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Modeling Employee Performance in AI-Enabled Hybrid Work Systems: A Statistical and Machine Learning Approach

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Abstract

This study examines the impact of work conditions and AI technical support on employee performance in hybrid work settings among Indian professionals. Data from 210 respondents were analyzed using regression, mediation, and machine learning techniques. Role clarity, psychological wellbeing, social cohesion, and hybrid adaptability emerged as the strongest predictors of performance. AI support showed an indirect, enabling influence. Mediation results confirmed the role of social cohesion between role clarity and performance. Non-linear models outperformed linear regression, indicating complex interaction effects. The findings highlight the importance of human and organizational factors in AI-enabled hybrid work systems.

Keywords - Hybrid Work; Artificial Intelligence; Employee Performance; Psychological Wellbeing; Social Cohesion; Machine Learning; Role Clarity; Remote Work

1. Introduction

The sudden growth in telework and hybrid work arrangements has transformed organizational behaviour, especially in the digitally progressive economies like India, from a contingency measure to a strategic, technology-driven way of working [12]. Currently, AI-based systems are enabling communication, coordination, and monitoring of performance in remote settings, thus altering the employee experience beyond the traditional workplace. Existing literature suggests that work conditions, including role definition, workload management, autonomy, and technology readiness, have been found to impact performance and well-being substantially [10]. In hybrid work settings, psychological well-being, flexibility, and social integration play a crucial role in mediating productivity and satisfaction. This study investigates the combined effect of work conditions and AI technical support on employee performance in hybrid work settings, specifically in the Indian professional context. It also uses employee experiences as mediating factors to explain the differences in performance. By combining statistical and machine learning approaches, this study is able to identify linear as well as non-linear relationships. The results are expected to provide valuable inputs for designing effective AI-enabled hybrid work systems.

2. Research Gap

Despite the growing body of research on remote work, digitalization, and employee well-being, there are still large gaps in the literature. Previous research often examines work conditions or digitalization independently, providing little information on the combined and indirect effects of AI technical support and employee experiences on performance outcomes. Moreover, previous research has mainly used linear statistical models, which are not capable of capturing the complex, non-linear relationships between psychological, social, and organizational variables in hybrid work settings [11]. The empirical findings of previous research are also mainly based on Western societies, which makes it difficult to apply these findings to emerging economies like India, where the organizational landscape and digitalization maturity are significantly different [3]. To fill the gaps in the literature, this research combines work conditions, AI technical support, and employee experiences in a single framework

and uses statistical and machine learning approaches to investigate employee performance in Indian hybrid work settings.

3. Objectives of the Study

To examine the impact of work conditions and AI technical support on objective employee performance in remote and hybrid work settings.

To analyze the mediating roles of psychological wellbeing, hybrid adaptability, and social cohesion in the relationship between work conditions, AI support, and employee performance.

To evaluate the role of workplace satisfaction as a secondary outcome influenced by work conditions and employee experiences.

To identify the key drivers of performance in AI-enabled hybrid work environments using both statistical and machine learning approaches.

4. Problem Statement

The rise of telework and hybrid work arrangements has increased the pressure in AI-enabled work environments. While role clarity, digital readiness, and AI-related technical support are considered to be performance-related factors, their relative importance in hybrid work arrangements is not well understood. Similarly, employee experiences such as psychological well-being, flexibility, and social integration are recognized but not well differentiated in terms of their influence on performance. This has made it a challenge to address the problem of determining the key drivers of performance in AI-enabled hybrid work arrangements**.**

5. Review of literature

5.1 Digital Readiness and Telework

Digital readiness is a core competency that helps employees successfully operate in telework and hybrid work environments. Empirical findings show that digital technology and digital skill competency are important determinants of employees' adaptability and performance in technology-mediated work environments where digital tasks are common and telework is frequent [1].

5.2 Work Autonomy and Employee Outcomes

Work autonomy, which refers to employees' control over work decisions, has been linked to higher perceived performance and satisfaction. Findings show that giving employees choices about work location and task performance is effective in promoting intrinsic motivation, perceived control, and well-being in telework settings [4].

