

AI and Machine Learning in the HR Ecosystem: Driving Employee Engagement

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ABSTRACT

The primary goal of this study is to explore the potential of cutting-edge AI and ML technologies in enhancing employee engagement and streamlining Green Human Resource Management (HRM) processes. This study proposes that, given the growing convergence of technology and sustainability challenges, incorporating artificial intelligence (AI) and machine learning (ML) might considerably benefit and improve the practice of Green HRM. Various Scholarly literature was reviewed to understand the AI and ML in employee engagement. Data was collected through the distribution of standardized survey questionnaires; purposive sampling was used to identify people who are thoroughly aware of HR strategy and are involved in sustainable initiatives. Improved working conditions, higher levels of engagement, and more ambitious life goals would be portrayed in employees through the integrative approach of AI and ML technologies. Our research, therefore, contributes to knowledge of how AI-based solutions can raise employee engagement and consequently offer long-term sustainability for HR practices. The findings suggest that AI and ML driven technologies are organizational practices that may be adapted to enhance Green HRM. This, in turn, could attract more engaged employees with more sustainable HR practices and thus be more aligned with the organization's broader sustainability and technological advancement goals.

Keywords: Disruptive Technologies, Sustainable HR practices, Green Initiatives, Future of Work.

INTRODUCTION

In the uncertain and ever-changing world, Businesses and firms reveal themselves to the vast balance of sustainability values and workers that call for care and safe haven that will aid in their health, welfare, and attitudes toward their companies. Human Resource Management (HRM) practices have changed a lot when it comes to the role of technology if any role involving machine learning or artificial intelligence in human resources is present. Besides the machine learning (ML) and artificial intelligence (AI) of HRM systems, which encompass the entire workflow, they could also act as a triggering factor for organizational changes. Firms could then change their methods and patterns to be more eco-friendly or to address the need for next-gen workers. The last thing that would come into play would be the procedure of being active in numbered areas like recruitment & employment, work appraisements, & education interventions. Moreover, this will help the HR specialists be more precise and effective regarding strategic planning and decision-making

based on the data from data analytics by competition.

Green HRM, as the name suggests, is the application of Human Resource Management policies to the environmental front, or in simpler terms, is the use of HRM policies to promote the sustainable use of resources within the business and develop a work culture that supports ecological balance, green practices, etc., ultimately contributing in the sustenance of the environment. This occurs subsequently, which is achievable with the help of environmental professionals being employed, and local carbon footprints will be minimized. It encompasses several ecological concepts, such as saving energy, the office's environmental policies, and community practices. Thus, this strategy not only helps the companies to achieve the goals of their Corporate Social Responsibility (CSR) purpose but also lets them stand out of the crowd by incorporating the affective element to the employees, which, again, is another great attraction for an ecologically aware citizen. Workers should be the main motor in the business process because they can produce new ideas and do so at the lowest costs due to efficiency. Therefore, individuals who remain and can adopt new ways of thinking contribute to a better quality of work.

Along with the enlightenment of environmentally responsible organizational behaviors and HR policies that align with the green HRM approaches. It is this trilogy of designing a sustainable workforce, executing conserving practices at the workplace, and greening activities that the strategy is, in fact, part of corporate social responsibility while it is also an effort towards environmental issues at the same time. With artificial intelligence (AI) and machine learning (ML), we witness a new method that helps convert traditional human resources (HR) methods to clever techniques by the provision of data analytics and intelligent systems, task automation to boost efficiency, and proactive analysis to predict future capabilities. The enablement of these technological wonders empowers human resource management with access to a vast substantiation of data that would otherwise be infeasible, thus bringing about informed decisions that can come in handy, especially in process optimization involving productivity improvements at various levels in the organization's daily operation.

