Mediating Effect of Green Innovation and Knowledge Sharing on the Relationship between Green Entrepreneurial Orientation and Environment Performance

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Abstract

The purpose of this research is to examine the mediating effect of green innovation (GI) and knowledge sharing (KS) on the relationship between green entrepreneurial orientation (GEO) and environment performance (EP) with special reference to in context of industrial firms in Pakistan which is one of the contextual gap of the study. This study used a quantitative approach due to its ability to produce large and standardized data sets. The data was collected using structured questionnaires on 216 respondents drawn from different industrial firms. To examine the mediation effects, the Process Hayes (2012) was used whereby the data was analyzed using SPSS. The findings obtained show that GEO has a positive impact on EP in the organization. The results obtained demonstrate that GI and KS mediate the impact of GEO on EP, which means that the positive effects of GEO emerge through the strengthening of green innovation and knowledge sharing. These results also reveal positive statistical relationships between GEO, GI, KS, and EP that may support the mediation shown in the proposed model. Managers are advised to enhance a comprehensive green entrepreneurial culture, which involves the establishment of sustainable organizational objectives and targets, dedication of resources to green innovation and diffusion of available knowledge. Such actions can improve environmental performance and full establish companies as leaders, especially in sustainable development. It is an original contribution to the literature aimed at explaining how precisely process GEO affects evaluation EP with the help of theoretical constructs GI and KS. It offers an explicit account of how companies' active green initiatives can be a catalyst for superior environmental conditions.

Keywords: Green Entrepreneurial Orientation, Environmental Performance, Green Innovation, Knowledge Sharing, Industrial Firms, Mediation Analysis

Introduction

The industrial sector in Pakistan is one of the most important sectors in the economy contributing roughly 20 percent of the Gross Domestic Product (GDP) and employing a sizeable part of the working population. It encompasses major industries like textiles, cement, steel, chemicals, and pharmaceuticals (Economic Survey of Pakistan, 2025). However, in addition to these, the sector is also burdened with chronic issues such as energy deficit, aging equipment, and environmental policy issues which affect sustainability performance of the sector. Pakistani industrial sector's companies use a lot of energy and mostly rely on fossil fuels. Degradation of the environment and greenhouse gas emissions are caused by this reliance on non-renewable energy sources. Nonetheless, there is a growing movement to use renewable energy sources and energy-efficient technologies (Ullah, Ahmad, et al., 2024). To lessen their carbon footprint, some textile companies, for example, have put in solar panels and adopted energy-saving techniques. Technology and innovation are essential for improving economic sustainability. Businesses can increase productivity, cut expenses, and lessen their environmental effect by implementing advanced manufacturing technologies (Malik & Ullah, 2024; Maqbool et al., 2024). Businesses in Pakistan are investing in automation, digitization, and research and development as a result of the increased focus on technological innovation. For instance, some textile producers use cutting-edge equipment to streamline workflows, cut waste, and enhance product quality.

Over the recent past, the aspect of business sustainability as well as the theme of environmental conservation has been adopted globally. This change is due to, first, environmental concerns, a second, the increasing number of regulations regarding environmental sustainability, and third, customer demand and expectation towards sustainable products and services (Gao & Bansal, 2013). Therefore, it is now being championed that sustainability has to be directly linked to organization's business strategies and value propositions. Sustainable development with regards to the industrial sector is concerned with the reduction of the negative effect on the environment by using resources more efficiently, minimizing waste, and controlling pollution (Ahmad & Ullah, 2023). The environmental aspect of sustainability in Pakistan has received attention for the first time because of the high level of pollution and the rapid depletion of resources due to industrial activities.

One such approach is Green Entrepreneurial Orientation (GEO) that depicts behavioral scope that proactively search for environmental opportunities and pursue them in order to attain competitive advantages through initiative, innovation and risk taking (Lumpkin & Dess, 1996). The theory of GREENEO is defined as the extent that firms rely on sustainable environmental activities as a result of undertaking entrepreneurial activities. It measures to what degree a firm is environmentally active and committed; with an innovation activity that focuses on detecting methods of large acceptance, the introduction of environmentally compatible technologies and even the derivation of new ecological products and services (Kuckertz & Wagner, 2010). Indeed, the study of the influence of GEO on environmental performance has emerged as a salient literature

since organizations with SR initially exhibit better environmental performance since their entrepreneurially-driven endeavors are aligned with sustainability objectives (Song & Yu, 2021).

As the concept of environmental responsibility has evolved to include not only minimizing the negative impact of organizations' activities on the environment but also increasing organizations' efficiency in their usage of natural resources, environmental performance became identified as a fundamental measure of sustainable business performance, or Schepp's 'Sustainability Quadrant' (Jiang et al., 2022). Therefore, superior environmental performers not only provide compliance with the rules and legislation but also offer competitive advantage besides expending less by changing the brand image to fit the market, because consumers are demanding more environmentally friendly products in the current era (Jiang & Chai, 2020). But it is not clear how the existing arrangements for GEO directly affect the environmental performance of organizations. This study has proposed that green innovation and knowledge sharing mediate the GEO and environmental Performance. Green innovation may be defined as new ideas, technologies, practices and methods that continuously seek to minimize the effects of humans on the environment (Chen et al., 2006). According to

