

Short Empirical Insight: Leadership and Artificial Intelligence in the Pharmaceutical Industry

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ABSTRACT

This study aims to analyze the importance of the emerging idea of green talent management and its effect on employees' innovative work behavior. In addition, the study examines how ethical leadership and artificial intelligence influence Pakistan's pharmaceutical industry. Four hundred and seven (407) survey forms were gathered from the management departments of five pharmaceutical industries in the twin cities of Pakistan (Islamabad and Rawalpindi). The data collected were analyzed using PLS-SEM with the help of Smart PLS. The empirical evidence presented in this study supports the notion that green talent management significantly affects employees' innovative work behavior. Furthermore, the results reveal that ethical leadership and artificial intelligence are crucial in regulating the connection between green talent management and innovative work behavior. This study provides managerial and theoretical implications derived from its results. These implications can help leaders in pharmaceutical industries effectively leverage green talent management to stimulate innovative work behaviors of their employees and attain a competitive edge in their respective marketplaces. Several studies focused on addressing the difficulties faced by organizational leaders in cultivating and maintaining people who can make valuable contributions to their companies and help gain a competitive edge in their markets. However, studies that investigate these risks are limited.

Keywords-ethical leadership; green talent management; artificial intelligence; work behavior; competitive advantage; pharmaceutical industry

I. INTRODUCTION

In recent years, there has been a growing focus on organizational performance. This ever-increasing concern can be linked to the dynamic and competitive development of the global market [1]. According to [2], organizations aim for organizational performance to gain a competitive edge in their market. The former seek compelling advantages, prompting researchers to explore innovative approaches, which will motivate positive employee outcomes [3-4]. Effective and efficient workforces are crucial to organizational success and require ongoing training and development of human capital [5]. Human capital is vital for organizations to achieve competitive advantage. Retaining talent remains a global challenge, particularly as organizations need technologically compliant

employees to remain competitive [6-7]. Talent management practices should incorporate green human capital development programs to attract, nurture, maintain, and deploy talent for competitive advantages [8]. The concept of green talent management, as discussed in [9], is defined as a strategic approach employed by organizational leaders to effectively invite, improve, and retain brilliant employees in the context of the organizational competitive advantage.

This study analyzes the importance of various critical variables in the Pakistani manufacturing industry. Ethical leadership involves organizational leaders who employ ethical ideas and values in their decision-making to cultivate a positive workplace culture [10]. Green Talent Management (GTM) involves strategies and methods focused on recruiting,

nurturing, and keeping individuals who are environmentally aware and capable of promoting sustainable innovation in companies [1]. Artificial Intelligence (AI) uses sophisticated algorithms and technology to automate tasks, increase decision-making processes, and improve organizational efficiency [11]. Work behavior refers to visible acts and behaviors that individuals exhibit at work, including their Innovative Work Behavior (IWB) which entails the creation and execution of new ideas to enhance organizational processes and results [12].

There is a prevailing view that innovation plays a crucial role in enabling companies to endure in a highly competitive and globalized environment [13-14]. The existing literature lacks clarity on the elements that determine IWBs in employees. More research is needed to discover the mechanisms that enhance "innovative behavior" and examine their relationships with other factors within organizational settings, particularly in the GTM setting. In [15], four distinct categories of variables were identified, namely leadership, work, group and network, and institute. Similarly in [16], it was found that worker and administrative individualities significantly promote IWB. Meanwhile, the outcomes derived from each category display inconclusive findings. Consequently, leadership style has been indicated to be of considerable importance in modern innovation [17]. In [18], it was argued that competent leadership can effectively fulfill essential roles in advancing work operations, simplifying complicated activities, and facilitating knowledge sharing, which can boost team productivity and ultimately provide organizations with a competitive advantage.

According to [10], ethical leadership (EL) is believed to be the style of leadership that most frequently stimulates employee creative thinking. EL entails setting an exemplary example, acting with justice and honesty, and being committed to doing what is right [19]. Ethical leaders demonstrate a commitment to addressing the needs and interests of their employees, stakeholders, and the wider community rather than solely prioritizing their own interests or those of the organization. EL has been found to have a favorable influence on the promotion of IWBs among employees [20]. The impact of GTM on IWB, in the context of manufacturing industries and specifically in pharmaceuticals, has not been thoroughly investigated. This study area is fascinating, as it provides valuable information on the predictive capabilities of GTM, EL, and AI with the innovative behavior of employees. Achieving a leading position in the market is highly influenced by the performance of employees, and this also applies to academic institutions [21]. This is because the performance of human resources within the manufacturing industry, and particularly of the top-level managers who are vital participants in research activities, significantly affects the overall effectiveness of the organization [22-24]. This study focuses on the pharmaceutical sector because of its significant role in promoting medical research and development. IWB is essential to encourage breakthroughs and enhance healthcare results with the assistance of AI [25-26]. Furthermore, considering the increasing ambiguity around the volatility of digitalization, it is necessary to study the influence of leadership style and AI on the connection between GTM and IWB of employees [2, 13, 27-28]. After analyzing data and literature, it is evident that