Objectives of the study

Broadly, the objectives of this study can be narrowed to three essential purposes:

1. The purpose is to understand how AI and machine learning can be utilized in HR processes in conjunction with green HRM.
2. Our research initiative aims to assess the impact of sustainability initiatives on employee engagement and workplace happiness
3. The study aims to uncover how AI- and ML-driven Green Human Resource practices influence employee engagement

Key Research question

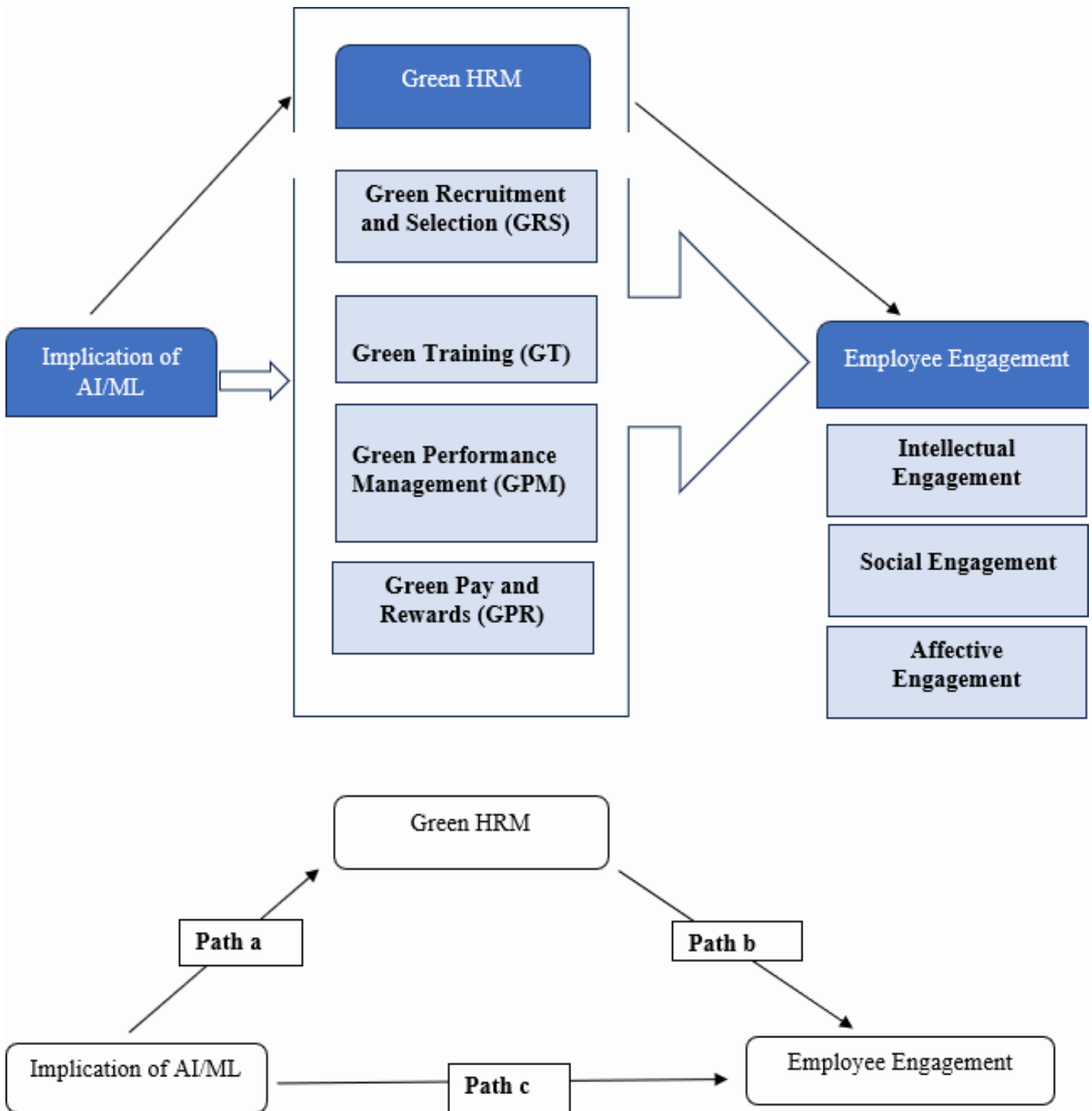
Does the implication of AI- and ML-mediated by green HR initiatives have positive relationships with employee engagement?

Hypotheses

H1: AI and ML mediated with Green HR Initiative has a positive relationship with Employee Engagement.

Ho: AI and ML mediated with Green HR initiatives do not have positive relationships with Employee Engagement.

Conceptual Framework:



The current study investigates the relationship between implementing Artificial Intelligence (AI) and Machine Learning (ML) and employee engagement, taking Green Human Resource Management as a mediating variable.

