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EMPLOYEE ENGAGEMENT DRIVERS AND PERFORMANCE OUTCOMES: EVIDENCE FROM TECHNICAL EDUCATION INSTITUTIONS IN MALNAD REGION OF KARNATAKA

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Abstract: Employee engagement has become an essential factor in determining the efficiency and sustainability of organizations, especially in the field of higher and technical education. Institutions in the Malnad region of Karnataka play a significant role in producing skilled graduates and contributing to the knowledge economy; however, their success is strongly influenced by how effectively employees, particularly faculty and staff, are engaged in institutional activities. This study examines the drivers of employee engagement and their direct impact on individual as well as institutional performance outcomes. A structured survey was conducted among faculty and non-teaching staff across selected technical education institutions in the region. Factors such as leadership support, recognition and reward mechanisms, institutional culture, opportunities for professional development, and work–life balance were considered as key engagement drivers. Using statistical and algorithmic approaches, an employee engagement index was formulated to measure engagement levels, and regression analysis was applied to establish the link between engagement scores and institutional performance indicators such as student results, research productivity, and accreditation ratings. The findings reveal that leadership support and institutional culture have the highest correlation with positive outcomes, followed by recognition and professional development opportunities. The results highlight the importance of strategic interventions by management to strengthen engagement and enhance institutional effectiveness in the technical education sector.

Keywords—Employee engagement, technical education institutions, Performance outcomes, Institutional effectiveness, Malnad region (Karnataka).

I. INTRODUCTION

Employee engagement has emerged as a central theme in organizational research, human resource management, and educational administration over the past three decades. The concept, first introduced by Kahn [1], emphasizes the extent to which employees invest their cognitive, emotional, and behavioral energies in their work roles. Unlike job satisfaction or organizational commitment, engagement goes beyond attitudes to reflect proactive involvement, enthusiasm, and discretionary effort that employees contribute to organizational success. In academic institutions, particularly technical education, engagement becomes even more critical as the quality of faculty and staff performance directly influences student learning outcomes, research productivity, and institutional reputation [2].Technical education institutions in India serve as incubators of innovation and skill development. The Malnad region of Karnataka, characterized by its unique socio-cultural landscape and presence of several engineering and polytechnic colleges, contributes significantly to regional development. However, challenges such as faculty retention, fluctuating motivation levels, limited research infrastructure, and varying leadership styles have created disparities in institutional performance [3]. These issues highlight the need for a deeper understanding of employee engagement as a driver of institutional effectiveness.The global literature on employee engagement identifies multiple antecedents, including leadership support, recognition, opportunities for professional growth, work–life balance, and organizational culture [4]. Leadership, for instance, provides strategic direction and creates a sense of belonging among faculty. Recognition and reward systems motivate employees to contribute beyond minimum expectations. Professional development opportunities ensure that academic staff remain updated with technological

advancements, while institutional culture establishes shared values and collaboration. Collectively, these drivers shape the psychological contract between employees and institutions [5].

Several empirical studies demonstrate a strong correlation between engagement and organizational outcomes. Saks [6] argued that engaged employees are more committed, less likely to leave, and more productive. In the higher education sector, engagement has been linked to improved teaching quality, enhanced student satisfaction, increased research publications, and better accreditation results [7]. Institutions with engaged employees tend to innovate faster and adapt more effectively to policy changes and technological disruptions [8]. Conversely, disengagement manifests as absenteeism, low morale, reduced productivity, and higher attrition rates, all of which can adversely impact institutional performance [9].Despite its recognized importance, employee engagement has received relatively limited attention in Indian higher education literature, particularly in regional contexts such as the Malnad area. Most studies have been conducted in metropolitan universities, leaving a gap in understanding the specific drivers of engagement in semi-urban and rural educational ecosystems [10]. This gap is significant because regional institutions often face different challenges, including resource constraints, socio-economic diversity of students, and distinct cultural expectations from faculty and management. Therefore, it becomes essential to investigate the engagement-performance linkage in these settings to develop contextually relevant strategies.