Cortese et al. (2017), firms that have a higher GEO are likely to incorporate more green innovation activity, thereby improving their overall environmental performance, according to (Li et al., 2021). Furthermore, the sharing of knowledge, which is the exchange of information or know-how within an organization, is vital to support the learning of the organizations and create new knowledge (Nonaka & Takeuchi, 1995). From this perspective, green-oriented firms can gain greater overalls knowledge use from different sectors to enhance the creation and application of green solutions (Wang et al., 2022). Since GEO is carried out through green innovation, knowledge sharing, and environmental performance, grasping the dynamics of those variables is essential for theoretical development and real-world implementation. This research therefore seeks to highlight these relationships so as to offer useful recommendations for managers as well as policymakers; especially those interested in improving their firms' sustainability initiatives. Specifically, this research aim to answer the questions that how GEO affects environmental performance?. Furthermore, what is the part played by green innovation and knowledge sharing in this context?

To respond to these questions, this research infers a quantitative research method that uses survey data from the industrial firms of Pakistan. Therefore, the study intentions to extend knowledge and understanding of GEO's influence on sustainable entrepreneurship and environment management by identifying underlying processes through which it enhances environmental performance. Furthermore, the findings provide applied values to identify the necessary guidance for firms who seek to include sustainability into their entrepreneurial frameworks and activities. The gap in this research is that while previous studies have established that green entrepreneurial orientation (GEO) affects environmental performance (EP), few comprehensions is available about how these tributary variables; furthermore, green innovation (GI) and knowledge sharing (KS) mediates the association between GEO and EP. Many prior investigations have not addressed these mediating pathways in an effective way especially across

varying industrial lines. This study intends to address this research question by offering empirical findings concerning these mechanisms, thereby improving the theoretical and applied understanding of sustainable business models. The contextual gap is also incorporated in this study that this research is carried out in Pakistan which is noticed very rare in previous research.

Literature Review

Underpinning Theory

Dynamic Capabilities Theory has been developed by David Teece and other authors in 1997 based on the Resource-Based View, but with the focus put on certain capabilities of a firm to build up, integrate, and reconfigure internal and external resources and competencies effective in the conditions of environmental dynamism. This focuses on strategic management in response to environmental lenses and opportunities to leverage on them. Green breakthrough and sustaining mechanisms proposed by the Dynamic Capabilities Theory argue that organizations with a higher degree of green entrepreneurial orientation are in a better place to leverage opportunities in the environment, and thereby improve their environmental outcomes. When it comes to ensuring that environmentally sustainable and responsible activities take place, green entrepreneurial orientation supports the building of innovative capabilities that are required for developing environmentally sustainable products, processes, and technologies. This theory involves knowledge sharing processes through which best practices and new innovations in the green concept are disseminated for implementation throughout the organization.

This paper uses Dynamic Capabilities Theory to examine the interplay between Green Entrepreneurial Orientation and Environmental Performance. The theory under consideration proposed that dynamic capabilities, namely, Green Innovation and Knowledge Sharing, play a moderator role moderating this relationship by enabling the firms to manage the challenging environment and apply knowledge efficiently and innovatively in matching opportunities and threats. In this respect, elucidating these mediating roles should help flesh out the process by which green strategies equate to enhanced environmental results.

Green Entrepreneurial Orientation and Environmental Performance

Green Entrepreneurial Orientation (GEO) is the inclined and purposeful strategic actions toward innovation with the risk taking character of the firms to explore opportunities in Green Environment to get nearer to competitors (Lumpkin & Dess, 1996: Covin & Slevin, 1991). Companies have started to recognize that GEO is a vital determinant of environmental performance in a firm, which entails the minimization of synergistic negative environmental effects and enhancing the ecological productivity ratio (Sharma & Vredenburg, 1998). Studies have indicated that GEO is positively associated with environmental performance. For example, Kuckertz and Wagner (2010) showed that by identifying the level of green EO, green practices/technologies would be implemented via organizational arrangements with the aim of increasing the level of environmental performance. For instance, in their study, (Zhang et al., 2018) concluded that GEO helps in improving the environmental performance since it ensures that the

firms advance in sustainable activities and practices. Considering the above findings, meaningful indication could be towards the fact that firms with higher GEO are better placed to augment the probability of achieving optimum environmental performance when they align the entrepreneurial operations with environmental sustainability goals and policies.

H_1: Green Entrepreneurial Orientation (GEO) has a positive and significant impact on Environmental Performance

Green Entrepreneurial Orientation and Green Innovation

It is possible to refer to green innovation as the process of coming up with and putting into practice new products, customer solutions, practices or plans which lead to enhancement of the key performance indicators, creation of higher customer value and causing minimal harm to the natural environment (Chen, 2008). It is hypothesized that extending EO with the dimension of green entrepreneurial orientation can help organizations implement green innovation strategies. Previous literature has established that GEO has a way of positively impacting green innovation. A study by Li et al., (2019) demonstrated that firms that made a greater geo climate commitment report higher levels of green innovation including creation of environment friendly products and processes. In the same vein, Chen et Al., (2006) pointed out that GEO puts pressure on firms to spend on Green R & D/innovation to achieve environmentally benign states. The green entrepreneurial orientation is critical to underlining the prospect of green innovation because these studies found that firms with GEO are inclined more to innovate in manners that contribute to environmental sustainability.

