

The Impact of Green Transformational Leadership, and Green Human Resource Management on Green Innovation Performance: Moderating Role of Green Organizational Culture.

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Abstract

With the current trend of environmental sustainability across the globe, companies are adapting their strategies and prioritizing more towards green innovation. This study investigates the effect of Green Transformational Leadership (GTL) and Green Human Resource Management (GHRM) on Green Innovation Performance (GIP), and studies the moderating effect of Green Organizational Culture (GOC) on these relationships. The research adopts the Natural Resource Based View (NRBV) and the Ability-Motivation-Opportunity (AMO) theory, all in an effort of building a holistic framework to better understand the relationship between the leadership and HR practices to derive eco-friendly outcomes. A structured survey was used to collect data from small and medium size enterprises of Punjab, Pakistan. In this process 316 questionnaires were retained (70.2% response rate). Of these, 316 questionnaires were retained after discarding incomplete and inconsistent responses. The study tested the relations as shown in the model through Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicate that GTL and GHRM have high and positive influence on GIP. In addition, GOC has a relevant role in reinforcing the relationships between GTL and GIP, and between GHRM and GIP, so that these positive impacts are more evident in organizations with a strong culture of pro-environment. The model accounts for 64.7% of the variance in the green innovation performance. The findings underscore the importance of a holistic approach where strategic leadership, HR development and a positive culture all work together to improve green innovation results in a green market.

Keywords: Green Transformational Leadership (GTL), Green Human Resource Management (GHRM), Green Innovation Performance (GIP), Green Organizational Culture (GOC), PLS-SEM, SMEs

Introduction

The early 1800s onwards, environmental issues have been intensified due to the excessive consumption of resources and rapid economic development by globalization (Tang et al. 2018). But now, more studies have been focusing on pointing fingers at companies for their contribution to climate change, as they are major part of harmful substances in the environment (Mousa et al. 2025b). The warming that we see today is primarily due to human activities, according to the United Nations Foundation. This is demonstrated by the fact that the concentration of carbon dioxide in the air is much higher than it has been in the last 2 hundred, thousand years or more. This has resulted in an increase in the global temperature. The average global temperature today is over a degree above the pre-industrial level. As a result, there are increased predictions of uncertainty regarding the weather, an increase in extreme weather events, and increased risk to food supply. This all emphasizes the need for action and collaboration in various areas of society (UN 2023). As a countermeasure, multiple countries have developed environmental policies and regulations to enable sustainable and circular development (Perez et al. 2023; Thaher et al. 2025). Environmental organizations and experts suggest that companies should be implementing sustainable practices, and that leadership plays a crucial role in achieving this transformation (Farrukh et al. 2022). Government regulations, customers, and investors are driving companies globally to minimize their environmental footprint and contribute to the development of a circular economy. One aspect of the change is the development of new products, processes or systems that reduce environmental impact and also provide value to the company and its customers, which is known as ‘Green Innovation.’ However, getting high levels of Green Innovation Performance (GIP) isn't just about using new technology. It demands a great shift in the way companies utilize their resources, their personnel and their approach to leadership. There are several factors that have been identified to contribute to green innovation, but how leadership, HR practices, and culture impact each other remains unanswered. But, from a different perspective, research indicates that green human resource management (GHRM) practices have a significant positive effect on a company's environmental performance. Workers and managers are crucial to the success of these practices and to wider sustainability efforts, as they rely on their knowledge, skills, and attitudes (Jaaron et al. 2025). The challenges posed by climate change, resource scarcity and rising stakeholder expectations have transformed environmental sustainability to a business priority in the current business world. Businesses are facing a regulatory, customer and investor push to minimize their footprint and embrace a circular economy (Hart, 1995). The core of this change is “Green Innovation”, which refers to developing new products, processes, or systems that can reduce environmental pollution and still benefit the company and the customers (Li, Tian, Li, & Zhang, 2022). But it is not only about the adoption of new technology to reach high levels of Green Innovation Performance (GIP). It demands a significant shift in resource management, people management and leadership approaches of an organization. While a number of factors are at play behind green innovation, the interplay of leadership, HR and company culture is complicated.

This study focuses on two types of management tools, Green Transformational Leadership (GTL) and Green Human Resource Management (GHRM). GTL gives a clear vision and motivation for environmental change, while GHRM sets up the systems needed to develop and use the skills required for green projects. While these factors are important, there's growing agreement that how well they work depends on the company's environment. This study proposes Green Organizational Culture (GOC) as one of the crucial factors which can make GTL and GHRM more effective in enhancing the performance of the green innovation. Green transformational leadership (GTL) is one of the essential tools to encourage employees to think innovatively, generate new ideas and take action to protect the environment. These activities play a crucial role in shaping the company's innovative and sustainable nature. GTL provides direction and motivation for change in the environment while GHRM gives the structures to develop and utilize human resources for green projects (Iqbal, Akhtar, & Ahmad, 2021). While vital, there is a consensus that these strategies are best implemented in the appropriate company culture. This study proposes to incorporate another key factor for improving the performance of GTL and GHRM on green innovation: Green Organizational Culture (GOC).