there is a significant lack of research in the pharmaceutical industry on the evaluation of GTM [1] and its correlation with IWB [29], EL [30], and AI [27]. Previous studies have explored these concepts separately in different sectors, but there is a shortage of studies that precisely analyze how they interact in the pharmaceutical industry.

The existing literature mainly focuses on GTM [1] or on innovative behavior [29] individually, with minimal consideration given to their confluence within particular industries, such as pharmaceuticals. This gap highlights the need for a thorough investigation of how GTM techniques impact innovative behavior in pharmaceutical companies, considering the distinct constraints and opportunities of this industry. This study fills a knowledge gap and offers valuable insights for pharmaceutical companies that use GTM techniques to promote innovation and sustainable growth. In addition, it connects theoretical frameworks with practical implications, providing actionable suggestions for industry practitioners and policymakers.

II. LITERATURE REVIEW

GTM is a vital technique for companies seeking to incorporate environmental sustainability into their human resource procedures [6]. Many studies have illustrated that GTM methods, such as environmentally friendly recruitment, training, and development, correlate favorably with organizational sustainability performance and innovation [31]. Furthermore, GTM has been shown to increase employee engagement and dedication, resulting in enhanced organizational outcomes [32]. Ethical leadership influences business culture and employee behavior toward ethical and sustainable practices [10]. Ethical leadership benefits employee attitudes and behaviors, such as job satisfaction, organizational commitment, and ethical decision-making [33]. Ethical leadership in sustainability promotes trust and transparency, motivating employees to participate in ecologically responsible actions [34].

AI transforms the industry through automation, predictive analytics, and optimization of production processes [35]. AI technologies, such as predictive maintenance and intelligent manufacturing systems, improve industrial operations' productivity, quality, and safety [1]. Furthermore, AI assists in making data-driven decisions, allowing companies to pinpoint the chances of lasting innovation and efficient resource management [36]. IWB is crucial for firms looking to adapt to dynamic market conditions and maintain competitive advantage [27]. Studies indicate that employees' desire to participate in innovative actions is affected by elements, like organizational climate, leadership support, and individual traits [37]. Creating an environment that promotes innovation is essential in the manufacturing industry to facilitate advances in products and processes, increase efficiency, and sustain growth [38].

III. HYPOTHESES

This study examines the difficulties of talent management techniques with an environmental focus on promoting innovation among employees in a diverse workplace. The

former aims to understand how EL affects the innovation of manufacturing employees. Given the growing use of AI in pharmaceutical workplaces, the way AI affects the IWB of employees is investigated. The relationships among GTM, EL, and AI are specifically examined to be determined whether EL can moderate the impact of talent management strategies on innovation. The current study aims to illuminate the complex linkages and moderating effects that lead to a complete understanding of IWB. Five hypotheses were proposed according to this conceptual framework:

- H1: Employees' IWB is significantly affected by GTM.
- H2: The IWB of employees is directly influenced by EL.
- H3: AI directly influences IWB.
- H4: EL acts as a moderator among GTM and IWB.
- H5: AI moderates the connection between GTM and IWB.

IV. METHODOLOGY

The constructs examined in this study are AI, EL, IWB, and GTM. The GTM measurement consists of five components adapted from [1]. IWB was measured using five questions adapted from [29], while AI and EL were assessed using a set of four and five items, respectively, developed and modified from [27, 30]. A five-point Likert scale was used for each construct, ranging from strongly agree to strongly disagree. The study sample consisted of management staff members from pharmaceutical industries in Rawalpindi and Islamabad, Pakistan. The selection of the sample size was based on [39], which allowed the achievement of an appropriate sample size. Before distributing the questionnaire, participants received assurance about the confidentiality of their information, communicating that their participation was voluntary while actively encouraging it. As a result, 700 forms were distributed among management staff. Of these, 450 questionnaires were returned by participants. After careful consideration, 407 questionnaires were selected for the final analysis.