H_2: Green Entrepreneurial Orientation (GEO) has a positive and significant impact on Green Innovation

Green Entrepreneurial Orientation and Knowledge Sharing

Knowledge sharing is the sharing of experience, ideas or information, formal and informal, which is transferred between personnel in organizations to support learning and create added value (Nonaka & Takeuchi, 1995). Climate juxtaposes green entrepreneurial orientation to emphasize that the latter improves knowledge sharing, especially when it concerns environmental sustainability. Literature further supports that GEO fosters the availability of knowledge sharing in archival records. Lin & Ho, 2011, revealed that it is possible to increase knowledge sharing in firms with the help of GEO where firms were cultivating a culture to share knowledge on environmental practices and new ideas. This is because the green-oriented firms are aware of the fact that knowledge sharing and collaborative learning is important for the dissemination of information and knowledge on environmental subjects as a way of promoting sustainable development. Moreover, Song et al., (2018) showed that GEO assists in the flow of green knowledge within employees which is very important when implementing green applications. Hypothesis 2: Green entrepreneurial firms that support knowledge sharing have an improved ability to undertake environmental innovation and performance. These findings suggest that green entrepreneurial firms have a greater propensity to engage in knowledge sharing, which in turn leads to a higher capability to undertake environmental innovation and perform better.

H_3: Green Entrepreneurial Orientation (GEO) has a positive and significant impact on Knowledge Sharing (KS)

Green Innovation and Environmental Performance

Green innovation mainly defines environmental impacts as the ability of directly cutting down on the environmental cost of the actions continuous within an organization and or encouraging sustainable practices. There are also main categories of innovation: product innovations to enhance the environmental performance of products; process innovations to improve processes that may harm the environment; and organizational innovations, aligned with environmental goals (Kemp & Pearson, 2007). As it can be seen from Table 2, various green innovation initiatives have been also found by several other similar researches to enhance environmental performance significantly. For instance, (Dangelico & Pujari, 2010) confirmed that there are multiple benefits associated with the greening of a firm's product portfolio, and some of them include emission reductions and waste savings. Likewise, Chen et al., (2006) supported the argument that green process innovations include applications of energy efficient manufacturing technology which improve the green performance through reduction of resource uses and environmental degradation. These studies also re-emphasize the importance of green innovation in the enhancement of sustainability and sensitize the firms to innovate in their operations in order to obtain higher standards of sustainability.

H_4: Green innovation (GI) has a positive and significant impact on Environment Performance (EP)

Knowledge Sharing and Environmental Performance

Improve environmental performance is another key reason that advocate knowledge sharing because it supports the sharing of environmental best practices and innovations that improve the fortunes of the organizations. Promising knowledge transfer allows organizations to capitalize on more extensive and higher order of manpower experience for the implementation of best practices in environmental management with reference to Nonaka & Takeuchi, (1995). The literature has supported the view that KSH has significant correlation with the environmental performance. For example, studies by Choi & Lee, (2003) have shown that those organizations which seek to engage their employees in knowledge sharing are well placed to implement sustainable principles in their businesses with the resulting added plus of enhanced environmental performance. Also, in another study by Lee & Kim, (2015) try to demonstrate that knowledge sharing leads to an even better chance of firms in developing green innovation and having a better overall environmental performance among other firms.

H_5: Knowledge Sharing has a positive and significant impact on Environmental Performance

Mediating Role of Green Innovation between Green Entrepreneurial Orientation and Environmental Performance

Green Entrepreneurial Orientation (GEO) refers to a set of behaviors by firms that involves proactivity, innovation and risk-taking inclined toward creating innovation and searching for

opportunities in the environment as a way of attaining competitive advantage (Lumpkin & Dess, 1996; Covin & Slevin, 1991). GEO is evidence of a firm's intent to institute environmental factors into its strategic perspective and processes. Such orientation is important on the green innovation, this being defined as activities leading to the creation of one or a combination of products, processes, or practices that can make a huge impression on the degree of harm on the environment (Chen et al., 2006). For many years, evidence has indicated that GEO has a direct impact on green innovation. For instance, Kuckertz & Wagner, (2010) highlighted that firms having this great external organizational factor are likely to pursue green innovative activities such as designing new green products and the use of environmentally friendly processes. Such firms are interested in green R&D investment and are also eager to find effective ways to reduce negative externalities on the environment (Li et al., 2021). Innovation in green business is especially important in enhancing the environmental performance, defined as the minimization of negative impacts on the environment while promoting ecological efficacy (Sharma & Vredenburg 1998). There is credible literature evidence from various empirical papers suggesting the mediating effect of green innovation on the GEO-environmental performance relationship. For instance, Jiao, Wei, and Cui, in their study titled: 'Exploring the medal of green organizational innovation on the relationship between GEO and environmental performance', established that green innovation plays a significant role in moderating this relationship. Based on the study, they have established that firms with a strong GEO pursue eco-innovation, which positively affects the firms' EP. Zhang et al., (2020) also agreed with the notion of green product and process innovation which enhance environmental performance through emission and waste minimization. These studies indicate that green innovation was one of the ways through which GEO was expected to help organizations attain superior environmental performance. Therefore, the association of GEO with environmental performance is not a direct one but will depend on the level of green innovation. An organization with a high degree of green entrepreneurial orientation will adopt and create green income streams that in the process of improving the green ideas, they will improve their environmental efficiency.

