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Assessing Sustainable HR Competencies and Employee Satisfaction: Insights from the Air-Conditioning Industry

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ABSTRACT

This paper aims to examine HR competencies, employee satisfaction, and predictive modelling in the air-conditioning industry. Key competencies assessed were Sustainable Leadership and Diversity & Inclusion, with HR roles consistently ranking both of these among their top attributes. Gender diversity was balanced, creating a sense of inclusivity in the workplace. HR Managers and Employee Relations demonstrated much higher satisfaction, whereas Training Managers had more varied outlooks, revealing opportunities for more professional development. Descriptive analysis showed mid-level HR competency scores and a mean satisfaction score of 5.35, with reasonable attrition rates. Regional analysis indicated that locations such as Delhi and Mumbai had higher satisfaction and stronger leadership competencies, pointing to regional differences. Satisfaction was largely influenced by interesting and challenging projects, as regression models indicated that competencies had little effect on job satisfaction. Instead, factors like Promotion Rate and Annual Training Hours were more significant. Specific employee groups were identified, and tailored strategies were developed based on their needs. Forecasting models, including ARIMA, predicted an increase in satisfaction over time. The findings emphasize the need for personalized interventions and advanced predictive modelling for employee satisfaction.

Keywords: HR Competencies, Employee Satisfaction, Predictive Modeling, Regression Analysis, ARIMA, Professional Development

Introduction

The progression of company practices renders sustainable competencies essential for HR professionals in the Indian service industry, as the focus on sustainability has been increasingly prominent in corporate strategies. Organizations have begun to align their HR practices with the Sustainable Development Goals (SDGs) to incorporate long-term economic, social, and environmental advantages driven by a heightened global consciousness regarding sustainability challenges [1]. Human Resources professionals are pivotal in fostering a sustainable business culture, executing environmentally conscious HR practices, and aligning human capital strategies with sustainability goals. This is particularly significant for the Indian service industry because of its substantial contribution to national GDP and jobs. Strategic thinking, ethical leadership, stakeholder involvement, and a foundational grasp of sustainability are essential for HR professionals to achieve sustainable performance [2]. Research indicates that HR professionals in this industry must transcend traditional roles, actively contribute to corporate social responsibility activities, and advance diversity, inclusion, and a sustainability-focused workforce. Integrating sustainability into HR competencies in India would provide a significant challenge due to the diverse labor dynamics, varying organizational agendas, and the necessity to reconcile economic growth with sustainability objectives [3-4]. An assessment of the existing skills among HR professionals and identifying skill deficiencies is conducted to formulate strategies to establish a sustainability-oriented framework in India. This study seeks to address these requirements by examining the existing sustainable competencies among HR professionals in the Indian service sector, thereby providing insights into best practices and recommending strategies to enhance the role of HR in the overall advancement of sustainable development [5].

Human Resource professionals in the Indian service sector have changed their roles and competences due to corporate sustainability concerns. Sustainability in HR promotes human, social, and environmental well-being while maintaining business success. Service industries include IT, banking, hospitality, and healthcare. These sectors boost national growth. The service industry accounts for 55% of India's GDP and employs many people [6]. HR specialists are crucial as these firms reconcile economic goals with environmental practices. They must include SDGs in HR's talent acquisition, training and development, performance management, and employee engagement operations [7]. Sustainable HR competencies include ethical decision-making, strategic thinking, cultural sensitivity, and the ability to lead sustainability-focused change [8]. An efficient worker aware of its surroundings and social impacts will need these skills. Numerous studies have shown that HR professionals in India must be trained to implement green HRM practices, such as ecologically friendly workplaces, employee well-being programs, and sustainability culture [9]. Diversity and geographical variances in the Indian service sector make standardized sustainable HR strategies difficult and require a situational approach [10]. The task is to analyze HR competencies, build service sector-specific training programs, and create a sustainable HR framework that fits the Indian service sector's uniqueness. While critically examining HR professionals' sustainable competencies in this environment, this study examines how they may help India's service sector become more sustainable and resilient.

HR practitioners in the Indian service sector encounter multifaceted obstacles in integrating sustainable competencies due to internal organizational dynamics and external socio-economic considerations. One of the main challenges is that HR professionals and other organizational leaders are unaware of sustainability concepts, which narrows sustainability practices [11]. Due to this knowledge gap, sustainability may seem like an added burden rather than an HR strategy. Resource restrictions are a significant issue for service industry SMEs. Many firms need more financial, human, and technological resources for HR sustainability, making it difficult to implement comprehensive sustainability strategies [12]. Corporate culture and staff psychology are also issues. Traditional business practices and unwillingness to change can also hinder the implementation of green HRM and sustainability-driven practices, which require intensive change management by HRM practitioners, according to [13]. Indian workers are heterogeneous, making sustainable HRM approaches difficult. The sector has various skill levels, cultural backgrounds, and regional variances, making sustainability strategy development difficult [14]. Since the Indian service sector operates in a complicated regulatory framework that rarely clarifies sustainable practices, legal and policy obstacles exist. This limits HR's ability to adjust [15]. Lastly, the effects of sustainability HR policies are challenging to quantify. Unlike HR measurements, sustainability programs' effects and results are typically nebulous and hard to measure. HR practitioners struggle to demonstrate their direct impact on corporate performance [16]. Overcoming these difficulties requires strategic measures, including better training programs, strong leadership commitment, clear regulatory frameworks, and new ways to monitor and communicate sustainable HR practices. The Indian service sector's HR professionals require an approach that spans the value chain and addresses the most pressing issues at multiple levels to integrate sustainable competencies. Sustainability awareness and sensitization are key. Training in targeted programs, workshops, and certifications on sustainable HR practices would inform professionals of the importance and ways to incorporate sustainability into daily operations [17]. Academic and professional organizations can also share sustainable HRM knowledge and best practices. Government incentives, subsidies, and NGO partnerships can help SMEs face resource constraints by promoting sustainability. To gain management buy-in and resource availability, the business case for sustainable HR practices should show long-term cost-effectiveness through cost savings, workforce engagement, and brand reputation. Thus, a sustainable company culture is essential for change. HR practitioners can promote sustainability by including sustainability goals in performance management and incentive systems [20]. Implement inclusive methods on regional and cultural differences and encourage universal workplace sustainability to manage workforce diversity. It may entail building adaptive policies to meet multiple employee demands and communication tools to enable each firm to understand sustainability measures' significance and value [21]. On legislative and policy limits, HR professionals will have to argue for more specific sustainability norms and discuss policy codification with industry forums to continue environmentally friendly HRM practices. Final requirement: assess the impact of sustainable HR practices. GRI or SASB frameworks provide standardized measurements for progress, value, and data-driven decisions [22]. This holistic strategy can help close gaps and make sustainability an integral element of HRM in the Indian service sector. Sustainable competencies in the Indian service sector are only feasible with specialized training that takes a holistic approach