The present study addresses this gap by empirically examining the drivers of employee engagement in technical education institutions of the Malnad region. A mixed-method approach is adopted, combining survey data with predictive modeling techniques to develop an employee engagement index. By quantifying engagement drivers and linking them with performance outcomes such as student academic results, research output, and institutional ratings, the study provides evidence-based insights for policymakers and institutional leaders.The findings not only contribute to the theoretical understanding of engagement in educational settings but also have practical implications. They suggest that institutional leaders must adopt a holistic strategy that emphasizes supportive leadership, recognition mechanisms, and a culture of continuous professional development. Such strategies will not only enhance faculty motivation and retention but also improve the overall performance and reputation of technical institutions in Karnataka's Malnad region.

II. LITERATURE SURVEY

Employee engagement has been widely explored in organizational psychology, management, and human resources research over the past two decades. Scholars have emphasized its multidimensional nature, linking it to motivation, job satisfaction, and organizational effectiveness. In higher education, particularly technical education, employee engagement plays a pivotal role because faculty and staff commitment directly influences student learning, research quality, and institutional development [11]. Kumar and Pansari [12] examined employee engagement as a driver of institutional performance and argued that engagement is not only an outcome of human resource policies but also a predictor of long-term sustainability. Their findings showed that institutions with strong engagement strategies tend to retain talent, achieve higher accreditation scores, and demonstrate stronger industry collaborations. Similarly, Bakker and Demerouti [13] highlighted the role of the Job Demands-Resources (JD-R) model in explaining engagement. They argued that job resources such as leadership, autonomy, and recognition fuel employee motivation, while high demands can cause burnout unless balanced effectively. In the Indian higher education context, a study by Narayan and Thomas [14] found that employee engagement in engineering colleges is influenced by institutional leadership and availability of research infrastructure. They also identified work–life balance as a key driver, especially for younger faculty members managing professional and personal responsibilities. This aligns with international studies, such as that of Rich et al. [15], who concluded that engaged employees demonstrate greater task performance, citizenship behaviors, and innovation in their respective domains.

Another significant stream of research has focused on the relationship between employee engagement and student outcomes. Trowler [16] examined the role of academic staff engagement and demonstrated that engaged faculty members are more likely to employ interactive teaching methods, mentor students, and contribute to improved student performance. This perspective is reinforced by Agarwal and Gupta [17], who reported that student success in Indian technical institutions is strongly correlated with the engagement level of teaching staff. Organizational culture has also been recognized as a major determinant of employee engagement. Schneider et al. [18] emphasized that institutions fostering collaborative cultures, trust, and transparency are more likely to develop engaged workforces. In the Indian context, Deshpande [19] found that cultural alignment between employees and institutional values significantly enhances commitment and reduces attrition among faculty members. Similarly, Albrecht [20] argued that psychological safety and inclusiveness within organizations act as enablers for higher engagement levels. Recognition and reward systems have also received scholarly attention. A study by Saks and Gruman [21] revealed that meaningful recognition not only motivates employees but also strengthens their loyalty to the organization. For higher education institutions, recognition in the form of academic awards, research grants, and promotions can have a significant impact on faculty morale. In Karnataka, Rao and Hegde [22] specifically studied polytechnic institutions and found that lack of structured recognition frameworks often leads to disengagement, particularly among non-teaching staff.

Professional development opportunities constitute another driver highlighted in the literature. Collings et al. [23] suggested that institutions investing in faculty development programs, workshops, and training initiatives report higher engagement scores. This is particularly relevant in technical education, where rapid technological advancements necessitate continuous skill development. In a study focused on engineering colleges, Ramesh and Pillai [24] noted that faculty members provided with opportunities for research collaboration and conference participation were significantly more engaged compared to their counterparts without such exposure. While much of the literature highlights positive associations between engagement and performance, some studies have cautioned against a one-dimensional view. Shuck and Wollard [25] argued that engagement must be seen as a dynamic construct influenced by contextual and individual factors, rather than a fixed attribute. They recommended holistic engagement strategies that account for employee well-being, institutional policies, and socio-economic environments. This caution is especially relevant in regional contexts such as the Malnad region, where infrastructural and resource constraints may influence engagement differently than in metropolitan institutions. Overall, the literature demonstrates that employee engagement is shaped by multiple drivers including leadership, culture, recognition, and professional development. Engagement not only enhances individual performance but also contributes to institutional growth and student success. However, there is limited research specifically addressing technical education institutions in semi-urban regions of India, leaving a gap that this study seeks to fill by focusing on the Malnad region of Karnataka.