Literature Review and Hypothesis Development

Theoretical Background

This study is based on two key theories: the Natural Resource-Based View (NRBV) and the Ability-Motivation-Opportunity (AMO) theory. The NRBV builds on the traditional Resource-Based View (RBV) and suggests that a company's competitive edge comes from its connection to the natural world. Hart (1995) argues that companies that build special abilities like reducing pollution, managing products responsibly, and focusing on sustainability are more likely to do better. In this study, Green Technology Leadership (GTL) and Green Human Resource Management (GHRM) are seen as important tools that help build these green abilities. GTL helps create a shared vision and dedication to being environmentally friendly, while GHRM ensures the company has the right skills and knowledge for green work. The AMO theory looks at how HR practices affect how employees act and come up with new ideas. It says that how well someone performs depends on their ability (skills and knowledge), motivation (their willingness to work hard), and opportunity (the environment that lets them act). When applied to the environment, GHRM practices like green training (ability), green rewards (motivation), and involving employees (opportunity) create a workforce that is both skilled and motivated to innovate in a green way. GTL adds to this by offering the kind of inspiration and encouragement that gets employees thinking creatively about environmental issues.

Variables of the Research Study

Green Transformational Leadership (GTL)

GTL has become a topic that more and more scholars are studying because of its impact on employees' environmental behaviors (Mansoor et al. 2021). GTL is about leadership actions that encourage and motivate employees to reach the organization's

environmental goals by clearly explaining a green vision and supporting environmental actions that go beyond what is required by rules (Chen and Chang 2013; Chen and Wu 2022). This idea comes from transformational leadership theory, which Avolio and Bass (1988) said includes four main areas: role modeling environmental values, inspiring through a clear vision, encouraging creative solutions for environmental issues, and showing care for each employee's development. These four areas have been adapted to focus on the environment (Farrukh et al. 2022). Green idealized influence means leaders show by example that they care about the environment. Green inspirational motivation is about sharing a strong environmental vision that matches the organization's main goals. Green intellectual stimulation involves helping employees come up with new ideas that help improve environmental performance. Green individualized consideration means building supportive relationships between leaders and employees that help develop pro-environmental values and a sense of involvement (Sobaih et al. 2022). As a whole, GTL helps employees learn more about environmental issues (Hameed et al. 2022) and supports the creation of eco-friendly products, services, and new green processes, which in turn makes the organization perform better in terms of the environment (Niazi et al. 2023).

Green Human Resources Management (GHRM)

Human resource management has evolved over the years and since the 1990s, green human resource management (GHRM) has gained importance. Currently HRM is recognized as one of the greatest players in the environmental management, which makes the company more sustainable (Ahmad 2015). As competition around the world increases and environmental problems get worse, companies are starting to include environmental issues in their rules and systems (Sharma et al. 2022). Protecting the environment is reliant on awareness and action of the people, in this regard businesses should promote environmentally friendly behavior among their employees (Joshi et al. 2023). GHRM is a form of HRM which aligns HRM with the goals of green management. It contributes to the company's environmental outcomes and impacts employee thinking and behavior (Gim et al. 2022). GHRM supports environmental strategies through the creation of more effective employees, minimizing waste, and improving environmental performance (Adu Sarfo et al. 2024). The hiring of environmentally friendly-oriented professionals, training on eco-friendly performance, measuring the performance, and rewarding them for green behavior are some of the main components of GHRM (Darvishmotevali and Altinay 2022). These practices allow companies to implement environmental projects and enable employees to more effectively address environmental issues. The study considers GHRM as one of the important and evolving approaches that contributes to developing green workplace and sustainable performance (Pham et al. 2020). Even though it's becoming more important, there's not much research on it, so more studies are needed (Tanova and Bayighomog 2022).