5.3 Role Clarity in Telework

Role clarity is an important determinant of employee adjustment and performance in telework. The application of communication technology has been found to improve role clarity and coworker support, which in turn can reduce burnout and improve adaptability in hybrid work settings [5].

5.4 Workload and Well-being in Flexible Work Arrangements

Hybrid and telework arrangements provide greater flexibility but also affect workload. Research on hybrid worker well-being suggests that increased flexibility and reduced commuting time can increase productivity and satisfaction; however, digital overload and workload-related stress need to be managed to maintain employee well-being [3].

5.5 AI Support and Employee Efficiency

Artificial intelligence and intelligent technologies are increasingly considered dual-edged swords that can improve efficiency but also contribute to overload. Recent findings indicate that AI can enhance employee efficiency and organizational performance but also pose risks of techno-stress if not accompanied by support for employee well-being [9].

5.6 Psychological Wellbeing and Remote Work

The psychological wellbeing of employees in digital work environments has been identified as a current focus of research. The persistent digital demands and lack of boundaries between work and personal life can negatively impact psychological wellbeing, and there is a need for balanced digital policies and health-oriented workplace practices to counteract the negative effects in remote and hybrid work arrangements [1].

5.7 Hybrid Adaptability

Adaptability to hybrid work environments, including the ability to adapt to and between remote and office-based work, is a factor that affects performance outcomes. Longitudinal research on the intensity of remote work has found that psychological needs, such as autonomy and relatedness, affect engagement and satisfaction with work when the pattern of remote work varies across the week [6].

5.8 Social Cohesion and Sense of Belonging

Social cohesion in hybrid work environments entails maintaining social relationships despite decreased physical co-presence. Qualitative research shows that a sense of belonging and social interaction are important factors in employee engagement and satisfaction in hybrid work environments, despite the difficulties in virtual communication dynamics [7].

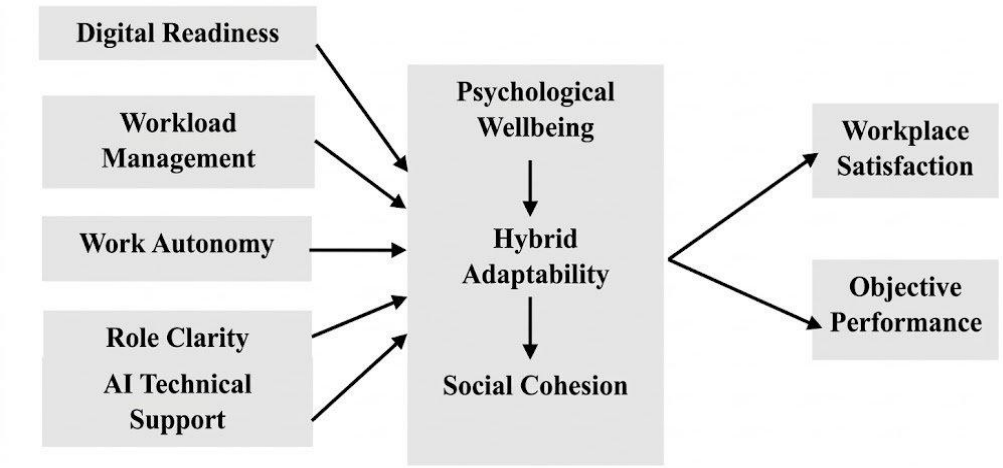
5.9 Objective Performance in Remote/Hybrid Work

Empirical research shows that remote and hybrid work arrangements can sustain or improve productivity compared to traditional work arrangements, but this depends on the availability of supportive structures, communication, and alignment of digital tools and processes [2].

5.10 Workplace Satisfaction and Flexible Work

Flexible work arrangements are associated with increased job satisfaction when accompanied by managerial support and organizational policies to counteract the negative effects of isolation and digital fatigue. The literature highlights the importance of work-life balance, supportive structures, and leadership in influencing satisfaction outcomes [8].