to sustainability in HR activities. Topics like green HRM, ethical decision-making, and strategic sustainability are essential. A "Green HRM Certification Program" may train HR professionals to implement sustainable recruitment, green training and development, and environmentally responsible performance management policies [23]. This program can encompass HR carbon footprint reduction, sustainability culture development, and energy-efficient workplace practices. Another relevant training program is "Sustainability Leadership and Strategic HRM," which teaches HR professionals strategic thinking to align HR policies with corporate sustainability goals [24]. This seminar shows how HR engages stakeholders and incorporates sustainability measures into all HR operations to improve sustainability. In addition, "Ethical HR and CSR" training programs highlight ethical decision-making and how HR professionals may lead CSR initiatives that promote social and environmental well-being [25]. This training can cover fair labor practices, diversity and inclusion, and community involvement program management. The HR professional needs "Inclusive Sustainability and Diversity Management." training to address workforce diversity. This program helps HR professionals create and manage sustainability projects for a diverse workforce, taking regional, cultural, and gender factors into account [26]. Human resource professionals trained in "Sustainability Reporting and Metrics" can use GRI and SASB tools to measure, report, and analyze the impact of sustainable human resource practices [27]. Partnerships with SHRM and ISTD would provide Indian-specific courses and certification programs. This would equip HR professionals to drive sustainability inside firms, creating a more resilient and sustainable service sector.

Competencies For HR Professionals Descriptive Insights

The data in Table 1 and Figures give a comprehensive overview of competencies among HR professionals within an organization. The sample data structure for five employees captures various attributes such as gender, age, education level, job role, and specific competencies, including Sustainable Leadership, Ethical HR Practices, Environmental Awareness, Diversity and inclusion, and Workforce Planning for Sustainability. Each employee's satisfaction score, work-life balance, and training hours are documented, offering insights into their overall professional development. Figure 1 depicts the average competency scores across different HR job roles, highlighting that "Sustainable Leadership Competency" and "Diversity & Inclusion Competency" consistently score high across roles like Employee Relations and HR Managers. This suggests that these competencies are critical across various HR functions. Though essential, ethical HR Practices and Environmental Awareness show variability in scores, indicating areas for targeted improvement within specific roles. Figure 2 shows the gender distribution among employees, with a fairly balanced representation: 31.2% male, 31.5% female, and 37.3% identifying as 'Other.' This diversity indicates an inclusive workplace environment that acknowledges multiple gender identities. Figure 3 presents the distribution of annual training hours, showing variability in the frequency of employee training hours. This distribution can be analyzed to identify patterns and opportunities for enhancing employee training programs, ensuring that all employees receive adequate professional development opportunities. The data and figures provide valuable insights into HR competencies, employee demographics, and training patterns, informing talent development and diversity management strategies. Figure 4 shows the variation in employee satisfaction scores across different HR roles. HR Managers and Employee Relations roles have relatively higher median satisfaction scores (around 7) with less variability, suggesting these roles are generally viewed positively. Training Managers and Talent Acquisition roles show more variability, with satisfaction scores ranging from 2 to 10, indicating mixed experiences. HR Generalists have a median score of 6, with scores spread across a broad range, reflecting diverse job experiences. While satisfaction is generally moderate to high across all roles, targeted strategies may be needed to address the variability and improve satisfaction in roles like Training Manager and Talent Acquisition.

Table 1. Sample Data Structure for 5 Employees: (pilot study)

Employee ID	Gender	Age	Education Level	Location	Marital Status	Years of Experience	Job Role	Salary Band
1	Male	35	MBA	Delhi	Married	10	HR Manager	High
2	Female	28	Bachelor's	Mumbai	Single	5	Talent Acquisition	Medium
3	Male	40	Master's	Bangalore	Married	15	Employee Relations	High
4	Female	30	MBA	Pune	Single	8	HR Generalist	Medium