AI and ML, as the independent variable, are advanced technologies that further enhance HR processes with automation and predictive analytics. GHRM is the mediating variable, comprising Green HR practices, which include Green Recruitment and Selection, Green Training, Green Performance Management, and Green Pay and Rewards. Employee Engagement is the dependent variable manifesting in Intellectual, Social, and Affective Engagement.

The framework hypothesizes that AI and ML positively affect GHRM practices, and the latter, in turn, enhances Employee Engagement. The mediation analysis analyses the direct effect of AI and ML on GHRM, the indirect impact of GHRM on employee engagement, and the total effect of AI and ML on employee engagement. Therefore, whether AI and ML are associated with Employee Engagement through GHRM will be established, determining the role of sustainable HR practices in technological advantages for more employee engagement.

LITERATURE REVIEW

Sabale et al. (2022) explored an empiric about Artificial intelligence (AI) incorporation with Green Human Resource Management (GHRM) practices in organizations for environmental sustainability and social responsibility. AI-supported green HRM practices can establish greener processes, improve economic cooperation, and address social responsibilities towards the company and the community while supporting sustainability.

Aktar and Islam (2019) studied how green HRM practices affect employee engagement in Bangladesh's Readymade Garment (RMG) sector. The study discovered that 'green employee participation' and 'green training and development' substantially impacted employee engagement. The study emphasizes the significance of green human resource management techniques in creating long-term corporate success.

Sudha Subburao and Elango's (2023) research work "An Analysis of Green Human Resource Practices on Green Employee Engagement in the Automobile Industry" investigated the impact of Green HRM practices on workforce engagement in the automobile industry. The study focused on collecting data from respondents using a Likert scale and analyzing the green performance evaluation criteria. According to the research, employing green human resource practices can help increase employee engagement while addressing concerns like turnover intentions. The study underlined the value of engaging employees through clear policies and tactics.

Garg et al. (2018) investigated the use of artificial intelligence (AI) in green human resource management (GHRM) to enhance environmental sustainability in organizational contexts. Businesses may maintain social responsibility commitments, promote economic partnerships, and optimize operations using AI-driven GHRM strategies. The research highlighted the significance of integrating artificial intelligence (AI) into general human resource management (GHRM) strategy to promote a sustainable culture, enhance corporate social responsibility initiatives, and create socially and ecologically responsible company settings.

Gupta (2018) conducted a study exploring the intricate landscape of Green Human Resource Management (GHRM) practices in the context of manufacturing companies. The study follows a systematic approach for identifying, ranking, and assessing these practices to show their impact from multiple dimensions on organizational performance and environmental sustainability. Exploring these dimensions offered exciting perspectives on how GHRM practices could contribute to building corporate responsibility and environmental awareness in the corporate world.

Chiarini and Bag (2024) investigated the relationship between green performance and green human resource management (GHRM) practices in the Italian manufacturing sector. Their study, which used a mixed-method research methodology, found that activities including improving the company's green reputation, matching management with environmental goals, and providing training have a good effect on green performance.

Singh and Pandey (2020) have studied the impact of Green Human Resource Management (GHRM) practices on employee engagement in auto clusters in Delhi/NCR. A quantitative study involving 300

employees was used to determine the most critical GHRM practices and how they affect the various components of employee engagement. The findings underscored the importance of initiatives such as Green Employee Relations, Green Recruiting & Selection, and Green Induction in promoting worker engagement. The practical consequences encompass promoting positive employee relations, rewarding environmentally conscious conduct, and introducing environmental criteria into recruitment processes.

Aboramadan (2022) empirically examined the relationship between Green Human Resource Management (GHRM) and the green behavior of employees in Palestinian higher education institutions. The paper proposed a model based on social exchange theory that connects GHRM practices with employee in-role, extra-role, and green innovative work behaviors (GIWB), mediated by green work engagement (GWE). The study shows that GHRM effectively predicts many types of employee green behavior with GWE as a mediating mechanism. Policymakers in higher education striving to enhance environmentally friendly policies within their institutions can highly benefit from these findings.

Ranasinghe and Welmilla (2022) researched on green employee engagement. According to the authors, GHRM is essential for companies that want to continue moving their environmental targets forward. This study conceptualizes employee engagement as a positive psychological state and elaborates on various elements of employee engagement. This paper revealed the fact that the process of getting the best talent and increasing environmental awareness is based on green employee engagement. Trade unions are essential for support in green practices and workable solutions, and employee involvement on their boards in such efforts is taken up.