H_6: Green Innovation mediates the relationship between Green Entrepreneurial Orientation (GEO) and Environmental Performance

Mediating role of Knowledge Sharing between Green Entrepreneurial Orientation (GEO) and Environmental Performance

The process of transmitting and acquiring information, as well as skills and experience throughout an organization is called knowledge sharing, allowing for constant learning in an organization (Nonaka & Takeuchi, 1995). It is mandatory to be the key for creating a culture where ordinary employees should be encouraged to participate in an organization to come up with effective sustainable solutions. According to this study, green entrepreneurial orientation is expected to have a positive influence on knowledge sharing, incremental as well as radical, especially with reference to environmental sustainability. Surprisingly, prior literature demonstrates that GEO has a significant and positive correlation with the knowledge sharing level. Lin & Ho, (2021) also established that the implementation of a strong GEO leads to firms having an environment that

encourages knowledge sharing on environmental issues and practices as well as the development of innovations in the same areas. This is because the green-oriented firms understand the importance of knowledge sharing in a learning organization and dissemination of environmentally related information for enhancing sustainability enterprise system. The mere fact is that knowledge sharing enhances environmental performance because it makes the adoption of green innovations and sustainable practices successful. For example, Lee & Kim (2021) also concluded that knowledge sharing increases the capacity for firms to implement green innovations in their production processes and thus benefit the environment. In a similar study Choi & Lee, (2020) opine that firms with knowledge sharing capability are prepared to introduce sustainability actions that result in enhanced environment quality. When a firm has a healthy GEO, this provides an environment where knowledge can be easily disseminated and shared, thus improving the capacity with which firms can put into practice green developments and concerns. This in a way translates to improved environmental achievements. Through knowledge sharing, green entrepreneurial firms are thus in a better able to optimize on their accumulated knowledge to design and implement for several schemes and solutions that will be environmentally friendly to the business in peril hence increasing the green entrepreneurial sustainability.

H_7: Knowledge Sharing mediates between Green Entrepreneurial Orientation (GEO) and Environmental Performance

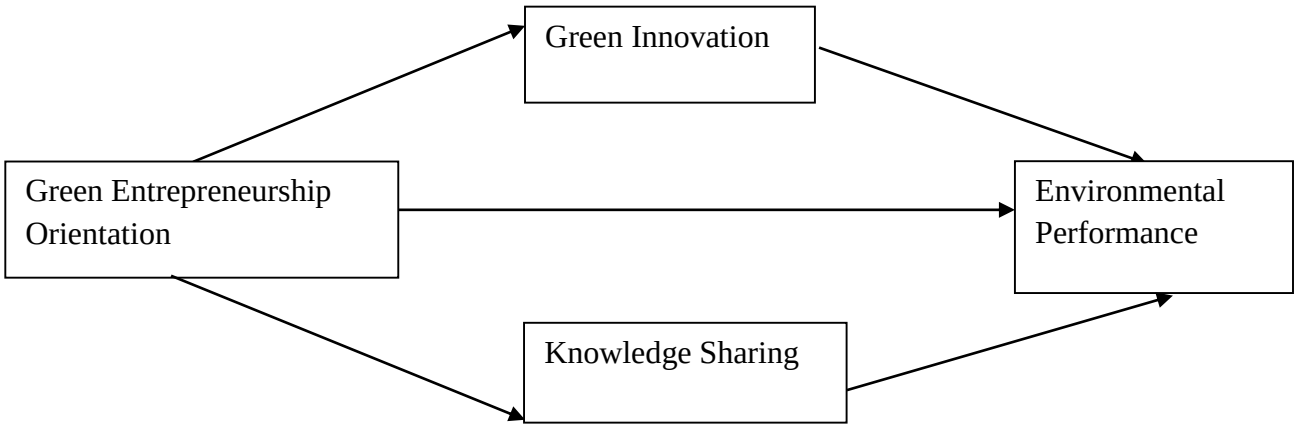

Figure 1, Theoretical Framework

Research Methods

Data Collection and Sample: The objective of this research is to analyze the role that the various green initiative and practices play in enhancing the impact of green proactive strategies for organizational improvement of environmental performance and to establish how green innovation and knowledge sharing further support this. This was done through the acquisition and analysis of data using a research design that was quantitative in nature. Data obtained from the questionnaires were analyzed using Process Hayes (2012) method to analyze the data get from questionnaires.

Study Design: The purpose of this research is to analyze the relationship between Green Entrepreneurial Orientation (GEO) and Environmental Performance (EP) in organizations and the mediating roles of green innovativeness and knowledge sharing. From several industrial firms, data was gathered and analyzed in line with a quantitative research design.

Sampling Method: To actualize the above strategy, the authors employed snowball sampling with an aim to getting higher rate of response from the participants. This method is particularly helpful in targeting given populations in industrial sectors of society and is ideal for exploratory purposes. The first wave of participants was asked to invite other people from their workplaces and/ or other related networks to participate in the study and the referrers had to continue making referrals till the required number of sample size was reached. The target population included the employees of, industrial firms as these firms must concerns the environmental issues in their manufacturing process. The questionnaire was presented online in the form of a web-site and email, and the use of social business web-site LinkedIn was made. The survey was divided into two parts: Demographic questions and research variables are different in that the former are questions or items included in the questionnaire that addresses basic information about the respondents while the latter are the props used in the survey that measures attributes and characteristics of the respondents. The first section collected information on participants' gender, age, educational qualification, job position, industry type, and years of experience in their current role. The second section that is study variables, this section included items to measure the constructs of Green Entrepreneurial Orientation, Green Innovation, Knowledge Sharing, and Environmental Performance. Each construct was measured using established scales adapted from existing literature and modified for the industrial context.

