102 on a scale of 1 to 4, reflecting a relatively widespread job satisfaction score.

These statistics provide a foundation for analyzing relationships among the variables and testing the hypotheses.

**Correlation Test and Result**

**H1:** Job Satisfaction is positively associated with engagement levels among employees.

**H0:** Job Satisfaction is not positively associated with engagement levels among employees.

**Table 2**

Variables	Pearson Correlation (r)	P-Value	R-Squared
<b>Engagement and Job Satisfaction</b>	0.8372734	0.0	0.701026

The analysis **Table 2** shows, the Pearson correlation coefficient indicates a strong positive linear relationship between Job Satisfaction and Engagement. Since the value is close to 1, it suggests a strong positive correlation. This means that as Job Satisfaction increases, engagement tends to increase as well. The p-value tests the null hypothesis that there is no correlation between Job Satisfaction and engagement. As P-value is 0.0 which is less than 0.05, indicates the correlation is statistically significant. The

R-squared value represents the proportion of the variance in engagement that can be explained by Job Satisfaction. An R-squared value of 0.7010 means that approximately 70.1% of the variability in engagement can be explained by Job Satisfaction. This is a high proportion, suggesting that Job Satisfaction is a good predictor of Engagement.

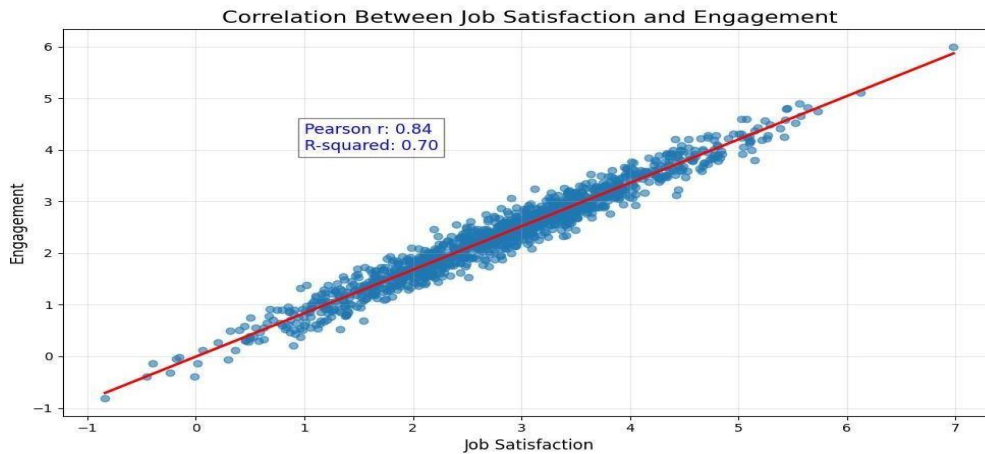


Fig. 5 (Scatterplot showing the correlation between Job Satisfaction and Engagement)

Pearson correlation coefficient of 0.8373 indicates a strong positive relationship between Job Satisfaction and Engagement. The P-value of 0.0 indicates that the correlation is statistically significant and the R-squared value of 0.7010 suggests that Job Satisfaction can explain 70.1% of variance in Engagement.

By the inference, the Null Hypothesis is rejected and the Alternative hypothesis is accepted, concluding that “Job Satisfaction is positively associated with employee engagement levels”.

**MEDIATION TEST AND RESULT**

**H2:** Engagement levels mediate the relationship between overtime and employee retention.

**H0:** Engagement levels do not mediate the relationship between overtime and employee

Table 3

Effect Value	Value
Direct Effect	0.7838
Indirect Effect	-0.0338
Total Effect	0.7500
Proportion Mediated	-4.50

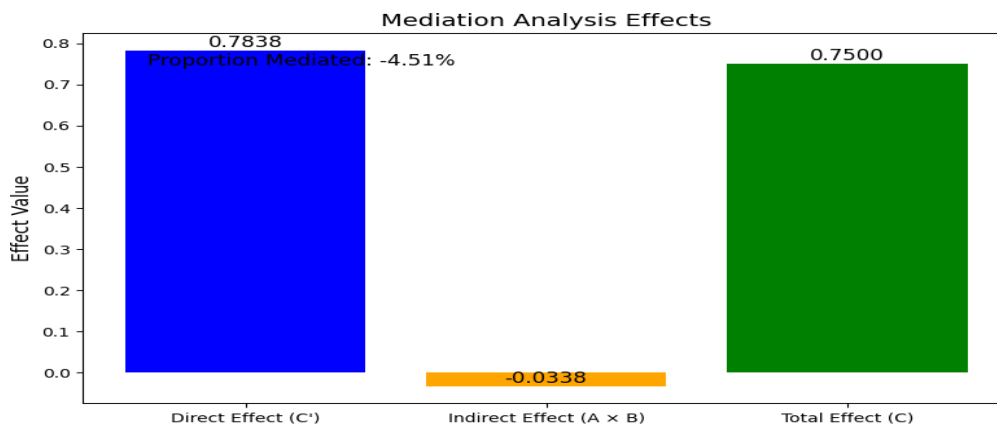


Fig. 6 (Plot showing Mediation analysis between Overtime, Attrition and Engagement)

**Direct Effect (c')= 0.7838**, this effect of overtime on Attrition after accounting for the mediating variable engagement indicates that overtime has a positive and direct impact on Attrition. **Indirect Effect (A x B)= -0.0338** represents the effect of overtime on attrition that is mediated through engagement. The negative value suggests that overtime slightly reduces attrition via its influence on engagement. **The Total effect (c)= 0.7500**, this is the overall effect of overtime on attrition, combining both direct and indirect effects, it shows that overtime positively influences attrition. **The proportion mediated= -4.50%** indicates that the mediated pathway explains a small proportion of the total effect. Still, the negative value suggests that the mediating value that is engagement slightly counteracts the direct effect of overtime on Attrition.