Yap and Tay (2019) researched the relationship between complex employee participation in sustainability and Green HRM practices. Their work has given insightful information on how HRM practices can become aligned with sustainability objectives to encourage greater employee participation in projects on environmental matters. These results show that organizational reputation can be enhanced, leading to greater sustainability.

Another pioneering research on the effect of green HRM practices on the green behaviors of employees was carried out by Ababneh (2020). The study described the complex dynamics causing the sustainability initiatives within companies through examinations of dimensions of personality traits moderating the relationship and intervening in employee engagement roles. The bulk of the relationship between individual green behavior and green HRM practices is mediated by employee engagement, given, among others, quantitative analysis involving employees from premium hotels in Jordan. The study underlines the need for a person-organization fit to raise the participation of employees in projects meant for environmental protection, with some insightful information relayed to firms willing to move up a rung in workplace sustainability.

Zhao and Huang (2022) analyzed the role of green innovation, Green HRM, in affecting the sustainable business performance of Chinese manufacturing enterprises. In the same research, they considered the perceived organizational support playing a moderating role in these links. It emerged that GTL, green HRM, and green innovation have a high-intensity direct influence in ensuring sustainable business performance. Furthermore, such relationships are moderated by organizational support.

Sova et al. (2023) studied the influence of digital HRM and artificial intelligence on sustainable growth. They noticed that companies did not like to encounter some challenges with integrating AI and digital HRM into sustainable HRM practices. The roles of sustainable HRM, combining HRM practices with those of sustainability and strategic HRM, and focusing on strategy and human resources were highlighted in the study. Their research showed how AI could influence society's norms and bring forth sustainable HRM with some helpful implications for striking a balance in resource use toward realizing sustainable development.

Shoaib et al. (2021) studied the GHRM practice in context with organizational commitment, having a mediating approach for green human capital. In this research, the AMA theory was applied to study the influence GHRM has on any dairy enterprise in Pakistan. The sample size of the respondents in this research was 287, and the data were collected through convenience-based sampling with self-administrative surveys. The study found that green recruiting and selection and green training and development influence organizational commitment directly.

Li et al. (2023) applied the supply-values fit theory to examine the effect of Green HRM practices on employee in-role green behavior after COVID-19, and at the same time, its mediating influence by psychological green climate and spiritual leadership's moderating effect. Their data from 374 Chinese MNC employees were analyzed using hierarchical multiple regression and through PROCESS Hayes, 2003. The results indicated that green HRM practices positively impacted in-role green behavior, and the psychological green climate-mediated that relationship.

Kathiravan and Prabu (2023) assessed the relationship between Green HRM Practices and Organizational Culture among Information Technology professionals in Chennai, India. They set forth a descriptive research plan and conducted parts of a surveyed questionnaire to a sample of 343 IT workers. The study tested the literature on green HRM practices and organizational loyalty with Smart PLS for data analysis and modeling of the structural equation for organizational loyalty. The results showed a robust and favorable correlation between Chennai City's IT workers' organizational cultures and green HRM practices.

Niazi et al. (2023) performed research on Green HRM practices and GI along with the impact of these on environmental performance, where GCSR mediated the framework when considering the function of GTFL. The methodology used for data collection in this paper was a survey questionnaire—and responses were obtained from 310 workers of public and private banks. The results indicated that GHRM and GI positively influenced GCSR, while GCSR positively affected environmental performance. Also, GTFL highly moderated the link between GHRM, GI, and GCSR, giving insight into how transformational leadership might leverage the influence of GHRM on GCSR.

Sulej et al. (2023) studied the impact of GHRM on the three types of EGB, green in-role, inventive, and extra-role behaviors for the environment management system as a conditional factor in the energy sector of Pakistan. The study results showed a positive impact of GHRM on all forms of EGB with moderation; the effect is found present in the relationship between GHRM and green divisive extra-role behaviors; it is also present between un-favorable work environmental conditions in the association between inventive behavioral motivations and GHRM in employee behaviors.

RESEARCH METHODOLOGY

Research Design

Both theoretical and empirical research forms the basis of the study. To gather information, a survey was conducted on workers at car firms in Chennai, India. A systematic questionnaire was created, primary and secondary data were collected, and a linked-in (Google Form) sample was obtained. Purposive sampling techniques were employed to acquire data, from which the sample was derived from data collected from 199 employees. The data was tested using SPSS and Smart PLS to ensure internal consistency and the link between the markers. Tests for discriminant validity and Cronbach's Alpha were also conducted. The idea was investigated using structural equation modeling, or SEM.