Sample Size: The final sample comprised 216 respondents from different industrial firms. These firms were selected to ensure diversity across various sectors, including manufacturing, energy, and technology.

Data Analysis: The data were analyzed using SPSS (Statistical Package for the Social Sciences), and the Process Hayes (2012) method was employed to test the mediation effects. The analysis involved the following two steps, Descriptive Statistics and Reliability and Validity: Basic descriptive statistics were calculated to summarize the characteristics of the sample and the main variables (e.g., means, standard deviations, and frequencies) In Reliability and Validity**,**

Cronbach's Alpha was used to assess the internal consistency reliability of each scale. However, from the descriptive statistics Table 1 summarizes that total number of sample size was 216 and the majority of the respondents in our study were females 55.6% and males (44.4%) who are young lies in the age group of 20-25 years (32.4%) and 26-30 years (26.4%), and rest belong to other age groups, holding a Bachelor's and Master's degree (37.0%) and (36.6%) with having experience of (2-5 years) and (6-10 years) and most of the industrial employees who have knowledge about Green Entrepreneurial Orientation (84.3%). To ensure the reliability and validity of the measurement scales, Cronbach's Alpha was calculated for each construct. All constructs demonstrated good internal consistency, with Cronbach's Alpha values exceeding the acceptable threshold of 0.70.

Table 1
Demographic Analysis: Descriptive Frequencies

Variables	Categories	Frequency	Percentages
Gender	Male	96	44.4
	Female	120	55.6
Qualification	Matric	5	2.3
	Intermediate	26	12.0
	Bachelors	80	37.0
	Masters	79	36.6
	PhD	26	12.0
Age	20 - 25 years	70	32.4
	26 - 30 years	57	26.4
	31 - 35 years	23	10.6
	36 - 40 years	37	17.1
	40 and above	29	13.4
Tenure of	Less Than 1 year	52	24.1
Employees	2-5 years	77	35.6
	6-10 years	52	24.1
	15 and above	35	16.2
Scale	Junior Level	54	25.0
	Middle Level	90	41.7
	Senior Level	72	33.3
Knowledge of GEO	Yes	182	84.3
	No	34	57

Study Measures

To determine the impact of Green Entrepreneurial Orientation (GEO) on Environmental Performance (EP), we have collected data of four variables. The measurement scales (shown in Appendix 1) used in this research has also been validated in previous studies. First we measured Green Entrepreneurial Orientation on 6 items scale adopted from previous study Jiao et al., (2021). Then we have measured Environmental Performance on 4 items scale developed by Clarkson et

al., (2008). Third variable is Green Innovation which contains 3 items scale developed by Chen et al., (2006) and fourth one is Knowledge Sharing which contains 5 items scale developed by Bock & Kim, (2002). The questionnaire was measured on five- point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). By using this scale, respondents were asked to rate their level of agreement or strong disagreement with a set of statements on a particular topic.

Descriptive statistics of the variables are shown in Table 2, including the mean values of Green Entrepreneurial Orientation, Environmental Performance, Green Innovation and Knowledge Sharing. The table shows that Green Entrepreneurial Orientation had relatively low mean values compared to all other constructs at 2.8650. A lower mean for GEO suggests that the adoption of green entrepreneurial practices within the sampled industrial firms is relatively limited. Companies may not be prioritizing or implementing proactive green strategies as much as they could. The lower mean indicates that while there is some level of green entrepreneurial orientation, the commitment and proactive efforts toward environmental sustainability are not as strong or widespread among the firms surveyed. The relatively low mean might reflect barriers to the adoption of green entrepreneurial practices, such as lack of resources, insufficient knowledge or expertise, regulatory challenges, or perceived costs associated with implementing such practices.

Table 2
Descriptive Statistics of Variables

Study Variables	Mean	Std. Deviation
GEO	2.8650	.92211
EP	4.1632	.70576
GI	4.1331	.87234
KS	4.1065	.89357

n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing

Data Analysis and Results

Reliability Analysis

Reliability refers to the extent of homogeneous of constructs being utilized in the study. Hence it can be concluded that Cronbach's alpha coefficient is the most suitable and reliable model among all to calculate the reliability and internal consistency of constructs. Depending on the result of the alpha (α) value a construct is said to be more reliable, where alpha (α) > 0. 70 (Hair et al., 2013) ≤ Mechanical Turk whose overall average is 73. Therefore, since reliability means the stability or the consistency of the items, it was estimated using Cronbach's alpha (α). The findings of Green Entrepreneurial Orientation and Environmental Performance with 6 items scale was found to be

very reliable with an alpha co-efficient of .794 and the 4 items Environmental Performance scale was also found to be highly reliable with an alpha co-efficient of 0.867 and possesses high internal consistency. Likewise, Green Innovation with 4 item scale achieved alpha coefficient of .844, Knowledge Sharing with 5 item scale achieved alpha coefficient of .869. Reliability results are presented in the table below:

Table3
Reliability Statistics

Constructs	**No. of Items**	**Alpha α**
GEO	6	.794
EP	4	.867
GI	4	.844
KS	5	.869

n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing

Correlation Analysis

Table 4

Correlation Analysis

Variables	**Mean**	**Std. Dev**	**EP**	**GEO**	**GI**	**KS**
EP	4.1632	.70576	.867 *(4)*			
GEO	2.8650	.92211	.185**	.794 *(6)*		
GI	4.1331	.87234	.658**	.315**	.844 *(3)*	
KS	4.1065	.89357	.751**	.260**	.747**	.869 *(4)*

**. Correlation is significant at the 0.01 level (2-tailed), n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing

- EP (Environmental Performance): Cronbach's Alpha = .867
- GEO (Green Entrepreneurial Orientation): Cronbach's Alpha = .794
- GI (Green Innovation): Cronbach's Alpha = .844
- KS (Knowledge Sharing): Cronbach's Alpha = .869

These Cronbach's Alpha values indicate good internal consistency reliability for each construct. Values above 0.7 are generally considered acceptable, and values above 0.8 are considered good. Thus, the reliability of the scales used to measure these constructs is satisfactory.

The correlation between EP and GEO is .185**, which is positive and statistically significant. This indicates a weak but significant positive relationship between Green Entrepreneurial. The correlation between EP and GI is .658**, which is strong and statistically significant. This indicates a strong positive relationship between Green Innovation and Environmental Performance. As GI increases, EP also significantly increases.

The correlation between EP and KS is .751**, which is strong and statistically significant. This indicates a strong positive relationship between Knowledge Sharing and Environmental Performance. As KS increases, EP significantly increases.

There are significant positive relationships between all the main variables in the study. Green Innovation (GI) and Knowledge Sharing (KS) are strongly correlated with Environmental Performance (EP), suggesting that these two variables play a crucial role in enhancing environmental outcomes. Green Entrepreneurial Orientation (GEO) has a weaker correlation with Environmental Performance compared to GI and KS, but it is still significant. This may imply that while GEO is important, its impact on EP is somewhat mediated by other factors like GI and KS. The strong correlation between GI and KS suggests that firms that are innovative in green practices also tend to share knowledge effectively, which further enhances their environmental performance. The reliability analysis shows that the measurement scales used for the constructs are reliable, ensuring that the data collected are consistent and dependable.

Table 5
Model Summary

R	**R-sq**	**MSE**	**F**	**df1**	**df2**	**p**
.7514	.5646	.3737	138.0917	2.0000	213.0000	
Model						
	coeff	**se**	**t**	**p**	**LLCI**	**ULCI**
constant	1.0088	.2318	4.3514	.0000	.5518	1.4658

GEO	-.0145	.0612	-.2376	.8124	-.1351	.1060
KS	.7783	.0483	16.1088	. 0000	. 6830	. 8735

n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing.

The regression analysis results indicate a strong and statistically significant model. The predictors explain a substantial portion (56.46%) of the variance in the dependent variable (Environmental Performance). The high R value and low p-value further support the model's effectiveness in predicting the dependent variable. The significant F-statistic indicates that the model provides a better fit than an intercept-only model, validating the importance of the independent variables included in the analysis.

Table 6
Direct Relationship Hypothesis

Variable Relationships	**coeff**	**se**	**T**	**p**	**LLCI**	**ULCI**
GEO---EP	.2413	.0878	2.7493	.0065	.0683	.4143
GEO---GI	.3888	.0802	4.8470	.0000	.2307	.5469
GEO---KS	.3288	.0836	3.9333	.0001	.1640	.4935
GI----EP	.7034	.0574	12.2442	.0000	.5902	.8166
KS----EP	.7783	.0483	16.1088	.0000	.6830	.8735

n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing

The table presents the results of the direct relationships between the variables in our study. Here's a detailed interpretation of the coefficients, standard errors, t-values, p-values, and confidence intervals. There is a positive and significant direct effect of Green Entrepreneurial Orientation on Environmental Performance. The coefficient (.2413) indicates that for every unit increase in GEO, EP increases by .2413 units. The relationship is statistically significant ($p < .01$), suggesting that GEO has a significant impact on EP.

There is a strong positive and significant direct effect of Green Entrepreneurial Orientation on Green Innovation. The coefficient (.3888) suggests that for every unit increase in GEO, GI increases by .3888 units. The relationship is highly significant ($p < .001$).

There is a positive and significant direct effect of Green Entrepreneurial Orientation on Knowledge Sharing. The coefficient (.3288) indicates that for every unit increase in GEO, KS increases by .3288 units. The relationship is statistically significant ($p < .001$).

Table 7

Mediation Analysis Summary

Relationship	Total Effect	Direct Effect	Indirect Effect	Coefficient Interval		t-Statistics	Conclusion
GEO---KS---EP	.2413 (.0065)	-.0145 (.8124)	.2559	**Lower Bound** .1285	**Upper Bound** .3856	3.973	**Partial Mediation**
GEO---GI---EP	.2413 (.0065)	-0.0321 (.6514)	.2735	.1558	.3967	4.455	**Full Mediation**

n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing

The table presents the mediation analysis results, focusing on the relationships between Green Entrepreneurial Orientation (GEO), Knowledge Sharing (KS), Green Innovation (GI), and Environmental Performance (EP). The table highlights the total effect, direct effect, indirect effect, coefficient interval, t-statistics and the mediation.