Figure 1. Conceptual framework



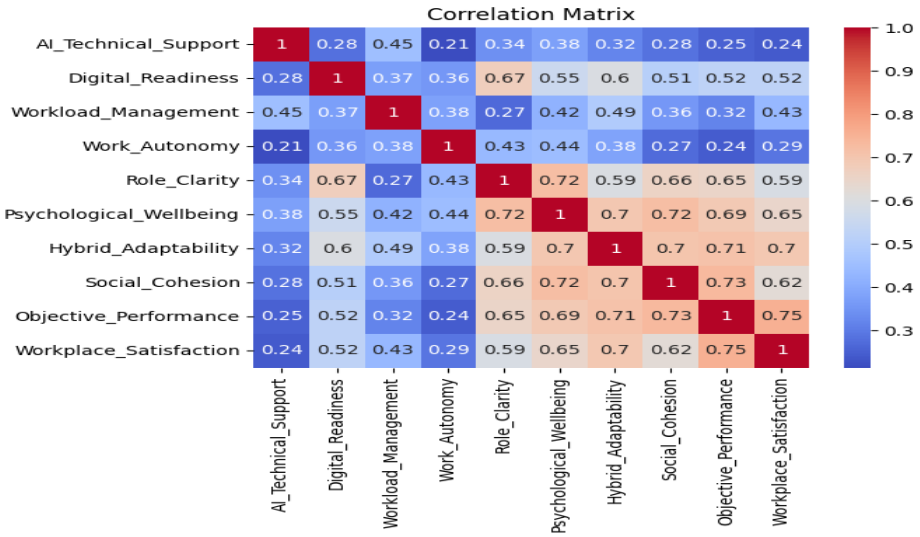
Research Methodology

A quantitative approach was adopted to explore the interplay between work factors, AI technical support, employee experiences, and outcomes in remote and hybrid work settings. A structured 45-item questionnaire was used to collect data from 210 Indian professionals through convenience sampling [13]. The independent variables included Digital Readiness, Workload Management, Work Autonomy, Role Clarity, and AI Technical Support,

with Psychological Wellbeing, Hybrid Adaptability, and Social Cohesion as mediators, Objective Performance as the primary outcome, and Workplace Satisfaction as a secondary outcome variable. The data were analyzed using Python, including descriptive statistics, reliability testing [14], correlation, regression, mediation analysis [15]. Machine learning algorithms such as Decision Tree (classification based on categorized performance levels), Random Forest, Support Vector Regression, and K-Means were used to explore the relationships.

4. Result and Interpretation

Figure 2. Correlation analysis



4.1 As shown in Figure 2, the correlation analysis reveals a positive and significant relationship between the organizational drivers, psychological states, and work outcomes. The Objective Performance shows the highest correlation with Hybrid Adaptability and Social Cohesion (around 0.65-0.75), which indicates that the adaptability and connectivity of the team members are crucial for productivity in a hybrid setting. There is a significant relationship between Role Clarity and Psychological Wellbeing, which indicates that stress is reduced when the role is clear. Although Digital Readiness has lower mean scores, it still has a positive correlation with performance, which indicates that small improvements can result in better performance.

Table 1. Comparison of regression model performance

Metric	OLS Regression (Linear)	SVR (Non-Linear RBF)	Delta (Δ) / Improvement
R-squared	0.657	0.867	+21.0%
Model Fit	Moderate-High	Very High	—
Complexity Handling	Linear Relationships	Non-linear Complexities	—
Error (MSE)	*Not Reported in Summary*	0.0472	—
Significance	$p < .001$ ($F=48.22$)	N/A (Machine Learning)	—

4.2 From this table 1, it can be seen that the comparison between models shows that the Ordinary Least Squares (OLS) model has a statistically significant basis ($R^2 = 0.657$, $p < .001$); however, it is likely to underestimate the

true level of complexity of hybrid work performance. However, a dramatic improvement in the model's ability to predict the outcome can be achieved by switching to a Support Vector Regression (SVR) model with a Radial Basis Function (RBF) kernel, which has an explained variance of 86.7%. This 21% increase suggests that the impact of drivers such as Psychological Wellbeing, Social Cohesion, and Hybrid Adaptability on Objective Performance is not purely additive or linear. Rather, these variables interact in high-dimensional "sweet spots" where particular combinations of support and clarity are used to optimize performance. The very low Mean Squared Error (MSE) of the SVR model (0.0472) further supports its accuracy and confirms its role as the better model for predicting employee outcomes in this data