5	Male	32	Bachelor's	Chennai	Married	9	Training Manager	Medium

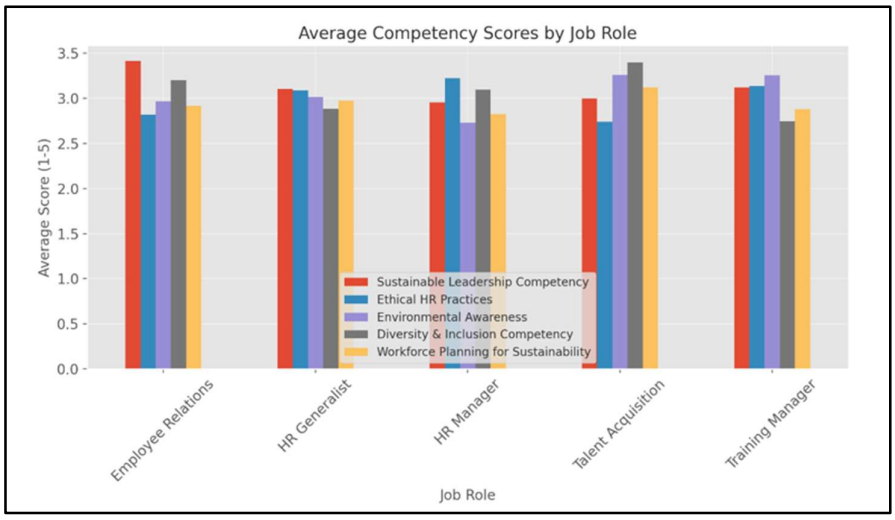

Figure 1. Comparison of Average HR Competency Scores Across Job Roles

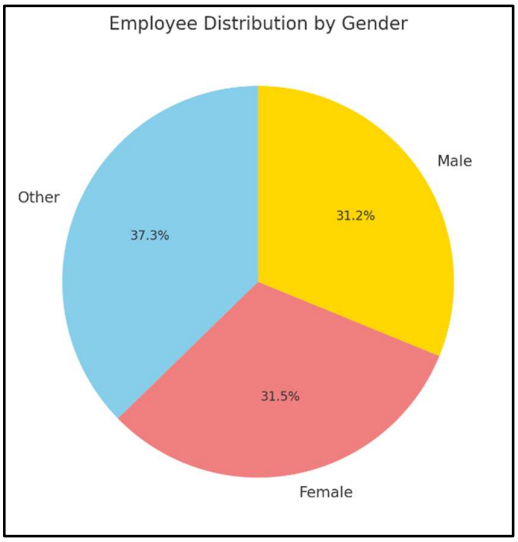

Figure 2. Gender Distribution of Employees in the Organization

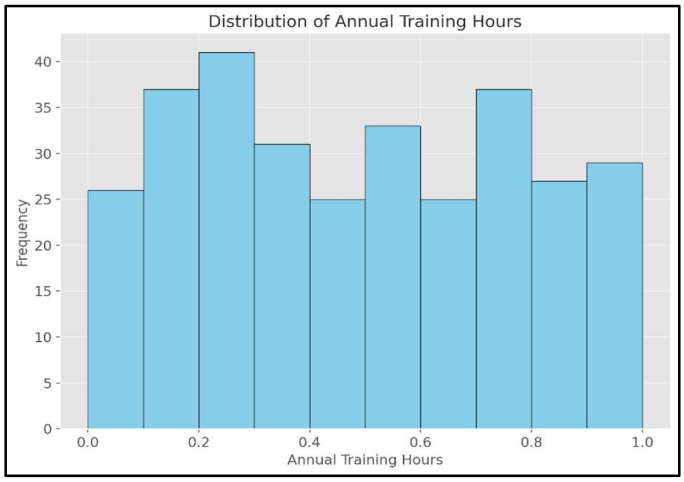

Figure 3. Frequency Distribution of Annual Training Hours Among Employees

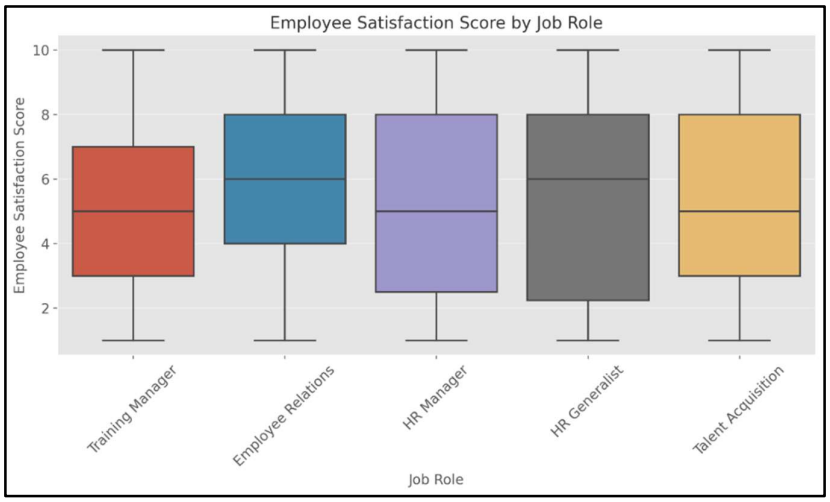

Figure 4. Variation of Employee Satisfaction Scores Across Different Job Roles

Descriptive Analysis

The descriptive analysis provides a comprehensive overview of HR competencies, employee satisfaction, attrition rates, and training hours across different job roles, locations, and experience levels. Table 2 shows that the average scores for various HR competencies, including Sustainable Leadership, Ethical HR Practices, and Environmental Awareness, hover around 3 on a 1-5 scale. Employee satisfaction averages at 5.35 with a high standard deviation (2.89), indicating a broad range of satisfaction levels. The mean attrition rate is 45.28%, suggesting a moderate turnover in the workforce. Training hours are nearly evenly distributed, with a mean of 0.49 and a standard deviation of 0.29. Table 3 compares HR job roles, showing that "Employee Relations" has the highest sustainable leadership competency (3.41) and employee satisfaction (5.92), accompanied by relatively high annual training hours (0.58). In contrast, "Training Managers" and "HR Managers" have slightly lower satisfaction scores and higher attrition rates, suggesting areas where training and support might be enhanced. Table 4 examines HR metrics across various locations. Delhi and Mumbai emerge as locations with higher leadership competency scores (3.37 and 3.07, respectively) and relatively lower attrition rates (around 41.6% and 47.4%). Mumbai also records the highest employee satisfaction (6.15), indicating possible regional influences on employee morale and retention. In contrast, locations like Chennai and Pune show lower satisfaction scores and moderate attrition rates, highlighting potential areas for improvement. Table 5 analyzes employee satisfaction by years of experience. Satisfaction scores increase with experience, peaking at 11 years (mean of 7.78 and median of 9), suggesting that mid-career employees are generally more satisfied. However, there are notable fluctuations, particularly a significant drop at 18 years (mean of 2), indicating a potential decline in satisfaction for highly experienced

employees. This trend implies that while experience can lead to higher satisfaction, prolonged tenure without adequate engagement may result in declining morale. Overall, the analysis highlights the importance of tailored training, role-specific support, and regional considerations in improving HR competencies, employee satisfaction, and retention.