DATA ANALYSIS AND INTERPRETATION

Table 1: KMO and Bartlett’s Test

KMO and Bartlett’s Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.847
Bartlett’s Test of Sphericity	Approx. Chi-Square	2032.547
	df	496
	Sig.	0

Table 1 presents the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity. The Kaiser-Meyer-Olkin measure of sampling adequacy in the table is 0.847. Therefore, the correlations among the variables are considered sufficient and reliable to generate meaningful factors. Bartlett’s test for sphericity indicated that they were correlated significantly (Approx. Chi-Square = 2032.547, df = 496, Sig. = 0). This suggests that factor analytic techniques can be applied to establish relations among our variables. The high KMO score and the significant Bartlett’s test indicate that the dataset is a good candidate for factor analysis, meaning that the analytical procedure had a sound starting point.

Table 2: Rotated Component Matrix

Rotated Component Matrix									
	Component								
	1	2	3	4	5	6	7	8	9
V23	.595								
V18G	.589								
V33	.554								
V38	.535								
V35	.529								
V34	.522								
V29									
V19									
V32		.683							
V24		.675							
V11		.612							
V8AI									
V20			.727						
V36			.702						
V28	.501		.544						
V14									
V31E				.740					
V10				.528					
V39									
V15									

V37					.769				
V27					.592				
V21									
V9						.732			
V12						.619			
V13									
V22							.799		
V17							.534		
V26								.784	
V30								.548	
V25									.691
V16									.589
Extraction Method: Principal Component Analysis.									
Rotation Method: Varimax with Kaiser Normalization.									
a. Rotation converged in 19 iterations.									

Interpretation of Rotated Component Matrix

The Principal Component Analysis (PCA) with Variable rotation extracted nine distinct components. The variable rotation process, which converged in 19 iterations, also led to more easily interpretable components. **Component 1-Component 9:** Nine distinct components emerged. Within each element, certain variables exhibited high loadings, implying that they represent a unique underlying dimension of the data set. Through this process, the implementation of Varimax rotation maximized the variance of squared loadings. It served to simplify the factor structure while maximizing the significant relationships produced by variables and components. These findings elucidate the underlying dimensions of the data and provide a firm platform on which the succeeding analysis and inference in the study are built.

Table 3: Reliability and Validity

	Cronbach's alpha	Composite reliability Rho_a	Composite reliability (Rho_c)	Average variance extracted (AVE)
AI	0.727	0.744	0.803	0.597
Green HRM	0.765	0.774	0.821	0.565
Engagement	0.761	0.771	0.825	0.547

Cronbach's alpha was employed to check the reliability and validity of Artificial Intelligence, Green Human Resource Management, and Engagement measures. Cronbach's alpha values lie between 0.727 and 0.765, indicating high internal reliability of AI 0.727, Green HRM 0.765, and Engagement 0.761. Finally, composite reliability, covered via Rho_a and Rho_c, explored high reliability by values from 0.744 to 0.825. The average variance extracted by AVE indicated satisfactory convergent validity: AI = 0.597, Green HRM = 0.565, Engagement = 0.547. These facts testify to the robustness of the measuring instruments for the study context examination of these constructs.

Table 4: Path Co-efficient

	Path Co-efficient
AI-Employee Engagement	0.524
AI- Green HRm	0.77
Green HRM- Employee Engagement	0.541

Table 4 shows the path coefficients between variables AI, Green HRM, and Employee Engagement. Path coefficients are the strength and direction of relations between variables in the SEM or path analysis.

AI to Employee Engagement (0.524):

A path coefficient of 0.524 between Artificial Intelligence and Employee Engagement indicates a Moderate /positive relationship. That is, as AI initiatives increase, so will Employee Engagement.

AI to Green HRM (0.770):

The path coefficient 0.770 indicates a strong positive relationship between AI and Green HRM. This suggests that while implementing AI, green practices are incorporated along with HRM strategies.

Green HRM to Employee Engagement (0.541):

The path coefficient is 0.541, which indicates a moderate Positive association between Green HRM and employee Engagement. The result shows that organizations implementing green HRM are likely to observe higher levels of employee engagement.