Figure 3. Multiple linear regression (OLS)Analysis

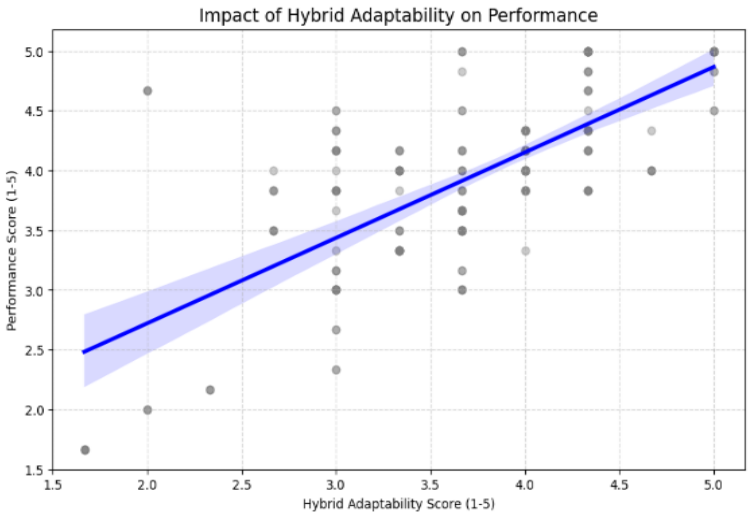
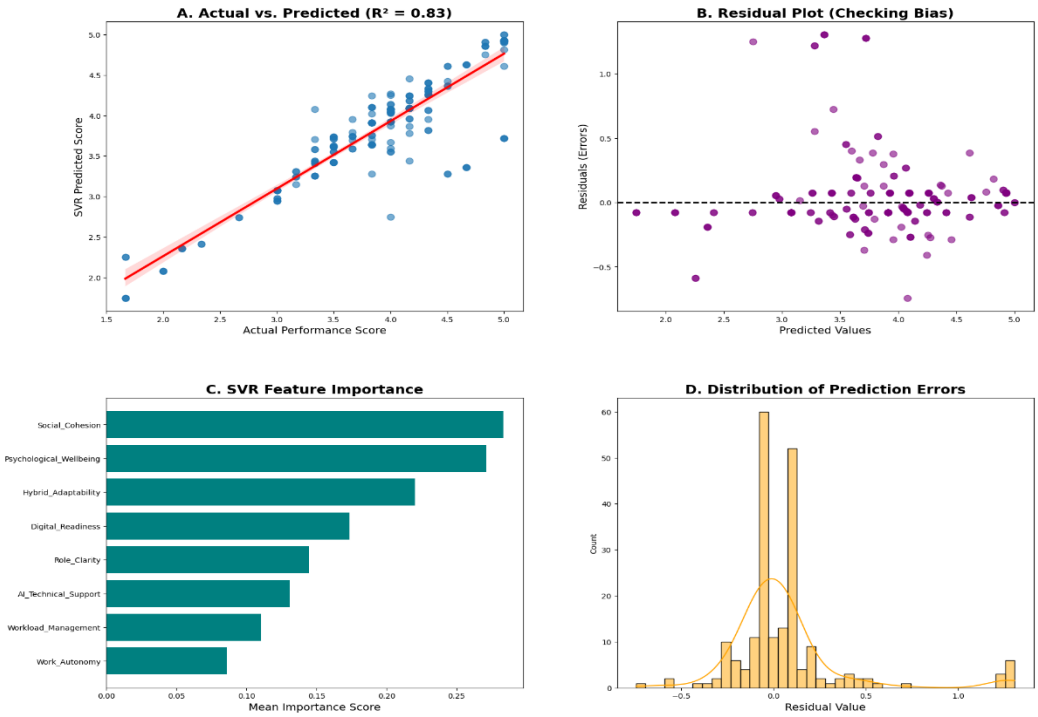


Figure 4. Support vector regression (SVR) analysis



4.3 The data in figures 3 & 4 shows how the changeover from a linear OLS model to a non-linear SVR model uncovers the complex dynamics at play in hybrid work performance. While the OLS model is statistically significant ($R^2 = 0.657$, $p < .001$), it only explains 65.7% of the data. By contrast, the SVR model with a radial basis function kernel demonstrates a substantial improvement in the coefficient of determination ($R^2 = 0.867$), a 21% increase that explains 86.73% of performance data.