Green Innovation Performance (GIP)

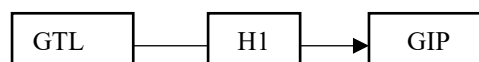
The meaning of innovation is taken from Joseph Schumpeter who stated: “Innovation is the process of creating something new such as a new product, new way of doing something, new market, or new organization of a business.” Traditional notions of innovation had to do primarily with money and technology advancement. However, due to the increased focus on the environment, the debate around innovation has shifted to focus on being more environmentally friendly (Sarfraz et al., 2023). Green innovation, also known as eco-innovation or environmental innovation, is the consideration of the environment in the design, production and management of products and services (Aprile, 2025). It aims to minimize the impact on the environment, but does not compromise its business performance. Green Innovation Performance (GIP) can be defined as how effective a company's eco-innovation initiatives are (Alshammari & Alshammari, 2023). It demonstrates the company's capacity to create green products, adopt green production processes, reduce pollution and waste, enhance energy efficiency, and implement sustainable production processes within the company (Rabal Conesa et al., 2024). Green innovation differs from traditional innovation in that it combines environmental and business/financial objectives. It strikes a balance between environmental protection and maintaining the efficiency and competitiveness of the company (Hayat & Qingyu, 2024).

Hypothesis Development

Green Transformational Leadership and Green Innovation Performance

Green Transformational Leadership provides an approach to leading that inspires followers to take on environmental challenges and makes them do more to contribute to sustainability. This is not the traditional kind of leadership, but rather about the environmental values and beliefs of employees. Green transformational leaders practice green behavior and set an example for others, making it easier to accept green behavior in the company. Research indicates that GTL is a good enabler of green innovation. If the leaders communicate a vision for green a clear way, the confusion about green projects can be avoided and a common purpose among employees can be established. The second important component of GTL is intellectual stimulation which invites employees to challenge the status quo and think creatively and innovatively about new sustainable solutions. GTL is, for instance, an effective tool for green innovation by providing a space where employees are empowered to experiment with new technology and approach (Li et al., 2022). Based on this, our initial hypothesis is that:

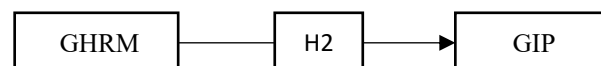
H1: Green Transformational Leadership positively and significantly influences Green Innovation Performance.



Green Human Resource Management and Green Innovation Performance

Businesses' environmentally friendly actions are important to green HRM (Song et al., 2020). The training programs which Green HRM offers enables employees to develop their skills, knowledge and abilities that will also enable them to think of new and creative ideas for green innovation. Research shows that there is a strong positive link between Green HRM and green innovation. Businesses that pay attention to the participation of their employees in green activities and provide them with training will be better equipped to develop new environmentally friendly products (Bahrami et al., 2016). The way companies pay their employees as part of Green HRM also affects how employees behave towards environmental issues, which in turn affects the company's sustainability (Song et al., 2020). Green innovation involves the creation of products that are better for the environment, using more environmentally friendly materials, and using fewer resources (Albort-Morant, Leal-Millán, & Cepeda-Carrión, 2016). Research conducted in India reveals that the effects of Green HRM can be indirect in fostering green innovation that can further influence the performance of a company (Sharma & Gupta, 2015). Environmental values and green training should be taken into account in the hiring process to foster innovation (Aggarwal & Sharma, 2015). Moreover, monitoring and rewarding employees' environmental conduct through it, can reinforce green conduct (Singh, Del Giudice, Chierici, & Graziano, 2020). Studies from Australia show that there is a positive connection between Green HRM and green innovation, but this relationship is influenced by green transformational leadership. It implies that the HR practices have the potential to enhance the green innovation and environmental performance of companies (Ahmeda et al., 2020). Environmental training programs led by Green HRM are proved as positive impacts on the green performance of the company and also generate awareness and motivation for green (Rehman, Kraus, Shah, Khanin & Mahto, 2021). Green HRM is believed to have a positive relationship with green innovation and has been investigated regarding the significance of Green HRM in promoting sustainable innovation in organizations. The discussion led to the following hypothesis:

H2: Green HRM positively and significantly impacts Green Innovation Performance.

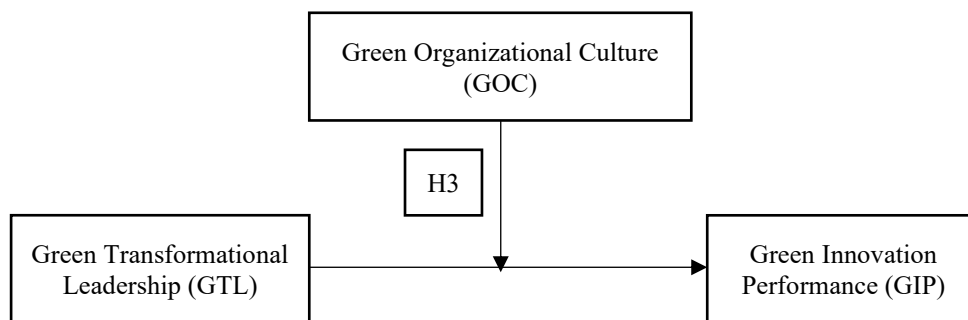


The Moderating Role of Green Organizational Culture

In the past 40 years, the concept of organizational culture has become a major subject of interest to individuals in organizations as well as researchers. It has been established as a trend in education and there are many studies on its impact such as school performance (Aktaş, Çiçek & Kıyak 2011). Organizational culture encompasses rules, doing things, procedure and systems that reward people. All these elements have an impact on the employees' motivation to work hard, thus influencing the performance of the organization (Erkutlu, 2011). Studies indicate that