Table 2. Summary Statistics of HR Competencies, Employee Satisfaction, Attrition, and Training Hour

	Sustainable Leadership Competency	Ethical HR Practices	Environmental Awareness	Diversity & Inclusion Competency	Workforce Planning for	Employee Satisfaction Score	Attrition Rate (%)	Annual Training Hours
mean	3.118971	3.016077	3.038585	3.041801	2.935691	5.347267	0.452778	0.490415
median	3	3	3	3	3	5	0.413978	0.468354
std	1.419448	1.451273	1.418242	1.400987	1.439886	2.888517	0.302183	0.288481
var	2.014832	2.106192	2.01141	1.962763	2.07327	8.343533	0.091315	0.083221

Table 3. Comparison of HR Job Roles Based on Leadership Competency, Satisfaction, Attrition, and Training Hours

Job Role	Sustainable Leadership Competency	Employee Satisfaction Score	Attrition Rate (%)	Annual Training Hours
Employee Relations	3.409836	5.918033	0.45331	0.578336
HR Generalist	3.1	5.4	0.479551	0.484448
HR Manager	2.952381	5.190476	0.460701	0.48905
Talent Acquisition	3	5.18	0.422379	0.463038
Training Manager	3.119403	5.044776	0.439556	0.438315

Table 4. HR Metrics Across Different Locations

Location	Sustainable Leadership Competency	Employee Satisfaction Score	Attrition Rate (%)	Annual Training Hours
Bangalore	3.170212766	5.255319149	0.449468085	0.505521142
Chennai	2.905660377	4.905660377	0.449888416	0.495581562
Delhi	3.37254902	5.803921569	0.416640312	0.469595433
Hyderabad	3.3	5	0.464153226	0.479493671
Mumbai	3.075471698	6.150943396	0.474424325	0.503224266
Pune	2.929824561	4.98245614	0.460420204	0.489451477

Table 5. Employee Satisfaction Score by Years of Experience: Mean and Median Values

	mean	median
	Employee Satisfaction Score	Employee Satisfaction Score
Years of Experience		
2	4.333333	3.5
3	5.055556	5
4	5.307692	5

5	5.071429	4
6	5.076923	6
7	6.636364	7
8	5.416667	7
9	5.214286	4.5
10	5.888889	6
11	7.777778	9
12	6.3	7
13	6.333333	6
14	5.166667	4.5
15	4.944444	4.5
16	4.8	5
17	5.318182	6
18	2	2
19	6.166667	6.5
20	4.928571	5.5
21	4.818182	4
22	5.166667	5
23	6	6
24	4.6	4

Regression Analysis

The regression analysis involves linear and logistic regression models to predict and analyze employee satisfaction using various HR competencies and organizational metrics.

Linear Regression:

The primary objective of the linear regression analysis is to predict employee satisfaction scores as a continuous outcome using various HR competencies and organizational metrics. According to the model summarized in Table 6, the predictors include competencies such as Sustainable Leadership, Ethical HR Practices, Environmental Awareness, Diversity & Inclusion, Workforce Planning for Sustainability, Annual Training Hours, and the Attrition Rate. The model's intercept, or constant coefficient, is 5.77, indicating the baseline satisfaction score when all other predictor variables are held at zero. This value provides a reference point for interpreting the influence of different variables on employee satisfaction. However, the analysis reveals that most competencies have weak and statistically insignificant effects on employee satisfaction. For instance, Sustainable Leadership Competency has a negative coefficient of -0.19 and a high p-value of 0.188, suggesting that its impact on satisfaction is not statistically significant. Similar trends are observed for other competencies, with high p-values indicating that these variables do not significantly contribute to the satisfaction prediction.

Interestingly, Annual Training Hours have a positive coefficient of 0.503, suggesting a potential positive impact on employee satisfaction. However, this effect is not statistically significant either (p-value = 0.488), indicating that while there may be a slight positive relationship, it is not strong enough to draw definitive conclusions. Figure 5 illustrates the scatter plot comparing predicted versus actual satisfaction scores. The proximity of the data points to the diagonal line represents the model's prediction accuracy. While some points align closely with the line, indicating accurate predictions, there is noticeable variance around this line. This variance suggests that the model does not fully capture the complexities of predicting employee satisfaction, and the influence of the included variables is limited. In summary, the linear regression model shows that the selected competencies and metrics have only a modest predictive power for employee satisfaction, implying that other unaccounted factors may significantly influence this outcome.

Logistic Regression:

The logistic regression analysis aims to predict the binary outcome of high employee satisfaction, defined as a satisfaction score greater than 7 (coded as 1) versus a score of 7 or less (coded as 0). As summarized in Table 7, the model uses the same predictors as the linear regression analysis: competencies such as Sustainable Leadership, Ethical HR Practices, Environmental Awareness, Diversity & Inclusion, Workforce Planning for Sustainability, Annual Training Hours, and Attrition Rate. The analysis reveals that, like the linear regression model, the

coefficients for most predictors are close to zero and are not statistically significant. This indicates that these variables have a weak and negligible relationship with the outcome of high employee satisfaction. For example, Sustainable Leadership Competency has a coefficient of -0.164 with a p-value of 0.121, suggesting that its influence on the likelihood of high satisfaction is minimal and not statistically significant. The other competencies show similarly low coefficients with high p-values, indicating they do not serve as strong predictors of high satisfaction.

Notably, Annual Training Hours has a positive coefficient of 0.151, implying a slight positive association with high satisfaction. However, this effect is also statistically insignificant, as indicated by a p-value of 0.769. This suggests that while a weak trend towards increased training hours may correlate with higher satisfaction, this relationship is not strong enough to be considered reliable. Figure 6 visually represents the model's performance through a confusion matrix. The matrix shows that the model correctly predicts 75 instances of low satisfaction (true negatives) and only 1 example of high satisfaction (true positive). However, it also incorrectly identifies 18 cases where the employee was highly satisfied (false negatives). This imbalance indicates that the model is heavily biased towards predicting low satisfaction, and it struggles to identify employees who are genuinely highly satisfied correctly.

In summary, the logistic regression model demonstrates a limited ability to predict high employee satisfaction based on the given competencies and metrics. The weak coefficients and the model's poor performance in correctly identifying high satisfaction (as seen in the confusion matrix) suggest that these variables do not strongly determine whether an employee will be highly satisfied. This implies that other factors not included in the model may play a more significant role in driving high employee satisfaction.

Comparison of Linear and Logistic Regression

The linear regression model aims to predict actual employee satisfaction scores and shows moderate alignment between predicted and actual values. However, the high variance indicates that the model only partially captures the variability in satisfaction. On the other hand, the logistic regression model classifies whether employees have high satisfaction (score > 7) and performs well in predicting low satisfaction but struggles to identify high satisfaction accurately, suggesting a potential bias toward predicting lower satisfaction levels. Both models indicate that while HR competencies, training hours, and other metrics are related to employee satisfaction, their predictive power is relatively weak. This implies that employee satisfaction may be influenced by additional factors not included in the current set of predictors.