Table 5: Model Fit

	Saturated Model	Estimated Model
SUMMER	0.077	0.087
d_ULS	3.955	3.955
d_G	1.04	1.04
Chi-Square	1064.019	1064.019
NFI	0.712	0.712

Table 5 Model fit indices

SRMR (Standardized Root Mean Square Residual)

Saturated Model 0.077 and Estimated Model 0.087

The SRMR indicates the measure of the difference between the observed and model-implied covariance matrices. Both models show SRMR values indicating a reasonable fit, but the Saturated Model has a slightly better fit.

d_ULS: Unweighted Least Squares discrepancy

Saturated Model: 3.955 and Estimated Model: 3.955

Equal values for both models indicate that the Estimated Model fits the data fit.

d_G or the Geodesic discrepancy:

Saturated Model: 1.04 and Estimated Model: 1.04

As in the above case of d_ULS, d_G is also used to assess the overall model fit, with lower values reflecting better fit. The model fits since the values for saturated and estimated models are equal.

Chi-Square:

Saturated Model: 1064.019 and Estimated Model: 1064.019

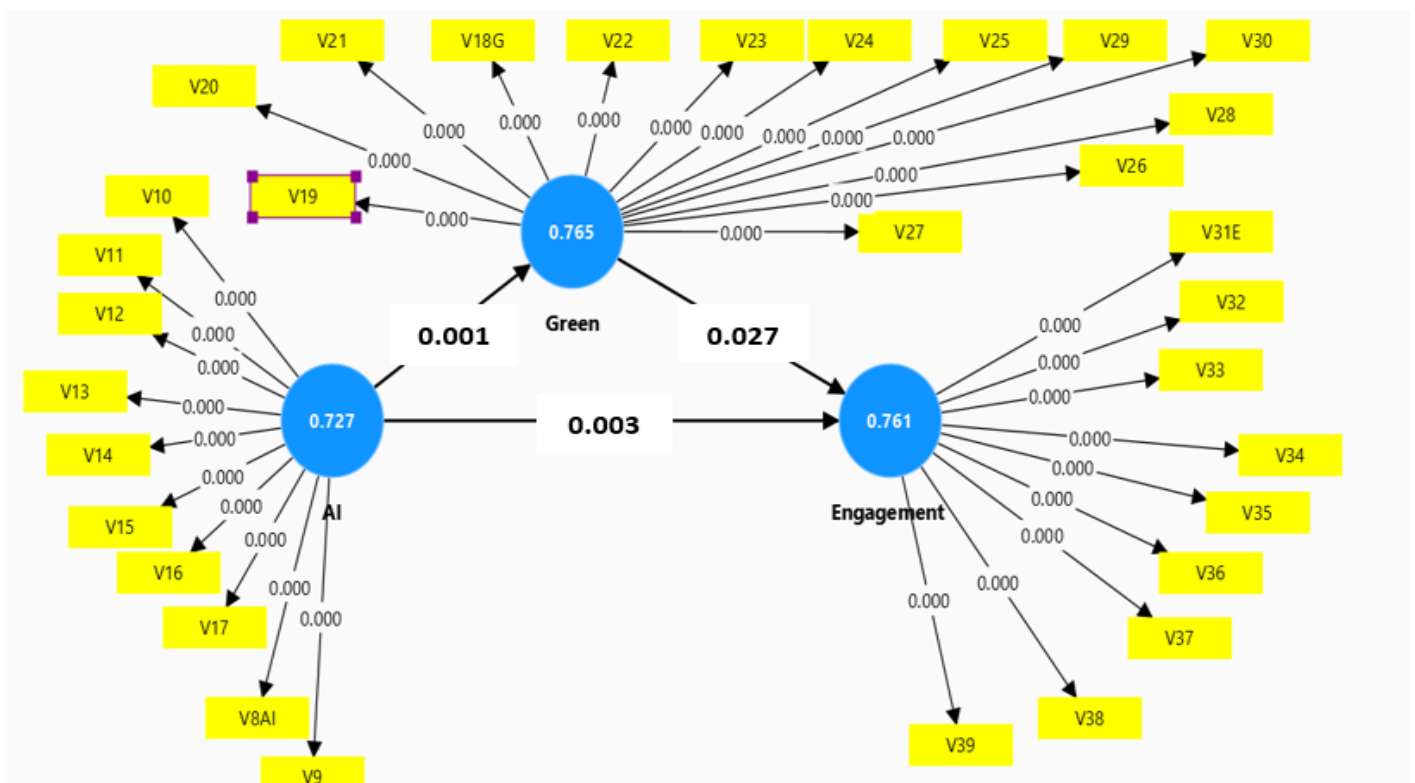
Chi-Square evaluates the difference between observed and expected covariance matrices. A good fit is reflected through a non-significant result, $p > 0.05$. Here, the values are the same, which means there is no significant difference between the Saturated and Estimated models; thus, the Estimated Model is good.