organizational culture is an influential factor in the relationship between green HRM and innovation (Ong, Magsi & Burgess, 2019). Mutual awareness of the social, political and physical influences on working. A positive company culture fosters a more competitive workplace in which employees are educated on how to apply new and improved methods of working, thereby improving the effectiveness of green strategies (Alhefity, Ameen, & Bhaumik, 2019). Besides, organizational culture plays a role in relation to green HRM, which indicates the significance of organizational culture for green HRM and green innovation (Erkutlu, 2011; Iranmanesh, Zailani, Hyun, Ali & Kim, 2019).

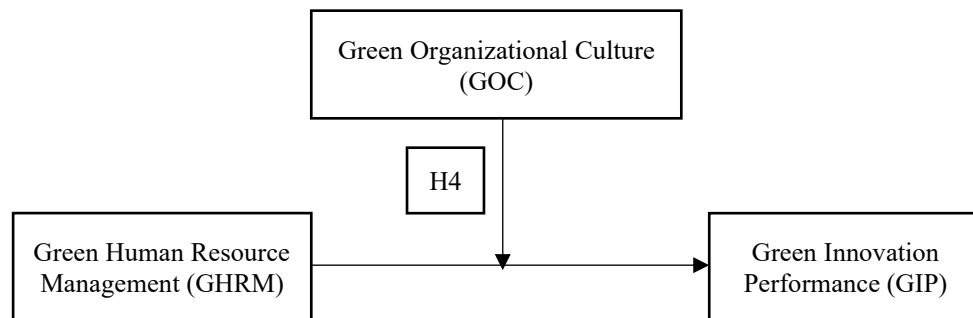
H3: Green Organizational Culture moderates the relationship between Green Transformational Leadership and Green Innovation Performance, making it stronger when GOC is elevated.



In addition, the way an organization behaves and the values it holds can affect how well green human resource management (GHRM) works and how much employees get involved, feel committed, and are passionate about their jobs (Liu, Ke, Wei, Gu, & Chen, 2010). Research from Pakistan and Malaysia shows that a strong organizational culture can help boost innovation and how employees act, which is useful for managers and leaders (Asiaei, Bontis, et al., 2022; Niazi et al., 2023). Green HRM initiatives aim to enhance the quality of human resources through policies and training initiatives, stimulate creativity, and promote green innovation, which can result in employees' actions and job satisfaction (Erkutlu, 2011; Tjahjadi et al., 2023).

Secondly, the culture of an organization is a factor of the effectiveness of GHRM. Green training and rewards are important indicators that a company truly cares about its values, considered as normal activity in a culture that appreciates the environment. Organizational culture can consolidate the individual's actions towards green goals, forming a common innovation capability. If the culture is strong in supporting green initiatives, then the employee will be more inclined to seize the opportunities offered by GHRM and will be more inclined to think of new ideas for green initiatives.

H4: Green Organizational Culture moderates the relationship between Green HRM and Green Innovation Performance, particularly when GOC is high.



The Methodology of Research

Methodology

Research Design and Sample

In this study, quantitative and cross-sectional research method was used to test the hypotheses. Small and medium sized businesses (SMEs) in Punjab, Pakistan were the focus. SMEs were chosen because they make up a big part of the industrial scene in developing countries and often struggle to adopt green practices because they have limited resources (Iqbal et al., 2021). The choice of the province of Punjab was made due to its being the most industrialized province in Pakistan which has a large number of manufacturing and service industries. To ensure a representative sample of the various industries, such as textiles, food processing, chemicals and light manufacturing, a stratified random sampling technique was employed. The study examined each organization as one entity, and included senior managers, HR managers and sustainability officers. These individuals had a good understanding of their company's green practices and innovation efforts.

Data Collection

Results were gathered using an online and in-person self-administered, structured questionnaire sent by e-mail and LinkedIn. The questionnaires were sent out over four months (January–April 2026) for a total of 450 questionnaires. In this process 316 questionnaires were retained (70.2% response rate). Of these, 316 questionnaires were retained after discarding incomplete and inconsistent responses. The sample size is greater than the minimum size recommended for PLS-SEM analysis, which is 10 times the number of structural paths directed to each construct that is measured in the model (Hair, Hult, Ringle, & Sarstedt, 2017).