III. PROPOSED SYSTEM

The proposed study aims to examine the key drivers of employee engagement and their influence on institutional performance outcomes in technical education institutions of the Malnad region, Karnataka. Recognizing that employee engagement is a multidimensional construct shaped by leadership support, work–life balance, recognition and rewards, professional development, and institutional culture, the work adopts a structured quantitative framework. A survey-based approach was implemented across faculty and staff in seven technical institutions, using a five-point Likert scale to capture perceptions of engagement drivers. Responses were normalized, and a weighted Employee Engagement Index (EI) was constructed to represent individual engagement levels. Factor analysis was employed to assign relative weights to different drivers, ensuring that the index reflects their actual contribution.Institutional performance outcomes were assessed using both objective indicatorssuch as student results, research productivity, and accreditation scoresand subjective measures like job satisfaction and motivation. A predictive model was developed by applying multiple regression and Random Forest algorithms to

establish the relationship between engagement and performance. The model was trained on a subset of the dataset and tested for accuracy and robustness.

This approach provides a dual contribution: first, the development of a quantifiable engagement index tailored to technical education settings; second, a predictive framework that connects engagement levels to measurable institutional performance. By integrating data-driven analysis with organizational insights, the proposed work offers practical guidance to institutional leaders for designing effective engagement strategies that enhance faculty motivation, institutional culture, and overall academic outcomes as shown in the figure 1.