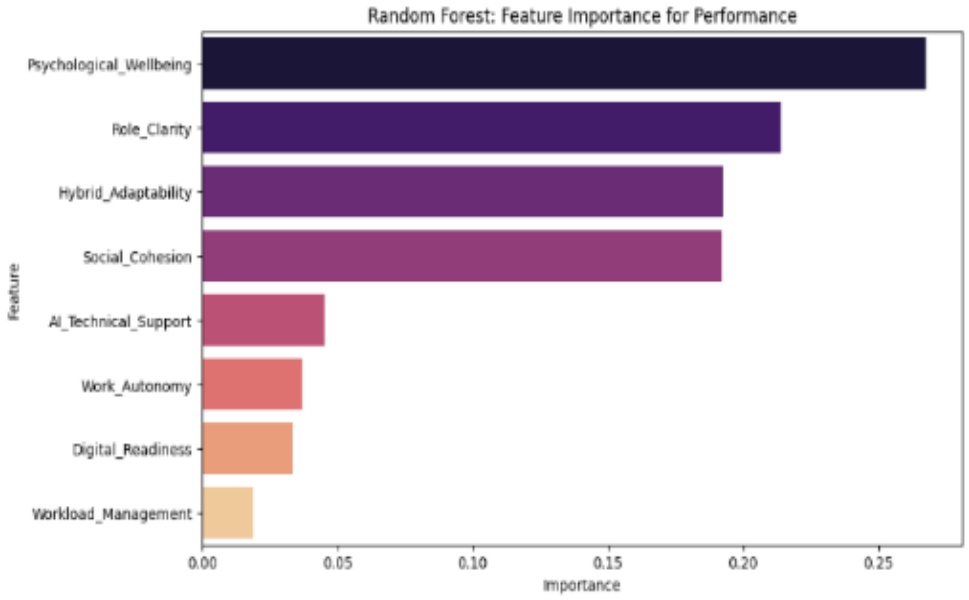
This improvement is further validated by the Actual vs. Predicted graph ($R^2 = 0.83$), which shows high levels of concordance between actual and predicted values. The feature importance test reveals Social Cohesion and Psychological Wellbeing as the top two non-linear determinants of performance. The reliability of the model is validated by the random scattering of residuals and the low mean squared error of 0.0472, which indicates that the SVR model is a highly accurate tool for predicting employee performance in hybrid work settings.

Table 2. Mediation analysis

Path Type	Path Description	Coeff. (β)	SE	p-Val	95% CI	Sig.
Path	X→ Social Cohesion	0.703	0.056	<.001	[0.59, 0.81]	Yes
Path	Social Cohesion →Y	0.715	0.046	<.001	[0.62, 0.81]	Yes
Total Effect	X→Y	0.680	0.055	<.001	[0.57, 0.79]	Yes
Direct Effect	X→Y (with Mediator)	0.310	0.062	<.001	[0.19, 0.43]	Yes
Indirect Effect	a×b	0.370	0.072	<.001	[0.24, 0.51]	Yes