Measures

All the constructs were measured using scales that were adapted from previous research. All items were rated on a scale of 1 to 7, with 1 being "strongly disagree" and 7 being "strongly agree". The questionnaire was first created in English and then

translated into Urdu. The back translation method was used to ensure the accuracy of the translation and to maintain the meaning.

Green Transformational Leadership (GTL):

It was evaluated by a 12-item scale which is adopted from Chen and Chang (2013). It consists of four elements idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. These are all aspects directed towards the environmental goals.

Green human resource management (GHRM):

The indicators are measured with a 15-item scale drawn from Renwick et al. (2013) and Iqbal et al. (2021). It addresses five aspects: green recruitment and selection, green training and development, green performance management, green rewards and compensation, and empowering employees in the field of environment.

Green Organizational Culture (GOC):

This is assessed on an 8-item scale, adapted from Harris and Crane (2002) and Singh et al. (2020). It examines the extent to which environmental values have become embedded in the norms, routine and decision-making processes of the organization.

Green Innovation Performance (GIP):

This is measured with the help of a 10-item scale that is developed by Chen, Lai and Wen (2006). It covers green product innovation (development of green products) and green process innovation (use of green production processes).

Common Method Bias

Common method bias (CMB) was minimized using both process and statistical methods (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). As the process went on, they were assured their answer would not be shared with others and their identity would not be disclosed. The questions were also presented in a random order. In terms of statistics, Harman's single factor test was performed which resulted in the largest group of related answers accounting for only 32.4% of the total variance, well below the 50% threshold. This implies that CMB is not a major issue. Furthermore, the VIF values for all the main ideas were below 3.3, indicating that there is no serious problem with CMB (Kock, 2015).

Data Analysis

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used with SmartPLS 4.0 software (Ringle, Wende, & Becker, 2022). The PLS-SEM method is suitable for this study due to its ability to handle complex models with numerous factors and interactions. Does not require data to have a normal distribution and is useful in prediction (Hair et al., 2017). The analysis was divided into two steps, the first was to check the measurement model to ensure reliability, convergent validity

and discriminant validity. Second, review the structural model to verify the hypotheses, review path coefficients, R2 values and effect sizes.

Results

Assessment of the Measurement Model

Prior to examining the relationships among the concepts, the measurement model was tested to confirm reliability and validity of the concepts. This validation was carried out with the internal consistency, convergent and discriminant validity.

Reliability and Convergent Validity

Table 1 shows the results of the reliability and convergent validity checks. Cronbach's alpha (α) and composite reliability (CR) were used to assess internal consistency. The internal consistency of all the concepts is good, as they have been given a minimum validity of 0.70 for α and CR (Hair et al., 2017). For convergent validity, Average Variance Extracted (AVE) was used and all the concepts were found to be above 0.50 which indicates that each concept accounts for more than 50% of the variance of the related measures (Fornell & Larcker, 1981).

Table 1: Reliability and Convergent Validity

Construct	No. of Items	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Green Transformational Leadership (GTL)	12	0.941	0.948	0.623
Green Human Resource Management (GHRM)	15	0.952	0.957	0.612
Green Organizational Culture (GOC)	8	0.918	0.932	0.661
Green Innovation Performance (GIP)	10	0.936	0.944	0.648

($\alpha > 0.70$, CR > 0.70 , AVE > 0.50).

Further, the loadings for all items were analyzed and were all greater than 0.70 with most of them above 0.75, showing good indicator reliability. The items excluded during preliminary analysis have loadings of less than 0.70 in order to improve the model fit.

Discriminant Validity

The discriminant validity is achieved by making sure that every construct is unique from the other constructs in the model. The Fornell-Lacker criterion, cross-loadings and Heterotrait-Monotrait (HTMT) ratio were used to examine the discriminant validity. Table 2 displays the square root of AVE on the diagonal for Fornell-Larcker Criterion. The AVE of each construct should be larger than the correlations between

each construct with the other constructs for discriminant validity (Fornell & Larcker, 1981). All constructs meet this criterion (see Table 2).

Table 2: Discriminant Validity – Fornell-Larcker Criterion

Construct	GTL	GHRM	GOC	GIP
GTL	0.789			
GHRM	0.612	0.782		
GOC	0.584	0.597	0.813	
GIP	0.658	0.683	0.621	0.805

Heterotrait-Monotrait (HTMT) Ratio: The HTMT ratio is a more stringent test of discriminant validity. Values below 0.85 (or 0.90 for conceptually similar constructs) indicate adequate discriminant validity (Henseler, Ringle, & Sarstedt, 2015). Table 3 shows that all HTMT values are below the 0.85 threshold, confirming discriminant validity.