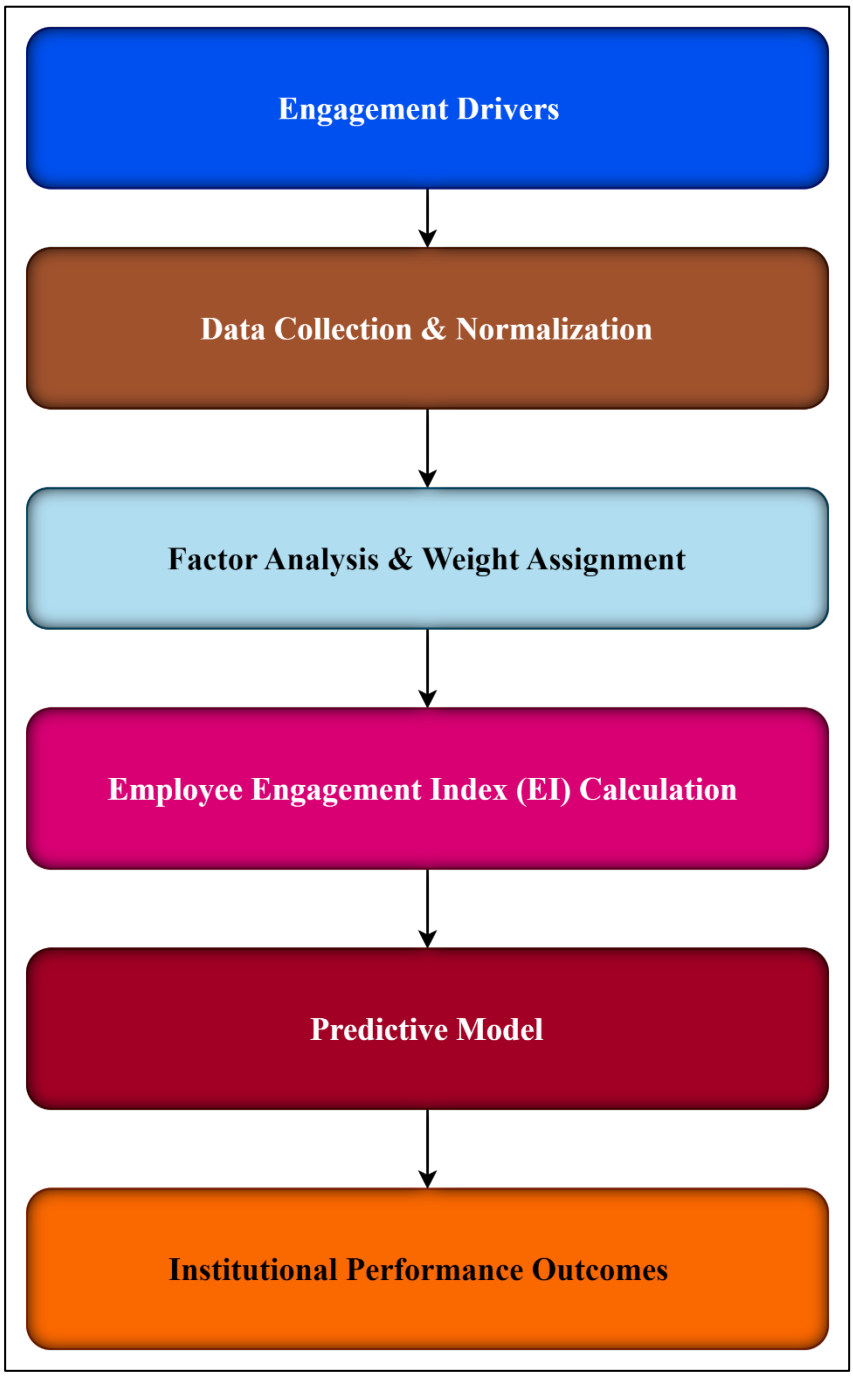

Fig.1: Proposed Framework for Unified Medical Image Classification and Explainable AI.

A. Proposed Work and it's Implementation:

1. Research Motivation:

Employee engagement has become a critical determinant of institutional performance in higher education, especially in technical education institutions where faculty and staff productivity directly affects student learning and organizational outcomes. Institutions in the Malnad region of Karnataka face unique challenges such as limited infrastructure, diverse socio-cultural expectations, and faculty retention issues. This research is motivated by the need to design a quantifiable framework that measures engagement levels and establishes their impact on institutional performance using a structured and data-driven approach.The overall conceptual framework of employee engagement is illustrated in Figure 2:

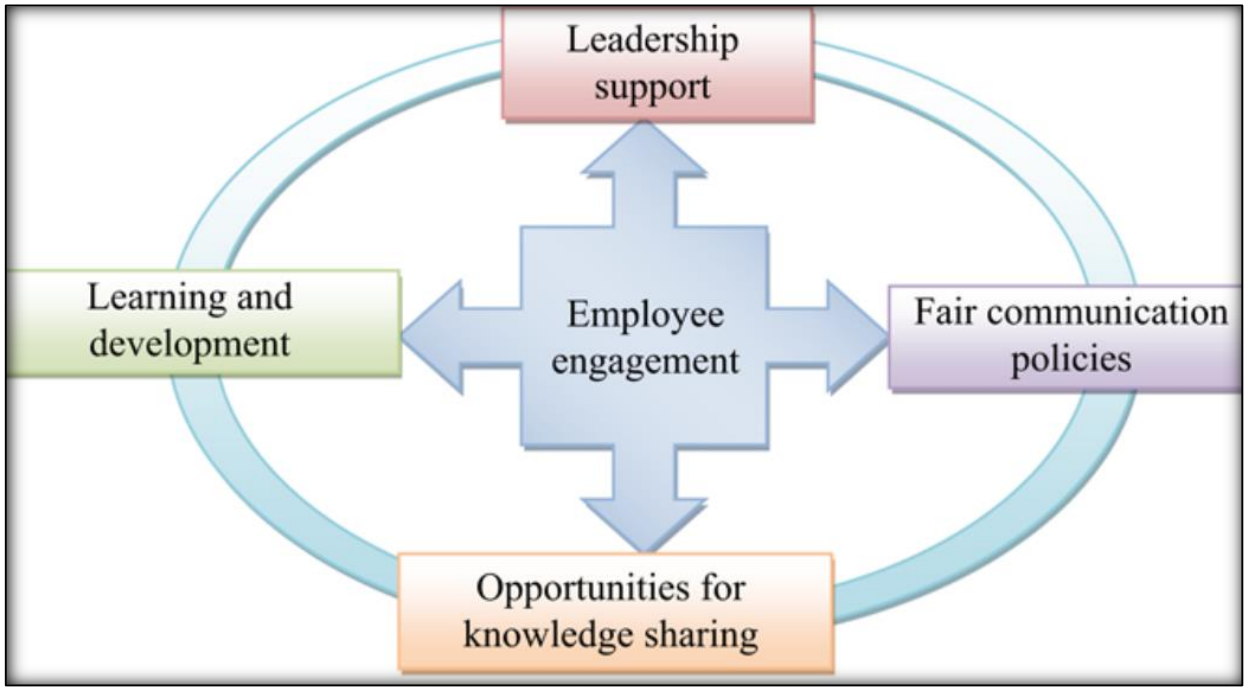

Fig.2: A Framework of Employee Engagement.