V. DATA ANALYSIS

A. Descriptive and Measurement Model Analysis

Data preparation and demographic analysis of the respondents were conducted using IBM's SPSS statistical tool. The respondents were 69% male and 31% female. PLS-SEM was employed to build the relationships suggested in the model, utilizing the SmartPLS software. Given the complexity of real-life scenarios, PLS-SEM is thought to effectively evaluate the connection between concepts and result predictions [39-40]. Additionally, it is effective when dealing with a large sample because it is independent of data normality. Table I portrays the analysis of the model's variables. The findings indicate that the all-factor loading items related to GTM, IWB, EL, and AI exceeded the value of 0.5. Furthermore, the p-values linked with these factor loadings were statistically significant at a confidence level of less than 1%. These findings suggest that the tool utilized to assess the constructs shows consequential convergent validity. Furthermore, the Cronbach alpha and composite reliability coefficients exhibited values exceeding the predefined criterion

of 0.7, as suggested in [40]. This finding provides evidence that the measurement instrument has a high level of reliability. Furthermore, all variables have an Average Variance Extracted (AVE) greater than the threshold value of 0.5 [41].

TABLE I. FACTOR LOADINGS, CRONBACH'S A, AVERAGE VARIANCE EXTRACTED, AND COMPOSITE RELIABILITY VALUES

Constructs	Loadings	α	AVE	CR
Green Talent Management		0.788	0.857	0.600
1. GTM	0.727			
2. GTM	0.755			
3. GTM	0.795			
4. GTM	0.818			
Ethical Leadership		0.892	0.918	0.692
1. EL	0.820			
2. EL	0.841			
3. EL	0.835			
4. EL	0.824			
5. EL	0.839			
Artificial Intelligence		0.911	0.928	0.721
1. AI	0.740			
2. AI	0.869			
3. AI	0.917			
4. AI	0.868			
5. AI	0.841			
Innovative Work Behavior		0.855	0.896	0.634
1. IWB	0.791			
2. IWB	0.814			
3. IWB	0.855			
4. IWB	0.771			
5. IWB	0.746			

α : Cronbach's alpha, AVE: Average Variance Extracted, CR: Composite Reliability.

To improve the constructs' discriminant validity evaluation, HTMT was created in response to the deficiencies of the Fornell-Larcker criterion [42]. According to [43], an acceptable criterion for the discriminant validity of a model construct is an HTMT value significantly less than 0.90. Table II displays the results of the model assessment, demonstrating that all values were smaller than 0.90, supporting the discriminant validity of the model variables. Variance Inflation Factors (VIFs) are preferable to fundamental correlation values to measure collinearity. According to [44], VIFs are advantageous in identifying which coefficients are influenced by collinearity. Typically, a variable β_i with a VIF below 10 indicates no multicollinearity. However, a tighter criterion was established in [45], requiring a VIF of less than 3.3 for β_i . Table III reveals that all values were below 3.3.

TABLE II. HTMT - DISCRIMINATING VALIDITY

No	Constructs	GTM	EL	IWB	AI	AI×GTM
1	GTM					
2	EL	0.482				
3	IWB	0.482	0.469			
4	AI	0.406	0.34	0.117		
5	AI × GTM	0.22	0.169	0.218	0.269	
6	EL × GTM	0.179	0.09	0.16	0.213	0.344

Common Method Variance (CMV) is a notable concern in survey-based research, particularly when based on an individual respondent. All variable items were inserted into a one-way ANOVA test in SPSS using this method. The initial

component accounted for only 36% of the variance, falling short of the 50% threshold, verifying that there are no issues with CMV in the dataset.

TABLE III. COLLINEARITY STATISTICS (VIF)

No	Constructs	VIF
1	GTM → IWB	1.280
2	EL → IWB	1.240
3	AI → IWB	1.138
4	AI × GTM → IWB	1.204
5	EL × GTM → IWB	1.153

B. Structural Model Assessment - Hypothesis Testing

The results in Table IV disclose that the GTM coefficients are positive and significant at the 5% significance level. As a consequence, H1 was supported, indicating that GTM significantly affects the creative behavior of the employees. Furthermore, a statistically significant positive correlation was found between EL and IWB ($b = 0.33$, $p < 0.001$). The findings demonstrate the considerable impact of EL on employees' IWB, thus supporting H2. Similarly, the evaluation of the direct influence of AI on employees' IWB revealed a positive and significant association ($b = -0.292$, $p < 0.001$). Therefore, the results support H3, leading to the conclusion that AI has a favorable impact on employees' IWB. Regarding the moderating role of EL, the results indicate that it increases the effect of GTM on IWB, validating the H4 hypothesis. The results on the hypothesized moderating role of AI indicated that it dampens the influence of GTM on IWB, supporting the H5 hypothesis.