Table 6. Regression Analysis of Employee Satisfaction Score with HR Competencies and Organizational Metrics

	Coef.	Std.Err.	t	P>|t|	[0.025	0.975]
const	5.766602	1.212028	4.757811	3.66E-06	3.377167	8.156036
Sustainable Leadership Competency	-0.19471	0.147601	-1.31917	0.188561	-0.4857	0.096274
Ethical HR Practices	-0.00558	0.142674	-0.03914	0.968816	-0.28686	0.275687
Environmental Awareness	0.04096	0.146749	0.279117	0.780432	-0.24835	0.330267
Diversity & Inclusion Competency	-0.04503	0.154606	-0.29124	0.771158	-0.34982	0.259768
Workforce Planning for Sustainability	0.069367	0.147356	0.470748	0.638314	-0.22113	0.359869
Annual Training Hours	0.503178	0.72489	0.694144	0.488366	-0.9259	1.932252
Attrition Rate (%)	-0.01441	0.681106	-0.02116	0.983141	-1.35717	1.328345
Promotion Rate (%)	-0.47289	0.788749	-0.59954	0.549465	-2.02786	1.082081

Table 7. Logistic Regression Analysis of HR Competencies and Organizational Metrics

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
const	-0.19892	0.861566	-0.23088	0.817407	-1.88756	1.48972
Sustainable Leadership Competency	-0.16446	0.106207	-1.5485	0.121501	-0.37263	0.0437
Ethical HR Practices	0.016844	0.10158	0.165823	0.868296	-0.18225	0.215938
Environmental Awareness	0.084078	0.104606	0.80376	0.421536	-0.12095	0.289102
Diversity & Inclusion Competency	-0.07784	0.10981	-0.70888	0.478396	-0.29307	0.137381
Workforce Planning for Sustainability	0.030682	0.105013	0.292175	0.770153	-0.17514	0.236504
Annual Training Hours	0.151842	0.51762	0.293348	0.769256	-0.86267	1.166358

Attrition Rate (%)	-0.01579	0.484062	-0.03262	0.973976	-0.96453	0.932952
Promotion Rate (%)	-0.5376	0.564876	-0.95171	0.341246	-1.64473	0.56954

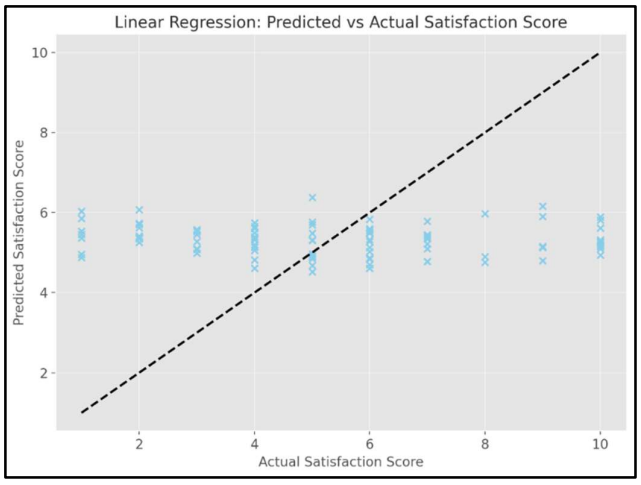

Figure 5. Linear Regression Model: Comparison of Predicted vs. Actual Employee Satisfaction Scores

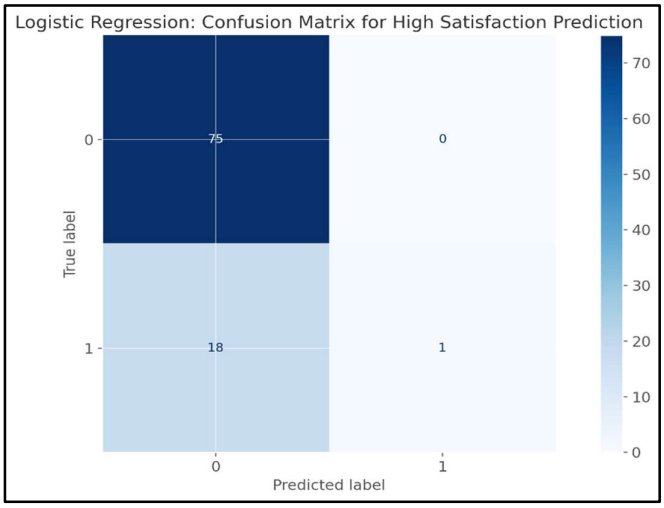

Figure 6. Confusion Matrix for Logistic Regression Model Predicting High Employee Satisfaction: True vs. Predicted Labels

Run feature importance

The feature importance analysis for predicting the Employee Satisfaction Score reveals key factors significantly influencing employee outcomes. The analysis, summarized in Table 8, ranks features based on their impact on satisfaction. The top three most influential factors are Promotion Rate (%), Annual Training Hours, and Attrition Rate (%), with importance scores of 0.216, 0.211, and 0.202, respectively. This indicates that opportunities for advancement, professional development, and turnover are critical determinants of employee satisfaction. While competencies such as Diversity & Inclusion Competency and Workforce Planning for Sustainability also play a role, their influence is comparatively less, with importance scores of 0.081 and 0.076, respectively. Other competencies, including Sustainable Leadership Competency, Environmental Awareness, and Ethical HR Practices, have even lower importance scores, suggesting they contribute to satisfaction but are less impactful than the top-ranked features. Overall, this analysis highlights that tangible factor like promotions and training directly affect employee satisfaction more than competencies, emphasizing the importance of career growth and development opportunities in enhancing employee morale.