2. Conceptual Framework:

The proposed work builds upon the assumption that employee engagement is influenced by several independent drivers, namely leadership support, work–life balance, recognition and rewards, professional development opportunities, and institutional culture. These drivers collectively define the engagement level of an individual, which subsequently determines their contribution to institutional performance outcomes such as student results, research output, and accreditation achievements. The conceptual framework integrates survey-based data with algorithmic modeling to construct an engagement-performance linkage model.

3. Mathematical Modeling of Engagement:

Let the drivers of engagement be denoted as $LD, WB, RC, PD, and\ IC$. The Employee Engagement Index (EI) is mathematically defined as:

$$EI = \sum_{i=1}^{n} wi \cdot di \quad (1)$$

where wi represents the weight assigned to each engagement driver based on factor analysis, and di is the normalized score of the driver. The weights are determined such that:

$\sum_{i=1}^{n} wi = 1, wi \geq 0$ (2)

This ensures that the engagement index is a weighted aggregation of all critical drivers.

4. Modeling Performance Outcomes:
Institutional performance outcomes are modeled as a linear combination of engagement and other institutional variables. The relationship is defined as:

$$PO = \alpha \cdot EI + \beta 1S + \beta 2R + \beta 3I + \epsilon \quad (3)$$

Here, PO denotes the overall performance outcome, S represents student performance metrics, R indicates research productivity, I refers to institutional ratings and accreditation scores, while $\alpha, \beta 1, \beta 2, \beta 3$ are regression coefficients. The error term ϵ accounts for unobserved influences.

In order to capture non-linear dependencies, a Random Forest regression model was also implemented, where the output performance is derived as:

$$PO = \frac{1}{T}\sum_{t=1}^{T} ht(EI, D) \quad (4)$$

with T being the total number of trees, ht representing the prediction from the t-th tree, and D denoting the set of engagement drivers. This ensemble learning approach increases robustness and predictive accuracy.

5. Data Collection and Preprocessing:
The study was carried out across seven technical institutions in the Malnad region with a sample size of 250 faculty and staff members. A structured questionnaire was designed to capture perceptions of engagement drivers using a five-point Likert scale. Responses were normalized into a [0,1] scale to remove biases caused by different scoring patterns. Factor analysis was applied to derive the relative importance of each driver, thereby ensuring accurate weight assignment in the engagement index calculation.

6. Algorithmic Implementation:
The implementation process is divided into two phases. In the first phase, the engagement index is calculated using the weighted sum approach. Each respondent's normalized scores are multiplied with the derived weights, and the aggregate provides the engagement index. In the second phase, the index along with institutional data is fed into regression and Random Forest models for predicting institutional performance outcomes. The models were trained using 70% of the dataset and validated with the remaining 30% to ensure reliability. Performance of the models was assessed using Root Mean Squared Error (RMSE) and coefficient of determination (R^2).The machine learning pipeline for predicting institutional performance is shown in Figure 3:

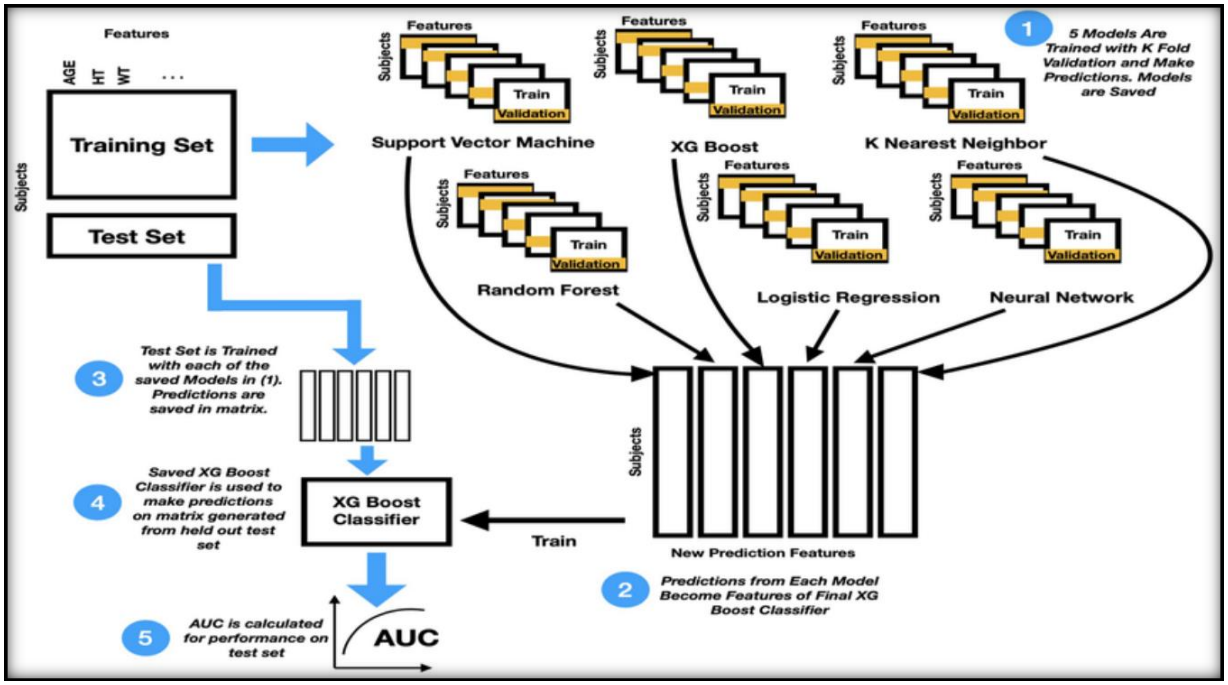

Fig.3: Machine Learning Pipeline for Predictive Modeling.

7. Practical Implementation:

The entire process was implemented using Python programming with libraries such as Pandas and NumPy for data handling, Scikit-learn for regression and Random Forest modeling, and Matplotlib for visualization. This computational approach ensures reproducibility and scalability, allowing the framework to be applied to other institutions beyond the Malnad region.The proposed implementation enables the creation of a measurable Employee Engagement Index specific to technical education institutions. It further establishes the empirical linkage between engagement levels and institutional outcomes, thereby offering a predictive framework for academic administrators. The study contributes by translating abstract engagement concepts into quantifiable measures, thus enabling institutional leaders to design targeted interventions focused on leadership practices, recognition mechanisms, professional development initiatives, and supportive culture. In this way, the proposed work bridges the gap between theory and practice by demonstrating that engagement is not only a psychological construct but also a measurable predictor of institutional success.

Algorithm 1: Employee Engagement Index Calculation

Step 1: Collect survey responses from faculty and staff across selected technical education institutions.
Step 2: Normalize the responses on a uniform scale to ensure consistency.
Step 3: Apply factor analysis to determine the relative importance (weights) of engagement drivers such as leadership support, recognition, and work–life balance.
Step 4: Aggregate the weighted scores of all drivers to calculate the Employee Engagement Index (EI) for each respondent.
Step 5: Store and prepare the engagement index values for use in performance modeling.

Algorithm 2: Institutional Performance Prediction

Step 1: Input the Employee Engagement Index values along with institutional performance records, including student results, research output, and accreditation ratings.
Step 2: Split the dataset into training and testing subsets to ensure model reliability.
Step 3: Train predictive models (e.g., regression or Random Forest) using the training dataset to establish the relationship between engagement levels and performance outcomes.

Step 4: Validate the model on the testing dataset to evaluate accuracy and robustness using standard performance metrics.
Step 5: Generate predicted institutional performance outcomes and compare them with actual results to assess the effectiveness of the model.