Table 3: Discriminant Validity – HTMT Ratio

Construct	GTL	GHRM	GOC	GIP
GTL	—			
GHRM	0.641	—		
GOC	0.618	0.634	—	
GIP	0.697	0.721	0.663	—

Cross-Loadings: Cross-Loading: Discriminant validity was confirmed by the examination of cross-loadings, which showed differences of more than 0.10 between all indicators and their proposed constructs with the highest loading on the construct. Overall, the measurement model was found to have high reliability and validity levels, which indicates a good basis for testing the structural model.

Assessment of the Structural Model

The adequacy of the measurement model was tested and, based on these results, the structural model was evaluated to test hypothesized relationships. The following path coefficients, significance levels, coefficient of determination (R^2), effect size (f^2) and predictive relevance (Q^2) were part of the assessment.

Hypothesis Testing and Path Coefficients

In this section, hypothesis testing and path coefficients are examined. PLS algorithm with the number of bootstraps 5,000 was used in the construction of the structural model to evaluate path coefficients. The answer to the hypothesis test is summarized in the results of the hypothesis testing presented in Table 4. The results of the hypothesis testing are summarized in the results of the hypothesis test presented in Table 4.

Table 4: Structural Model Results – Direct Effects and Moderation

Hypothesis	Path	β	S. E	t	p	95% CI	Decision
H1	GTL → GIP	0.342***	0.052	6.577	< 0.001	[0.241, 0.443]	Supported
H2	GHRM → GIP	0.389***	0.054	7.204	< 0.001	[0.283, 0.495]	Supported
H3	GTL × GOC → GIP	0.156**	0.048	3.250	0.001	[0.062, 0.250]	Supported
H4	GHRM × GOC → GIP	0.183**	0.051	3.588	< 0.001	[0.083, 0.283]	Supported

Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. CI = Confidence Interval.

H1: Green Transformational Leadership → Green Innovation Performance

The results indicate that GTL has a significant positive effect on GIP ($\beta = 0.342$, $t = 6.577$, $p < 0.001$). This finding is in line with H1, which states that employees' motivation to act in an environmentally friendly way, under the influence of inspirational and intellectually stimulating leaders, has a positive effect on the green innovation performance of the organization.

H2: Green Human Resource Management → Green Innovation Performance

The results also show that GHRM has an important positive impact on GIP ($\beta = 0.389$, $t = 7.204$, $p < 0.001$), which is seen as a supportive proof of the H2 hypothesis. The findings highlight the importance of HR practices in fostering the capacity, motivation and opportunity of employees to innovate green.

H3: Moderating Effect of GOC on GTL → GIP

The interaction term GTL × GOC is positive and significant ($\beta = 0.156$, $t = 3.250$, $p = 0.001$), supporting H3. This means that in organizations having strong green organizational culture, the positive relationship between GTL and GIP is stronger. This moderation effect is shown in figure 1 (simple slope analysis) which indicates that the slope of the GTL–GIP relationship is steeper at high levels of GOC than at low levels.

H4: Moderating Effect of GOC on GHRM → GIP

In the same way, the interaction term, GHRM × GOC, is positive and significant ($\beta = 0.183$, $t = 3.588$, $p < 0.001$), to justify H4. This result reaffirms that green organizational culture has an accented relationship with GHRM and green innovation performance. In organizations that have an environmental culture, investments in HR can be better converted into tangible innovation outcomes.

Coefficient of Determination (R^2) and Effect Size (f^2)

The coefficient of determination (R^2) is a measure of the amount of variance in the dependent variable accounts for the independent variables. The endogenous construct's R^2 values are shown in Table 5.

Table 5: Coefficient of Determination (R^2)

Endogenous Construct	R^2	Adjusted R^2	Interpretation
Green Innovation Performance (GIP)	0.647	0.642	Substantial

Note: R^2 values of 0.25, 0.50 and 0.75 are considered weak, moderate, and substantial, as compared to, respectively (Hair et al., 2017).

The model accounts for 64.7% of variance of green innovation performance and is considered as good. Frequently used in the field that can provide substantial predictive power. The adjusted R^2 (0.642) represents model The model is robust, as evidenced by its complexity and high levels of retained. Effect Size (f^2): The effect size (f^2) assesses the relative impact of each predictor on the endogenous construct.