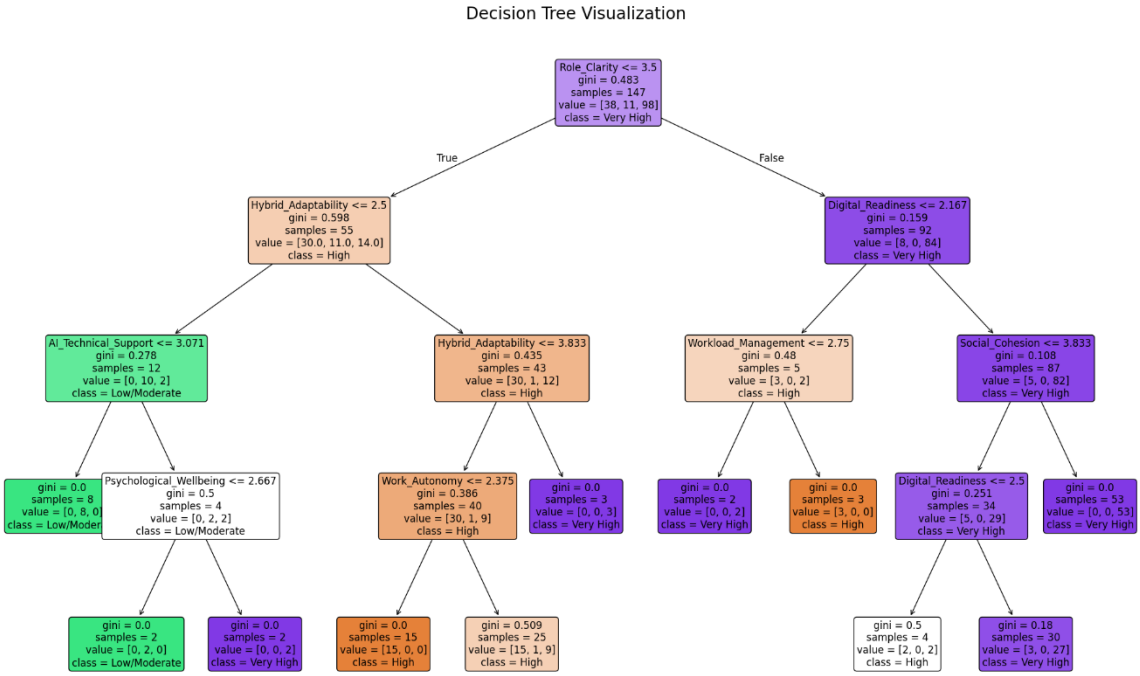
4.4 As shown in Table 2, the total effect of Role Clarity on Objective Performance is significant ($\beta = 0.6797$, $p < .001$), with a large indirect effect ($\beta = 0.3695$; 95% CI [0.2440, 0.5146]), thus confirming the importance of Social Cohesion as a mediator. The direct effect is also significant after controlling for the mediator ($\beta = 0.3103$, $p < .001$), indicating partial mediation. The results show that role clarity has a direct positive effect on performance but that this effect is significantly strengthened by the impact of improved team connectedness and feelings of belonging.

Figure 5. Random forest regression analysis



4.5 Figure 5 points to Psychological Wellbeing and Role Clarity as the most prominent predictors of success for employees. The R^2 value of 0.8313 for the Random Forest algorithm indicates that these more human-focused variables have more weight than technical ones. The role of Hybrid Adaptability and Social Cohesion is to offer a secondary source of influence in that it allows for continued productivity through adaptability and social cohesion.

Figure 6. Decision tree analysis



4.6 For classification purposes, objective performance was categorized into Low, Moderate, and High levels. As shown in Figure 6, based on the test dataset (n = 63), the Decision Tree Classifier identified Role Clarity as the primary determinant of performance level, achieving an accuracy of 80.95%. Those employees with Role Clarity greater than 3.6 and Digital Readiness greater than 2.167 consistently performed in the "Very High" range; this was exacerbated by Social Cohesion, which served to strengthen their overall performance.

After reaching a reasonable level of Role Clarity, if the AI Technical Support was greater than 3.8, the employees were likely to maintain "High" performance. However, if the employee experienced an insufficient level of Role Clarity, coupled with a lack of Hybrid Adaptability, as well as either low Digital Readiness or lack of Social Cohesion, they would typically be classified as providing "Moderate;" but in some cases, they could also fall into the "Low" performance category.