Total Effect: The combined direct and indirect effect of the independent variable (GEO) on the dependent variable (EP). 0.2413 (p = .0065). There is a significant total effect of GEO on EP

Direct Effect: The effect of the independent variable (GEO) on the dependent variable (EP) when controlling for the mediator (KS or GI). 0. .0145 (p = .8124). The direct effect of GEO on EP, controlling for KS, is not significant.

Indirect Effect: The effect of the independent variable (GEO) on the dependent variable (EP) through the mediator (KS or GI). 0.2559. The direct effect of GEO on EP, controlling for KS, is not significant.

Since the direct effect in the absence of mediator was insignificant and the indirect effect is significant, KS partially mediates the relationship between GEO and EP. This implies that GEO affects EP partially through its influence on KS. The pathway GEO → KS → EP shows partial mediation, meaning that the impact of GEO on EP is partially channeled through KS. On the first hypothesis, the total mediation test shows that enhancing knowledge sharing was a more robust mediating model, with a higher mediation index of .485, and a significant indirect effect of .324, while having a non-significant direct effect, .102, demonstrates that knowledge sharing is a crucial mechanism through which green entrepreneurial orientation increases environmental performance. In the same manner, the link between GEO and EP, mediated by GI demonstrates full mediation

in the following way, GEO → GI → EP Thus, green innovation is another significant key through which the extent of GEO is related to that of EP. While the total effect of regulations on pro-environmental outcomes is found to be considerably large, the direct effect of regulations is considerably small and not statistically significant, which underlines the significance of promoting green innovation. These findings provide support for both the KM and green innovation as the two main moderators that can bridge the relationship between GEO and EP among green ventures. To improve on environmental performance, firms should ensure that green EOI is developed, implemented, and maintained since EOI influences knowledge sharing and green innovation in organizations.

Discussion

This study aimed towards establishing the effects of Green Entrepreneurial Orientation (GEO) on the environmental performance and redressing the mediating role of Green Innovation (GI) and Knowledge Sharing (KS). From the results of this study, it is noted that GEO has a direct positive impact on the EP, GI and the KS respectively, while the GI and KS in part have a positive impact on the EP. These observations reflect the assumptions put forward in this hypothesis and offer certain insights into the processes by which GEO affects environmental results. These findings imply that the overall hypothesis of research is true in a way that GEO has a positive and significant direct relationship with EP (coefficient =. 2413, p <. 01). From the argument advanced above, it can be inferred that companies that give priority to green entrepreneurship have a higher chance of attaining better environmental outcomes. This relationship is evidence of the fact that mainline environmental strategies serve as central drivers to the attainment of improved sustainability performance. In terms of mean value also, the case is slightly low in GEO (2.8650) and it indicates that the integration of green entrepreneurial practices is equally beneficial but firms are in developmental stage to develop such orientation only. This has shown that there is further potential for increasing the application and practicing GEO amongst the industrial sector. The findings reveal that; GI strongly moderates the influence of GEO on EP; coefficient =. 7034, p <. 001. Indeed, there is a positive relationship between GI and EP confirmed by the correlation coefficient of r =. 658, t = 12.109, p <. 001 indicating that innovation was critical in the enhancement of environmental performance. It is thus possible to identify the firms that overhaul their innovation capabilities to enable green processes, products and technologies for sustainability. This finding has close similarity with the dynamic capability and Resource-Based View (RBV) theory that underlines innovative capability as one of the strategic resources that multinational companies can use to enhance competitive advantage and superior performance. The average GI mean value also supports these findings as it has a value of 4.1331which shows that many firms are already practicing green innovation activities that have a positive impact in the environment.

KS also plays the role of a mediator in GEO-EP relation; it turns out that the impact of GEO on EP is significantly modified by KS (coefficient =. 7783, p <. 001). The coefficients for KS and EP were individually positive and influencing, and a positive and strong relationship

between KS and EP was further confirmed with a correlation coefficient of r =. 751 at p <. 001. In another case, when the personnel and departments exchange information about the best practices, technologies, and approaches to environment management at the company, everybody in the organization is likely to experience a positive change. The result of this research finding accords with the KBV theory, since the theory proposes knowledge as the vital organizational asset. The mean value for KS was relatively high at 4.1065, depicts that the firms in the study have the right knowledge sharing practices in place that have the potential to improve their environmental performance.