TABLE IV. HYPOTHESIS TESTING

No	Hypothesis	b-value	SD	T-statistic	p-values	Status
H1	GTM→IWB	0.375	0.05	7.509	0.000	Accepted
H2	EL→IWB	0.33	0.041	8.046	0.000	Accepted
H3	AI→IWB	-0.292	0.062	4.686	0.000	Accepted
H4	EL×GTM→IWB	0.212	0.034	6.207	0.000	Accepted
H5	AI×GTM→IWB	-0.191	0.045	4.246	0.000	Accepted

b-value: Beta coefficients, SD: Standard Deviation, T-statistic: Hypothesis test statistic, p-value: Probability value.

VI. DISCUSSION AND CONCLUSION

This study examined the growing idea of GTM and its application within the pharmaceutical industry to achieve a competitive advantage by fostering innovative employee behavior. The purpose of this study was twofold: first, to investigate the connection between GTM and employees' IWB, and second, to offer insights into how companies could enhance their performance and gain a lead in their respective markets. Empirical evidence is presented supporting GTM's crucial and positive impact on employees' IWB. The findings are consistent with [1] and [46]. Various studies have shown the influence of GTM on employee withdrawal and work outcomes [47]. GTM positively affects employee innovation [6, 22, 47]. GTM involves increasing commitment through effective communication and supporting talent comfort and welfare. These characteristics foster an environment that encourages employee creativity and tacit knowledge, leading to

a competitive advantage for the organization. The influence of EL on IWB was additionally examined, highlighting the role of leadership in promoting novel thinking and creating a conducive work atmosphere for acquiring advanced knowledge and technology. The findings indicate that EL fosters employees' innovative behavior. Furthermore, this study identified AI as a noteworthy factor for neglecting employees' creative work behavior. This outcome aligns with [48-49], which suggested that employees' use of digital tools facilitates enhanced communication and knowledge sharing, promoting IWB.

Furthermore, it was discovered that EL and AI affect the relationship between GTM and IWB. According to [6], EL that demonstrates empathy, flexible control, effective communication, and inclusivity can mitigate the challenges associated with GTM and empower employees to express their innovative ideas. This study provides evidence that AI affects the influence of GTM on employees' creative behavior. AI has been recognized in previous studies [48, 50] to improve productivity and performance. The current study demonstrates that AI can mitigate the impact of GTM on IWB.

A unique perspective on how integrating GTM, EL, and AI might forecast employees' IWB within manufacturing industries, such as pharmaceuticals, is presented. The research was carried out within the geographical setting of Pakistan, which is situated in the Asian continent. This particular context has not been explored in earlier studies, thus providing an opportunity to offer novel and significant insights that hold relevance for both theoretical and practical applications. The EL phenomenon and its implications for organizations and the future of employment are also examined. It was found that GTM positively affects employee innovation. In the debate over AI's potential, evidence is provided to enhance the understanding of its roles. It is projected that AI directly affects employees' innovative behavior, while GTM will positively influence it. Insights from emerging fields in literature are provided, complementing and expanding the current understanding of GTM, EL, AI, and employees' IWB.

The conclusions of this study also have significant implications for practitioners and policymakers in developing guidelines to advance GTM in manufacturing sector settings. For a company to effectively cultivate and retain talents to enhance its competitive advantage, leaders and practitioners must prioritize the implementation of the values inherent in GTM. Organizations should consider employees with exceptional talent and dedication as valuable assets that require support to foster the development and dissemination of competitive advantages throughout the institution.

LIMITATIONS

By including additional pertinent indicators, the model created in this study opens opportunities for researchers and practitioners to develop models for examining the results of GTM or other antecedents of the innovative behavior of employees that are more complex, holistic, and comprehensive. However, a potential disadvantage is the current study's focus on a specific industry, which may restrict the ability to generalize its findings. Hence, it would be exciting to apply the

model within a different sector. Furthermore, this research explicitly examined managerial staff, limiting the potential for comprehensive insights that can be gained from a wider range of participants within the pharmaceutical industry. Therefore, further research is needed on this matter. Furthermore, it is suggested that future research should be a longitudinal investigation, encompassing a wide range of manufacturing and considering national and cultural factors. This approach would enhance the establishment of interconnection and the generalizability of this conceptual model.

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ETHICAL CONSIDERATIONS

This study was conducted following the Declaration of Helsinki and was approved by the Institutional Review Board (IRB) of the School of Management, Harbin Institute of Technology, China. Informed consent was obtained from all participants involved in this study. Data were collected online and participants were allowed to anonymously contribute their information voluntarily. The authors ensure that the collected data will not be shared with anyone and will be kept strictly confidential throughout this study and subsequent analysis.

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