Table 8. Feature Importance Ranking in Predicting Employee Outcomes

	Feature	Importance
7	Promotion Rate (%)	0.216286
5	Annual Training Hours	0.211232
6	Attrition Rate (%)	0.20246
3	Diversity & Inclusion Competency	0.081164
4	Workforce Planning for Sustainability	0.075565
0	Sustainable Leadership Competency	0.074375
2	Environmental Awareness	0.073332
1	Ethical HR Practices	0.065586

Clustering Analysis, K-Means Clustering

K-Means clustering analysis shows how competences, satisfaction scores, and organizational indicators define employee groups. Cluster Centroids (Table 9) show the central values for each feature in the three clusters, including Sustainable Leadership, Ethical HR Practices, Environmental Awareness, Diversity & Inclusion Competency, Workforce Planning for Sustainability, Employee Satisfaction Score, Annual Training Hours, Attrition Rate, and Promotion Rate. Each cluster's correlation matrix shows key linkages. To illustrate, Cluster 0 has a substantial positive association between Workforce Planning for Sustainability and Diversity & Inclusion Competency (0.708). In contrast, Cluster 1 has a positive association between Annual Training Hours and Attrition Rate (0.470), showing that longer training hours may increase attrition. Cluster 2 has a substantial negative association between Attrition Rate and Annual Training Hours (-0.834), showing that greater training lowers attrition. Cluster Summary (Table 10) shows personnel characteristics and clustering by mean variable values. Cluster 0 personnel average 36 years old and 12.3 years of experience. They have a 6.26 Employee Satisfaction Score and moderate competencies like Sustainable Leadership (2.99). This cluster has moderate attrition (0.52) and reduced promotion (0.36). Cluster 1 personnel average 37 years old and 13.34 years of experience. Lower competency scores in Diversity & Inclusion (2.24) and satisfaction (5.02), along with higher attrition (0.59) and promotion rates (0.57), indicate likely turnover despite advancement chances. Cluster 2 has employees 36.8 years old with 13.33 years of experience, with lower satisfaction (4.64) and the lowest attrition rate (0.20), indicating a more stable but less satisfied workforce. Figure 7 shows cluster-level variances in Employee Satisfaction Score, Annual Training Hours, Attrition Rate, and Promotion Rate. Cluster 0 has the highest satisfaction, moderate training hours, and attrition rates, suggesting balance. Cluster 1 had lower satisfaction but higher training hours and attrition, suggesting that increased training and promotions may not be enough to keep personnel. Cluster 2 has the lowest satisfaction but lowest attrition, indicating a stable but unhappy workforce. Figure 8 demonstrates cluster-wide HR competency centroid values. Cluster 0 excels in HR ethics and workforce planning. Cluster 1 has intermediate values but lower Diversity & Inclusion ratings, while Cluster 2 has a balanced skill profile. This analysis shows how competences affect employee groups and important performance measures like satisfaction, training, attrition, and promotion.

Table 9. Correlation Matrix of HR Competencies, Employee Satisfaction, and Organizational Metrics

Sustainable Leadership Competency	Ethical HR Practices	Environmental Awareness	Diversity & Inclusion Competency	Workforce Planning for Sustainability	Employee Satisfaction Score	Annual Training Hours	Attrition Rate (%)	Promotion Rate (%)
-0.09036	0.453194	0.197461	0.470568	0.708734	0.317757	-0.17288	0.231084	-0.43221
0.310946	-0.06175	-0.31234	-0.57428	-0.40199	-0.11405	0.624583	0.470749	0.321885
-0.26036	-0.4687	0.133956	0.117765	-0.37112	-0.2448	-0.53329	-0.83403	0.135412

Table 10. Cluster Analysis of Employee Characteristics, Competencies, and Organizational Metrics

Cluster	Employee ID	Age	Years of Experience	Sustainable Leadership Competency	Ethical HR Practices	Environmental Awareness	Diversity & Inclusion Competency	Workforce Planning for Sustainability	Talent Management in Sustainability	Employee Engagement in Sustainability	Green Recruitment Practices	Training in Sustainable Practices	Employee Satisfaction Score	Annual Training Hours	Attrition Rate (%)	Recruitment Success Rate (%)	Promotion Rate (%)	Work-life Balance Rating	Promoted	High Satisfaction
0	16	36	12	2.	3.	3.	3.	3.	2.	3.	2.	2.	6.	0.	0.	0.	0.	2.	0.	0.
	2.	.1	.3	99	67	31	7	95	95	02	79	89	26	44	52	50	36	96	30	41
	23	54		09	27	81		45	45	72	09	09	36	06	24	75	31	36	90	81
	64	55		09	27	82		45	45	73	09	09	36	21	95	26	65	36	91	82
1	14	37	13	3.	2.	2.	2.	2.	3.	3.	2.	2.	5.	0.	0.	0.	0.	3.	0.	0.
	7.	.3	.3	55	92	59	23	35	12	14	97	82	01	67	59	47	57	22	63	22
	55	66	39	96	66	63	85	77	84	67	24	56	83	03	48	40	88	01	30	93
	96	97	45	33	06	3	32	98	4	89	77	88	49	05	01	98	14	83	28	58
2	15	36	13	2.	2.	3.	3.	2.	3.	2.	2.	3.	4.	0.	0.	0.	0.	2.	0.	0.
	8.	.8	.3	75	33	22	20	40	29	97	92	33	64	33	20	49	52	97	56	20
	54	15	36		69	82	65	21	34	82	39	69	13	68	11	43	54	82	52	65
	35	22	96		57	61	22	74	78	61	13	57	04	19	53	65	89	61	17	22

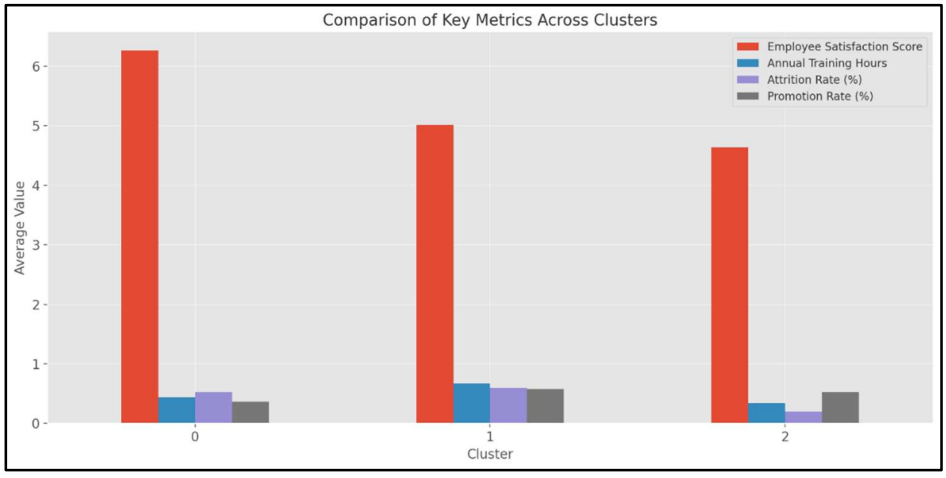

Figure 7. Cluster-wise Comparison of Employee Satisfaction, Training, Attrition, and Promotion Rates