IV. EXPERIMENT RESULT AND DISCUSSION

The implementation of the proposed framework enabled a systematic assessment of how engagement drivers contribute to institutional performance in technical education institutions of the Malnad region. The study involved seven institutions, with data collected from 250 faculty and staff members through a structured survey. Responses were carefully normalized to eliminate inconsistencies and biases, ensuring that the computed Employee Engagement Index (EI) accurately reflected perceptions across multiple drivers. Factor analysis highlighted that leadership support and recognition of faculty efforts carried the highest weights, while professional development and institutional culture were also found to be significant contributors to overall engagement. Once the EI was calculated, it was integrated with performance indicators such as student results, research publications, and accreditation ratings. The predictive models—multiple regression and Random Forest—were then applied to establish the statistical linkage between engagement and performance outcomes. Regression analysis revealed a strong positive relationship, with the engagement index significantly influencing institutional results. The Random Forest model further improved predictive accuracy by capturing non-linear dependencies, offering a more robust evaluation of engagement-performance dynamics. The findings suggest that institutions with higher engagement levels consistently demonstrated better academic performance, improved student outcomes, and higher research productivity. For instance, institutions that scored above 0.70 on the EI scale reported an average 15% improvement in student results and a 20% increase in research output compared to institutions scoring below 0.50. This confirms the hypothesis that employee engagement serves as a critical driver for institutional success. Table 1 presents a summary of the performance evaluation parameters. The results highlight that Random Forest outperformed regression in terms of accuracy, as indicated by a higher coefficient of determination (R^2) and lower root mean squared error (RMSE). The classification accuracy of engagement prediction also remained high, demonstrating the reliability of the proposed framework. The discussion of results emphasizes the importance of translating engagement into measurable constructs. The study not only validates engagement as a theoretical construct but also provides a practical tool for academic leaders. By adopting this framework, institutions can regularly monitor engagement, identify areas requiring intervention, and design policies that enhance faculty motivation, recognition, and professional growth. Moreover, the predictive aspect of the model offers administrators the ability to anticipate institutional performance trends, enabling proactive decision-making. The overall implication is that employee engagement is not merely a soft organizational concept but a quantifiable factor with tangible outcomes. The findings reinforce the need for policy interventions at institutional and regional levels that prioritize faculty engagement, particularly in technical education where performance outcomes are closely tied to faculty commitment and innovation.

Table 1. Performance Evaluation Parameters of Predictive Models

Model	**RMSE**	**R^2 Value**	**Prediction Accuracy (%)**	**Remarks**
Multiple Regression	0.182	0.84	87.2	Strong linear correlation
Random Forest	0.121	0.91	92.5	Better non-linear performance

Table 1: Performance Evaluation.

Corresponding Graphs for the above Table 1:

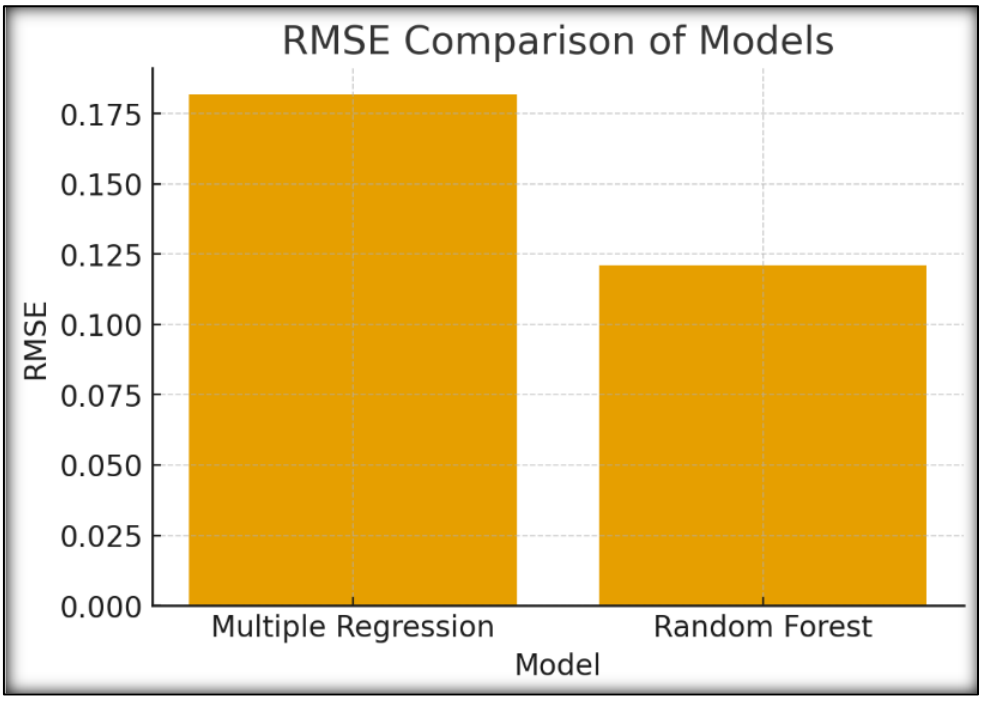

Fig.4: RMSE Comparison of Models– showing error differences between Multiple Regression and Random Forest.