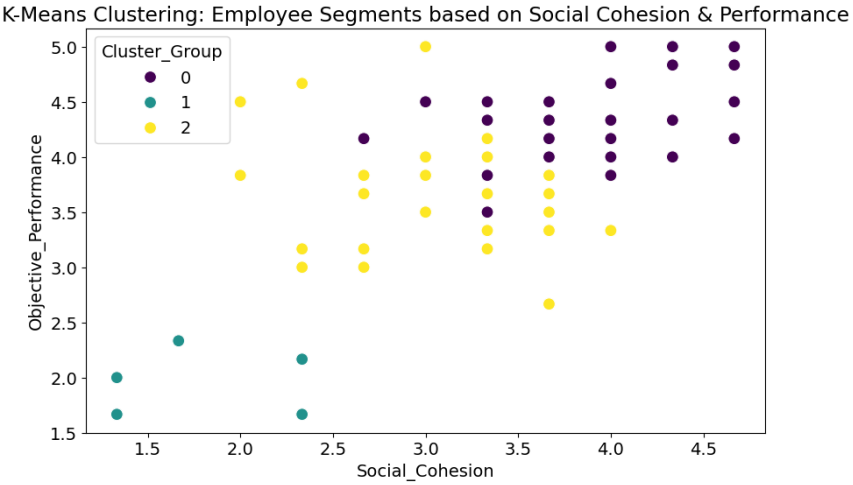
With a depth limit of four within the model, it becomes evident that both human and technical factors are primary differentiators; however, as it relates to success in hybrid work environments, foundational Role Clarity and Adaptability remain critical differentiators

Table 3. K- Means cluster analysis.

Cluster	Psych. Wellbeing	Hybrid Adaptability	Social Cohesion	Objective Performance	Profile Label
0	3.94	4.19	3.98	4.36	High-Performing Adapters
1	2.58	2.10	1.77	1.96	Critically Disconnected
2	3.12	3.27	3.11	3.66	Functional Mid-Tier

4.7 Table 3 shows that the Employees are grouped into three clusters in the table, which highlights Social Cohesion and Hybrid Adaptability as important factors that contribute to success in flexible work environments. Objective Performance (4.36) and Hybrid Adaptability (4.19) are highest in Cluster 0 (High-Performing Adapters), whereas Social Cohesion (1.77), Hybrid Adaptability (2.10), and performance (1.96) are lowest in Cluster 1 (Critically Disconnected). The primary focus for managerial improvement is Cluster 2 (Functional Mid-Tier), which maintains reasonable performance (3.66) but lacks Social Cohesion (3.11) and Psychological Wellbeing (3.12).

Figure 7. K- Means cluster analysis



4.8 Figure 7 illustrates how employee performance in hybrid settings is not consistent but rather falls into three different operational and psychological profiles. In particular, the Cluster 1 (Teal) group identifies a crucial "danger zone" where isolation results in performance failure, whereas the Cluster 0 (Purple) group shows that strong social cohesion is a basic prerequisite for elite performance (scores>4.0). This graphic demonstrates that rather than using a "one-size-fits-all" approach, managerial actions must be customized for each segment.

5. Overall Discussion

This study shows that organizational and human factors, rather than only technology, are the main drivers of employee performance in AI-enabled hybrid work environments. Role clarity, psychological wellbeing, hybrid adaptability, and social cohesion were consistently found to be the most powerful predictors of performance among Indian professionals across statistical and machine learning analyses.

While social connectedness maintains engagement, clear expectations and adaptability reduce ambiguity and strain, even if employees usually reported stable productivity in hybrid contexts. Digital Readiness and AI Technical Support, on the other hand, demonstrated few direct effects, indicating that their impact depends on the social and experiential settings of employees. While both performance and workplace satisfaction were examined, the findings predominantly highlight objective performance as the central outcome variable.

With SVR, Decision Tree, and Random Forest analyses proving the predominant involvement of "soft" human factors, advanced machine learning models further demonstrated the non-linear nature of hybrid work performance. The relationship between Role Clarity and Objective Performance was partially mediated by Social Cohesion, emphasizing that clarity works best when it promotes belonging, trust, and cooperation. Workforce heterogeneity was brought to light by cluster analysis, underscoring the inadequacy of one-size-fits-all hybrid strategies. Overall, the study emphasizes that successful hybrid work systems require structured roles, psychological support, adaptability, and strong social integration, positioning AI as an enabling factor rather than a major driver of performance.

6. Conclusion

This study demonstrates that role clarity, psychological wellbeing, social cohesion, and hybrid adaptability are the primary drivers of employee performance in hybrid work, with AI and digital tools serving as facilitators. Complex non-linear interactions that are missed by linear regression are revealed by machine learning methods. Integrating technology with defined jobs, solid social ties, and worker well-being is essential for effective hybrid performance.

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