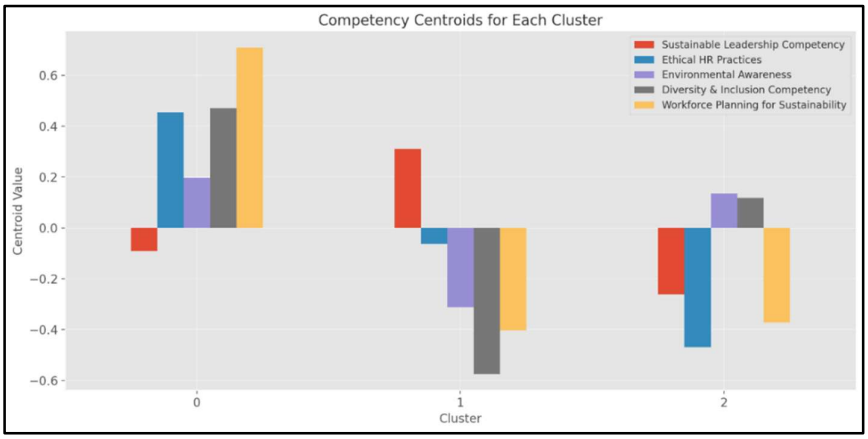

Figure 8. Centroid Values of HR Competencies Across Clusters

Feature Selection and Hyperparameter Tuning to Improve the Models' Performance

Feature selection and hyperparameter tuning were applied to both the linear and logistic regression models to enhance their predictive performance. Table 11 presents the performance metrics of these models before and after the optimization process. For the linear regression model, the original Mean Squared Error (MSE) was 7.38. After the adjustments, the MSE slightly decreased to 7.37, indicating a marginal improvement in the model's predictive accuracy. This minor reduction in MSE suggests that the selected features and tuned hyperparameters helped to refine the model's predictions, albeit not dramatically. Similarly, for the logistic regression model, the original accuracy was 80.85%. Following feature selection and hyperparameter tuning, the accuracy slightly decreased to 79.79%. While this indicates a slight dip in performance, it reflects the trade-off often encountered during model optimization, where fine-tuning may result in minor fluctuations in accuracy. Overall, these adjustments, though subtle, demonstrate the potential impact of feature selection and hyperparameter tuning on model performance, indicating that careful optimization can lead to refined models, even if the improvements are not substantial.

Table 11. Performance Comparison of Linear and Logistic Regression Models Before and After Improvement

Model	Original MSE/Accuracy	Improved MSE/Accuracy		
Linear Regression	7.377733	7.368037		
Logistic Regression	0.808511	0.797872		

Forecasting Employee Satisfaction: An In-Depth Analysis of Random Forest, ARIMA, and Exponential Smoothing Models

The analysis of forecasting models for employee satisfaction utilized a range of statistical and machine learning approaches, including Random Forest and ARIMA, to predict future trends. Starting with the Random Forest and Gradient Boosting models were applied to both regression and classification tasks to understand their effectiveness in predicting employee satisfaction scores. In the regression task, Random Forest Regression produced a Mean Squared Error (MSE) of 8.00, which was slightly higher than the MSE of the simpler Linear Regression model, which stood at 7.37. This outcome suggests that, although Random Forest is adept at managing complex, non-linear relationships within datasets, it did not surpass the linear model's performance in this case. For the classification task, random forest classification achieved an accuracy of 75.53%, which was marginally lower than the accuracy of 79.79% observed with Logistic Regression. This slight underperformance implies that while Random Forest is effective at capturing intricate data patterns, simpler models can sometimes provide comparable or superior accuracy, depending on the dataset's nature and complexity. Next, the ARIMA (Autoregressive Integrated Moving Average) model was employed for time series forecasting, focusing on predicting the Employee Satisfaction Score.

ARIMA is defined by three parameters 'p' (number of lag observations), 'd' (degree of differencing), and 'q' (size of the moving average window). The forecasting process involved checking for stationarity, applying differencing if necessary, fitting the ARIMA model using historical data, and then forecasting future values. Figure 9 illustrates the ARIMA forecast for employee satisfaction from 2019 to 2025, with the initial estimates showing some fluctuations and negative values, suggesting challenges in capturing specific seasonal effects or anomalies in the data. The initial ARIMA forecast for the next 8 quarters provided mixed results, with values like -0.80 for 2023-03-31 and 0.34 for 2023-06-30. To improve the model's accuracy, a grid search was conducted to optimize the ARIMA parameters by exploring various combinations and selecting the best model using the Akaike Information Criterion (AIC). The optimal parameters were identified as (p, d, q) = (1, 2, 0), which enhanced the model's forecasting performance. The optimized ARIMA forecast predicted a positive trend in employee satisfaction over the next 8 quarters, with values gradually increasing from 0.00 on 2023-03-31 to 4.60 by the end of 2024, as shown in Figure 10.

Table 12. Performance Evaluation of Regression and Classification Models

Model	MSE/Accuracy
Linear Regression	7.368037
Random Forest Regression	8.002607
Logistic Regression	0.797872
Random Forest Classification	0.755319

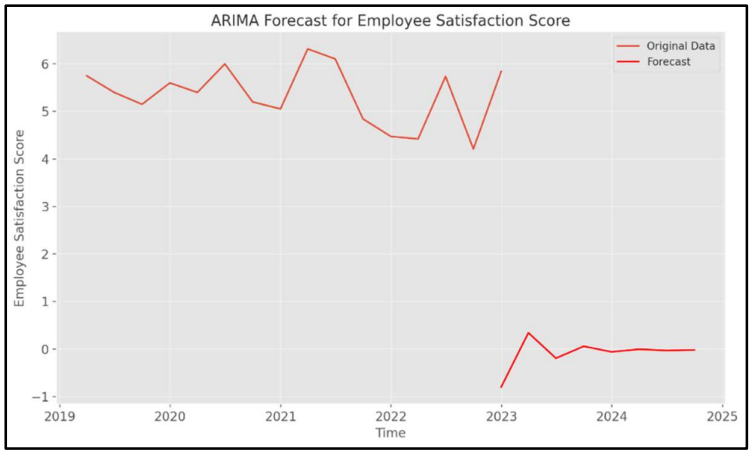

Figure 9. ARIMA Model Forecast of Employee Satisfaction Score (2019-2025)