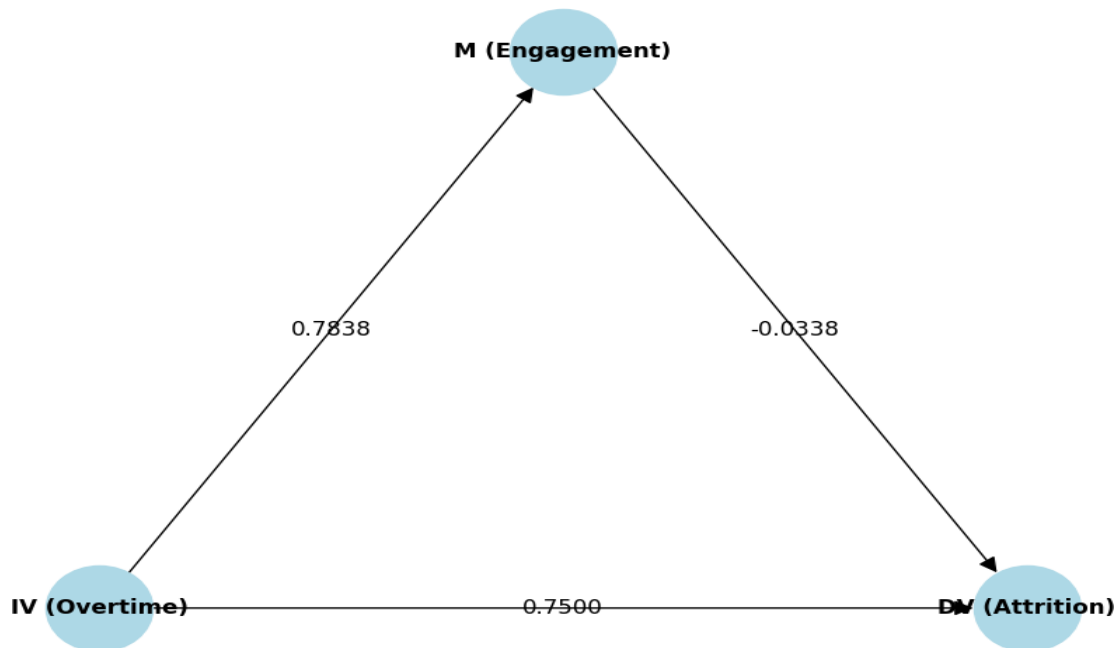


Fig. 7 ( Path diagram showing the mediation between Overtime, Attrition and Engagement)

Based on the results of the mediation analysis **Fig. 6 and 7**, we can conclude that engagement levels do mediate the relationship between overtime and employee attrition, but the mediate effect is weak. The direct effect of overtime on employee attrition is positive. The total effect of overtime on attrition remains positive, but the proportion mediated by engagement is small. While the mediation is weak and the effect is small, the analysis suggests that engagement does mediate the relationship between overtime and employee attrition.

Hence, the study rejects the Null hypothesis is rejected and the Alternative hypothesis is accepted concluding that “Engagement levels mediate the relationship between overtime and employee retention”.

**Opportunities and challenges of integrating Engagement Analytics for Retention:**

Integrating engagement analytics for retention presents significant opportunities to improve employee satisfaction, reduce turnover, and optimize organizational performance. However, it also comes with challenges such as data privacy concerns, measurement complexities, and resistance to change. To maximize the benefits, organizations must invest in robust data governance, ensure transparency, and commit to acting on insights. By addressing these challenges strategically, companies can create a sustainable framework for leveraging engagement analytics to drive retention.

**CONCLUSION**

From analysis performed in the previous section of the study, key findings of the study after conducting a Correlation test on Hypothesis one suggest rejecting the null Hypothesis and accepting the alternative hypothesis concluding that “Job Satisfaction is positively associated with employee engagement levels”. The mediation test conducted among Overtime, Engagement, and attrition also proves to reject the null hypothesis and accept the alternative hypothesis at a very minimal effect concluding that “Engagement



levels mediate the relationship between overtime and employee retention". Thus integrating engagement analytics into an organization can be one of the solutions to monitor employee engagement as well as turnover intention serving as a tool to retain the employees. However engagement alone cannot be a factor that is affecting the turnover intention as the study concludes, still it can serve as one of the key attributes that affects employees' retention.

After arriving at the discussion, the study concludes that Job satisfaction as a Job Resource is positively associated with employee engagement levels, and engagement has a minimal mediating effect on Attrition. Leaving scope for future studies to identify other factors that may affect engagement and Attrition. There are several other Job Resources and Job Demands that are unexplored. Future research could explore a broader set of factors to provide a more comprehensive understanding of employee attrition and retention. Having limited to secondary data, the current research also encourages future researches with primary data.

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