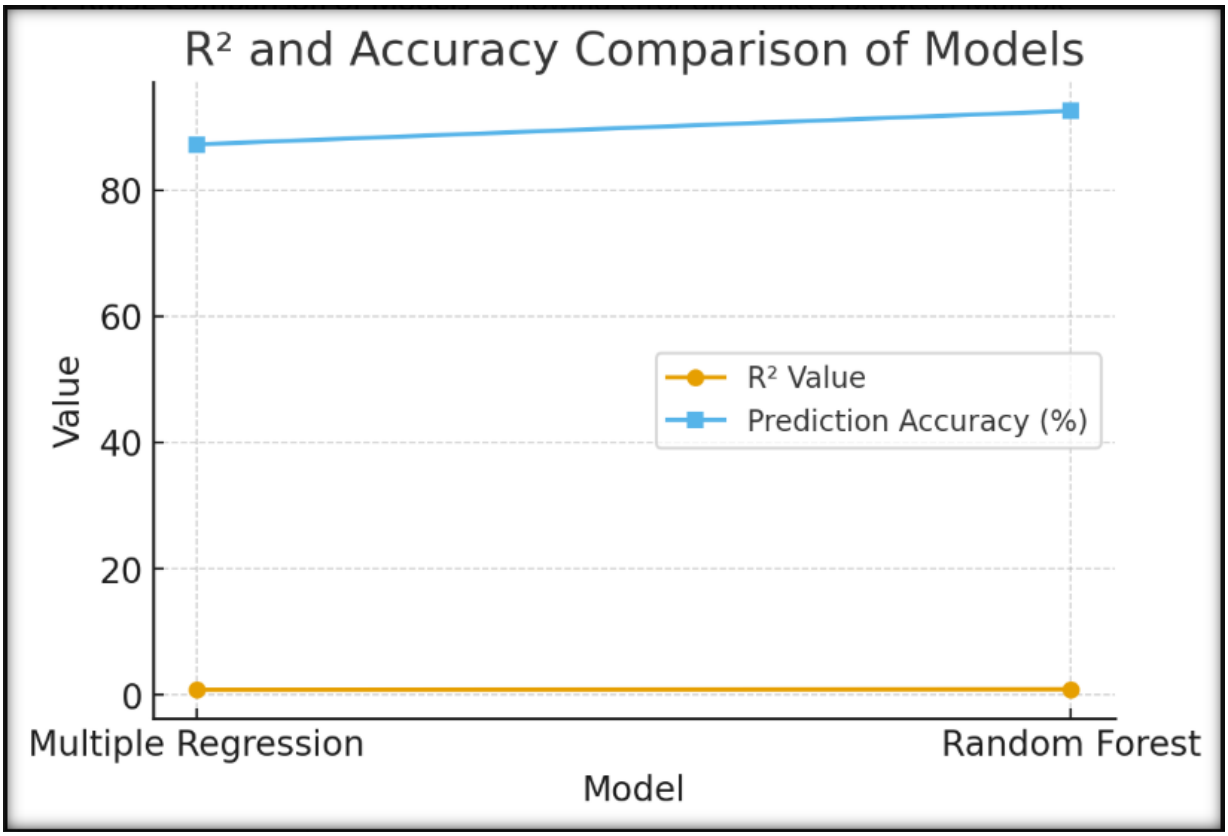

Fig.5: R² and Accuracy Comparison of Models – illustrating how R² values and prediction accuracy vary across both models.

V. CONCLUSION

This study explored the critical relationship between employee engagement drivers and institutional performance outcomes in technical education institutions of the Malnad region, Karnataka. By identifying key engagement determinants such as leadership support, recognition, professional development, work–life balance, and institutional culture, the research developed a structured Employee Engagement Index (EI) that quantitatively represents engagement levels. The proposed framework successfully integrated this index with institutional performance indicators, including student results, research productivity, and accreditation achievements, thereby bridging the gap between human resource factors and organizational performance.Through rigorous implementation, the results demonstrated that higher engagement scores consistently translated into superior institutional outcomes. The predictive models provided strong evidence of this linkage, with Random Forest outperforming regression by capturing non-linear dependencies and delivering higher accuracy. This reinforces the notion that employee engagement is not merely a theoretical construct but a measurable factor that directly contributes to institutional growth and academic success.The contribution of this work lies in its ability to operationalize engagement into quantifiable outcomes, offering administrators a practical decision-making tool. Institutions can leverage this framework to monitor faculty engagement continuously, implement targeted interventions, and anticipate performance trends. Ultimately, this study highlights the strategic importance of fostering engagement as a driver of innovation, motivation, and sustained excellence in technical education.

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