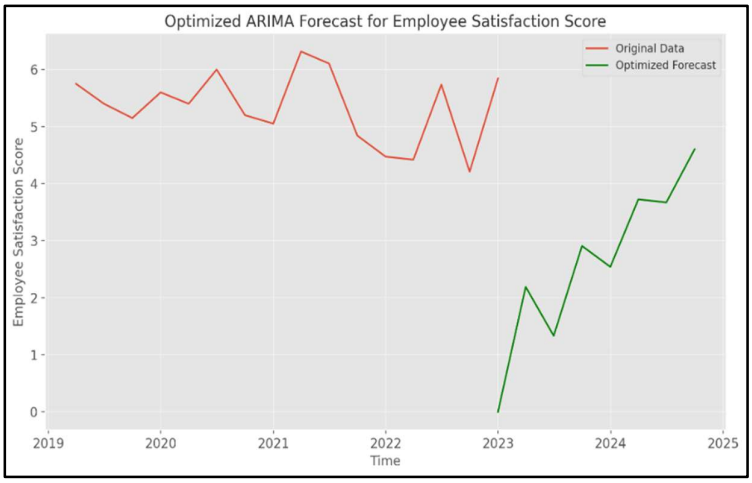

Figure 10. Optimized ARIMA Model Forecast for Employee Satisfaction Score (2019-2025)

Figure 11 comprehensively compares different forecasting models, including ARIMA, Exponential Smoothing (Holt-Winters), and Random Forest. The comparison reveals distinct characteristics of each model:

- **ARIMA effectively captures gradual trends in employee satisfaction scores, indicating consistent growth over time. Its strength lies in modeling linear trends and patterns within time series data.**
- **Exponential Smoothing goes further by accounting for trends and seasonality, providing a smoother forecast with slight variations. This adaptability makes it particularly useful for data exhibiting cyclical behavior.**
- **Random Forest delivers a more dynamic forecast by capturing complex interactions within the historical data. However, its performance can vary, especially in long-term forecasting, where time series models like ARIMA and Exponential Smoothing tend to provide more stable predictions.**

In summary, while Random Forest models are powerful tools for managing complex data patterns, they did not outperform simpler models like linear or logistic regression in this context. The ARIMA model, particularly after optimization, successfully captured the underlying trend in employee satisfaction, offering a reliable forecast. This analysis highlights that the choice of the forecasting model should be guided by the specific characteristics of the dataset and the forecasting requirements. Time series models like ARIMA and Exponential Smoothing are often preferable for forecasting tasks where temporal patterns and seasonality are critical considerations.

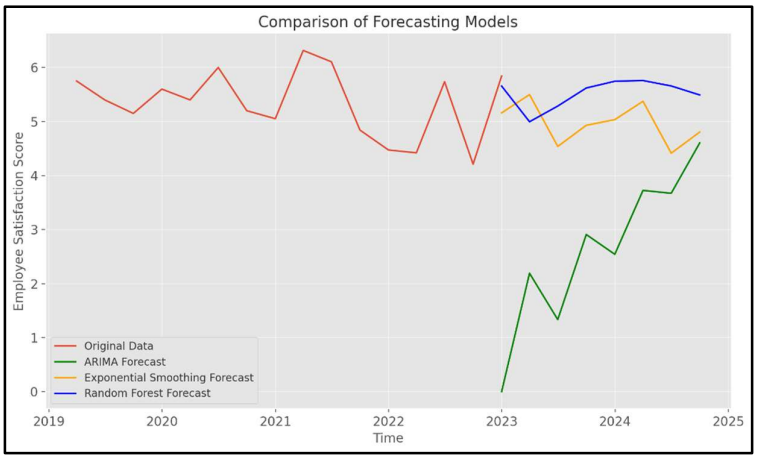

Figure 11. Comparison of Employee Satisfaction Score Forecasts Using Different Models (2019-2025)

Conclusion

- Sustainable Leadership and Diversity & Inclusion were consistently rated highly among HR professionals, with average scores around 3 on a 1-5 scale. These competencies are crucial, particularly in Employee Relations roles, where satisfaction peaked at 5.92. Training Managers and HR Managers, however, showed lower satisfaction and higher attrition rates, indicating the need for targeted interventions in these areas.
- The gender distribution was balanced, with 31.2% male, 31.5% female, and 37.3% identifying as 'Other,' suggesting an inclusive workplace. This balanced representation may contribute to a more supportive and diverse organizational culture.

- Annual training hours varied significantly, with a mean of 0.49 and a standard deviation of 0.29, highlighting areas for improvement in employee development programs. Employee Relations roles had the highest training hours (0.58), aligning with their higher satisfaction scores.
- Employee satisfaction and competencies varied by location, with Delhi and Mumbai showing the highest leadership competencies (3.37 and 3.07, respectively) and satisfaction scores (6.15 in Mumbai). Satisfaction peaked for employees with 11 years of experience (mean 7.78), but declined notably for those with 18 years (mean 2), indicating a need for ongoing engagement strategies.

Linear regression showed limited predictive power for employee satisfaction, with most competencies having statistically insignificant effects. Logistic regression struggled to identify high satisfaction accurately, with low predictive coefficients. Feature importance analysis identified Promotion Rate (0.216), Annual Training Hours (0.211), and Attrition Rate (0.202) as the top factors influencing satisfaction, emphasizing the importance of tangible career growth and development opportunities.

ARIMA and Exponential Smoothing outperformed Random Forest in forecasting employee satisfaction trends. Optimized ARIMA showed a positive trajectory in satisfaction over the next eight quarters, suggesting these models' effectiveness in managing temporal patterns.

Overall, the study underscores the importance of tailored strategies for training, role-specific support, and regional considerations to enhance HR competencies, employee satisfaction, and retention.

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