NFI: Normed Fit Index

Saturated Model: 0.712 and Estimated Model: 0.712

NFI pushes the estimated model to its maximum theoretical possible agreement by comparing the fit of that model to that of the Saturated Model. Values closer to 1 indicate a better fit. In essence, these values are identical. So, the estimated model fits acceptably with the best, perfect fit that the saturated model represents.

Figure 1: Mediation Analysis



This study used a mediation analysis to present a comparison of all the associations involving artificial intelligence, green human resource management, and employee engagement. The p-value of the path coefficient is given below:

The path from AI to Green HRM is significant at the 0.01 level; hence, AI adoption affects the implementation of Green HRM practices in an organization. This underscores the role of technological advancements in fostering environmentally sustainable HRM strategies.

AI has a significant direct effect on Employee Engagement. Organizations deploying AI technologies can exhibit higher levels of employee engagement, leaving a trace of impact developing through technological innovation on workforce outcomes.

The path from Green HRM to Employee Engagement is statistically significant, meaning that Green HRM practices significantly affect the level of employee engagement. This indicates that sustainable HRM practices have built a more engaged workforce.

Overall Mediation Effect

The overall impact of both routes, AI → Green HRM → Employee Engagement, presents proof for partial mediation. That suggests that Green HRM mediates the effect of AI on Employee Engagement in a partial way; more precisely, AI directly influences employee engagement, while some portion of it influences employee engagement in a way that affects sustainable HRM practices.

RESULTS AND DISCUSSION

The study's findings indicate the prominent role that both technological innovation and Green HR management play in improving outcomes in various organizations. AI, in this regard, directly impacts employee engagement once it is applied in an organization. In other words, the technologies related to AI play an increasingly vital role in renovating and improving workforce dynamics in present times. With AI, Businesses can create an exciting, efficient, and much more engaging work environment to help yield much better employee productivity and satisfaction. The study also highlights that Green Human Resource Management (HRM) practices in organizations significantly affect employee engagement. Sustainable HRM practices benefit the environment and result in a more motivated and committed workforce. This raises the organization's reputation and attracts environmentally sensitive talent, thereby improving the morale and engagement of the staff. These findings highlight the dual role of technological and environmental management practices in improving organizational outcomes. Strategic investments in AI, while directly contributing to improving employee engagement, also facilitate the adoption of sustainable HRM practices that further amplify the level of workforce engagement. From an organizational standpoint, insights like these are hardly inconsequential for firms trying to use technology and sustainability initiatives to build a more engaged and productive workforce.

CONCLUSION

Based on this study's findings, it can be concluded that AI significantly contributes to employee engagement. In organizations where AI technologies are implemented, there is more employee engagement, and AI automates routine tasks; besides, data-driven insight introduces innovation. In effect, the work happens to be more dynamic and challenging; hence, employees feel more valued and even motivated.

The study shows that Green HRM significantly affects employee engagement. Sustainable HRM practices provide results not only in environmental sustainability but also give the employees pride and a feeling of fulfillment. This engages them better and makes them more committed to the organization. The employees give growing importance to sustainability and environmental responsibility in the workplace, to the degree that green HRM is viewed as an indispensable component of present-day HR strategies.

This finding further implies that AI enactment has direct and indirect effects on employee engagement and consequently increases sustainable HRM throughout the process. This pathway thus reveals or defines the relationship between technological invention and sustainability, further establishing an organization's success. Shortly, AI adoption could be used to implement and regulate Green HRM to enhance employee engagement and lead to more tremendous organizational success.

In other words, this research contributes valuable insights into the development of the combined effects of

AI and Green HRM practices on employee engagement and organizational outcomes. Organizations that implement AI and cultivate sustainable HRM practices can be assured of having more motivated workforces and long-term sustainability in business, in addition to attaining better organizational results.

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