Table 6: Effect Size (f^2)

Predictor	f^2	Effect Size
GTL → GIP	0.142	Medium
GHRM → GIP	0.178	Medium
GTL × GOC → GIP	0.038	Small
GHRM × GOC → GIP	0.047	Small
GOC → GIP	0.021	Small

The effect sizes of both GTL and GHRM are medium, suggesting that they are significant predictors of GIP. The interaction effects (moderations) have small but meaningful effect sizes that are representative of the effects of moderation in an organizational context that is typical (Aguinis, Beaty, Boik, & Pierce, 2005).

Predictive Relevance (Q^2)

Blindfolding procedure was used to compute the Stone-Geisser Q^2 value, which was used to determine the model's predictive relevance. A Q^2 value of > 0 means that the model is of value for predicting the endogenous construct (Geisser, 1974). The Q^2 value for GIP was 0.412, which is greater than 0, indicating that the predictive relevance of the model is good.

Model Fit

PLS-SEM does not use the classical goodness-of-fit indices but the Standardized Root Mean Square Residual (SRMR) was estimated as a reasonable approximation to the model fit. The fit of the model was acceptable (Hu & Bentler, 1999) with an SRMR of 0.061 which was lower than the recommended value of 0.08.

Discussion and Implications

This study aimed to look into how Green Transformational Leadership and Green Human Resource Management affect Green Innovation Performance. It also checked how Green Organizational Culture influences this relationship. The findings strongly confirm all four hypotheses, providing valuable insights into the mechanisms companies can apply to better enable them to innovate in an environmentally responsible manner.

Direct Effects of GTL and GHRM on Green Innovation Performance

The results indicate that GTL and GHRM have a direct effect on Green Innovation Performance. The results show that both GTL ($\beta = 0.342, p < 0.001$) and GHRM ($\beta = 0.389, p < 0.001$) are important factors that predict green innovation performance. This result is consistent with the Natural Resource Based View (NRBV) which states that possessing unique environmental skills gives companies a competitive advantage (Hart, 1995). GTL does this by setting a common target and a shared sense of sustainability; GHRM does this by building up people skills to implement green projects. The fact that GHRM is slightly more influential than GTL implies that structured HR practices could more broadly impact the outcome of innovation than good leadership. This is consistent with the AMO framework which states that for long-term success, leaders must instill motivation, and HR systems must provide ability and opportunity (Appelbaum et al., 2000). Green training imparts the skills to workers for eco-friendly innovations; green performance reviews emphasize the importance of environmental goals and green rewards provide actual rewards for workers to act in an environmentally friendly way. All of these practices and more contribute to a robust support network inside the company that helps sustain green innovation. The impact of GTL cannot be underestimated, however. Transformational leaders are key in articulating a vision of the environment, challenging past practices, and motivating their employees to take action beyond the scope of their self-interest to advance the organization's mission (Chen & Chang, 2013). In small and medium sized enterprises, where resources are likely more limited and environmental programs might be thought of as expensive, it is especially important to have a clear-thinking leader in place. Having leaders who lead by example and encourage their staff to consider carefully can help alleviate resistance to change and rally the company's resources around promoting green innovation.

Moderating Role of Green Organizational Culture

An important contribution of the present study is the empirical evidence for GOC as a mediator between relationships of GTL and GIP and between GHRM and GIP. Significant interaction effects between leadership ($\beta = 0.156$) and HR practices ($\beta = 0.183$) with green innovation suggest that the effect of leadership and HR practices on green innovation depends on the cultural context. These results lend credibility to the idea that organizational culture is a "catalyst," which increases the effectiveness of management practices (Schein, 2010). Environmental values are integral to an organization's daily life, decision-making and employee interactions in organizations

where there is a strong green culture. In this understanding, the green vision of leaders which is presented in such a way will have a greater impact on the employees' understanding, since leaders' vision is in line with the belief and norms of the employees. Analogously, if the practices within the GHRM are not seen as genuine expression of the organization's values, but rather as mere compliance measures, then the practice is less effective. The stronger moderation effect of GHRM ($\beta = 0.183$) than GTL ($\beta = 0.156$) implies that culture may play a special role in the mediation of HR investments in innovation outcomes. This aligns with the research that indicates that HR practices work best when supported by a context of culture (Yong et al. 2020). Employees in a strong green culture are more likely to demonstrate the skills and knowledge acquired from green training, to positively respond to green performance appraisal, and to see green rewards as an award for their good work. Theoretically, these findings continue the NRBV in that cultural resources also need to be considered, besides the tangible and human resources. In contrast to Hart (1995) who focused on the need for capabilities such as pollution prevention and product stewardship, this study shows the importance of the cultural contexts within which the development of these capabilities takes place. Culture is the "social glue" that connects individual contributions to collective capacities and improves the performance of the organization's green innovation.

Implications for Small and Medium Enterprises in developing economies

It is important to note that this study is contextualized with the small and medium enterprises (SMEs) of Punjab, Pakistan, which brings a new value into the results. Despite the urgency to go green, SMEs in developing countries often encounter unique challenges in the implementation of green practices, including lower financial resources, technical knowledge, and other pressing business demands (Iqbal et al., 2021). But as this study reveals, a lot can be done in the field of green innovation, even for companies with limited resources, by smartly applying leadership, HRP and company culture. The cultural change is an economical solution for SMEs. Creating a green culture need not be the costliest of activities; simply demonstrating an interest in the environment through actions, telling stories about sustainability, making environmental values a part of the ordinary work of everyday people can help make a difference. Leaders can demonstrate environmentally responsible behaviors, acknowledge achievements related to environmental issues and incorporate environmental considerations into decision making. These behaviors can gradually help to develop a working environment that makes other formal leadership and HR initiatives more effective. Furthermore, the research indicates that SMEs should adopt an all-round strategy towards green innovation. Managers should not only be focused on leadership or HR; when it's integrated with the right culture then results will improve. This whole approach is in line with the AMO model which states that the 3 elements of ability, motivation and opportunity must all be present to achieve optimum performance.

Theoretical Implications

This research brings in new concepts that enrich the knowledge about green innovation and its facilitators. It presents two theories to explain the development of companies' green innovation abilities: ability-motivation-opportunity (AMO) theory and natural resource-based view (NRBV). The NRBV highlights the importance of environmental resources/capabilities in a company's strategy, while the AMO theory examines the treatment of people at work, and how that affects their actions. These theories, when applied together, provide a wider perspective that links key aspects of an organization such as leadership, and HR role and function to the contribution of employees towards green innovation. The study also reveals that organizational culture is one of the essential unknown resources which can be utilized better and enhance the company performance in terms of the environment. In addition, it contributes to the research on green transformational leadership by demonstrating the influence of a green culture in strengthening the relationship between leadership style and green innovation results. Consequently, it is essential to have the appropriate culture if leadership is to be effective. The research also contributes to the field of Green HRM by demonstrating that the effectiveness of green HR practices is dependent on the company's environment, offering a challenge to the belief that HR practices are effective in all companies. Finally, the study provides compelling evidence of how all three the leadership, HR practices, and company culture contribute to the support of green innovation. The model has captured a significant amount of the variance in the results of green innovation ($R^2 = 64.7\%$), highlighting the necessity to consider all of these dimensions together to gain insight and stimulate green innovation in organizations.

Practical Implications

The findings of this study have some helpful ideas for managers, HR and organizational development professionals, and policy makers who are interested in making companies more 'green'. Senior leaders should develop and communicate a clear and transparent plan for the environment that is aligned with the company's values and objectives. They should also seek to develop their skills in training leaders to be more inspirational, creative and growth-oriented or nurturing. Meanwhile, the leaders' behavior must be consistent with the company's environmental culture, otherwise, the potential for its own green initiatives to be ineffective will be realized. HR should consider incorporating environmental standards into the hiring, training, performance reviews, rewards, and promotions. They should ensure the consideration of environmental-related skills in selection for higher positions. They should also establish continuous training on green practices and offer opportunities to employees to be involved in green teams, suggestion programs, and sustainability projects. Organizational development professionals can play a key role in creating a robust corporate culture that embeds these values into the day to day, stories, traditions and self-perception of the company. They should also build on a system whose components are leadership, HR practices and culture to maximize their impact. Support small businesses through policy and industry initiatives by providing access

to knowledge-sharing opportunities, technical support and funding. They should also promote green leadership principles and enable business collaboration to enhance their sustainability practices and create more innovations.

Limitation and future research

The research method in this study was quantitative; qualitative research would provide more detailed information regarding processes and reasons for green innovation. Research into leadership that promotes green ideas, the implementation and experience of HR practices, and the development and maintenance of green cultures could be facilitated using the method of case studies, interviews, and ethnography. It would be very beneficial if mixed methods studies use both quantitative and qualitative methods in order to validate results and provide a comprehensive understanding of what is going on. While this study looked at how GTL and GHRM directly affect GIP and how GOC influences that relationship, it didn't look into the steps or paths through which these effects happen. For instance, employee green commitment, green knowledge sharing or green creativity could be the factors influencing GIP. Likewise, GHRM can be achieved via green human capital, green employee behavior, or organizational learning. More sophisticated models can be developed and tested in the future with the incorporation of these paths through methods such as mediated moderation or moderated mediation analysis.

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