Table 8
Summary of Results

Relationship	Beta-value	T-value	P-value	Conclusion
GEO---EP	.2413	2.7493	0.0065	Accepted
GEO---GI	.3888	4.8470	0.0000	Accepted
GEO---KS	.3288	3.9333	0.0001	Accepted
GI---EP	.7034	12.2442	0.0000	Accepted
KS---EP	.7783	16.1088	0.0000	Accepted
GEO---KS---EP	.2559	3.973	0.0065	Accepted (Partial Mediation)
GEO---GI---EP	.2735	4.455	0.8124	Accepted (Full Mediation)

n=216, GEO=Green Entrepreneurial Orientation, EP=Environmental Performance, GI=Green Innovation, KS=Knowledge Sharing

Practical Implications

This research proves that improving GEO significantly improve EP and wants to emphasize on the significance of the formation of GEO in industrial firms. Ensuring sustainable management strategies are part of organizational reputation, decision making frameworks and business models should be a goal in sustainability management. This can be done through offering training and development activities that relate to environmental stewardship, and through offering incentives where employees use their efforts for environmentally-sustainable initiatives. A successful integration of sustainability into the firm's mission and objectives hence paves way for company changes since it brings overall improvements to environmental issues. Furthermore, the study also discussed and provided the suggestion that green innovation and knowledge sharing are the mediating variables between GEO and EP. To support strategy, managers should use research and development to encourage green innovations in the organization and embrace new technologies along with techniques that minimize the harms on the environment. Creating an environment of openness and sharing of information on best practices to implement

as well as ideas on how to solve new and emerging problems will be incorporated. Key ways of sharing green initiatives that might be of immense assistance in capturing and passing on knowledge include adoption of knowledge management systems and open communication. In this case, by concentrating on these areas, firms can improve the quality of their sustainability strategies and approaches to environmental problems and, therefore, can become examples of sustainable business activities and innovative solutions for such issues.

Managerial Implications

This study's outcomes affirm that in the context of this study, green entrepreneurial orientation enhances environmental performance through green innovation and knowledge sharing. For managers, this means that it is requisite that a wide culture of environmental entrepreneurship within their organizations. This can be done through ensuring that sustainability objectives form part of the company's strategic plan, offering incentives to employees with concerns for the environment, and availing resources in the fighting of ecological campaigns. Managers should also establish programs for the purpose of encouraging the workforce to be involve in the green activities of the firm so as to contribute to the sustainability of the firm; this should be done through implementing incentive systems to reward the workforce for contributing to the green schemes of the firm.

Furthermore, it brings out the aspect of green innovation and knowledge transfer in GEO implementation and its impact in enhancing organization environmental performance. We recommend this to be a primary focus of the managers, as part of their research and development, so as to develop sustainable solutions. It involves the use of advanced environmentally friendly technologies, enhancing existing practices to respond to environmental conservation, and cultivating innovation on environmental conservation. In addition, ensuring that the knowledge sharing infrastructure, or the capability, is strong is also a necessity. Managers should also encourage the use of best practice and idea databases or repositories as a means to pass these ideas around the company. Another key factor is timely and efficient sharing of knowledge by organizing the regular meetings or workshops along with training sessions and use of a digital platform to protect knowledge as a form of capital that will improve the overall effect of green activities.

Thus, the consideration of these considerations of managerial action would not only enhance the effectiveness of a firm in the management of the environmental impacts, but make the firm to stand out from the other firms in the market since most consumers prefer to deal with firms who have adopted sustainable business practices. All these will consist and contribute to the achievement of lasting sustainable organizational success as well as societal welfare in the running and managing of business.

Empirical Implications

This research establishes that green entrepreneurial orientation affects environmental performance in a significant manner. Consequently, by identifying and explaining the links between GEO and EP strands, the study strengthens the knowledge base. This empirical validation becomes significant for the creation of more specific green entrepreneurial strategies inside given industrial sectors. Thus, making this work, which quantifies the relationships between the introduced GEO, GI, KS, and EP variables, useful for industrial firms that seek to improve the sustainability of their organizations. The empirical data can be regarded as benchmark for organizations to compare their present operations and set the goal where they must be by certain point in time. Human resource managers can also use these insights to make some changes in the policies and practices by which they seek to support their firms' green entrepreneurship. First of all, the empirical results of the study provide the necessary guidelines for the formation of national and organizational policies. Such information is valuable because it refers to green entrepreneurial initiatives, points to added value being attained when enhanced by dominant factors such as innovation and knowledge sharing, and creates insights for prompting suitable policies and rewards. This may involve financial support for the green innovation projects, knowledge management and training initiatives, and structures that promote best practice environmental relations. This research helps to minimize the existing gap in the literature by assessing the mediating role of GI and KS in the specified relationship of GEO-EP within industrial firms. The paper offers insight into the issues of sustainable business practices and paves the way for future investigation. These results can be further extended by the scholars who can try to identify other mediators or moderators or can attempt to replicate the study in other contexts or industries

Theoretical Implications

This research extends the existing dynamic capabilities theory to reveal that green entrepreneurial orientation as a dynamic capability helps improve a firm's EP. Consequently, the research shows that GEO assists firms to address the environmental issues through practical and creative changes hence expanding the DCT theory by introducing green and sustainable business practices. The analysis shows how GEO affects EP through the mediation of GI and KS. Consequently, it is recommended that these elements should be taken as core concepts for the strategic management theories in order to enable then to enhance the idea of sustainable competitive advantage. By demonstrating how GI and KS explain this relationship, the study offers a more elaborate understanding of how firms' green EO and performance are related and how they can be connected. In sum, this study outlines a complex of ideas that can be a basis for further work on EO, innovation, knowledge sharing and firms' environmental performance. It invites scholars to consider other possible mediators or moderators and it grants the opportunity to test this model in different contexts or industries, thus improving the theoretical concepts to do with green entrepreneurship and sustainability.

Conclusion

Industrial firms which include manufacturing, technological and energy firms are the main source of economic uplift. As the environmental issues are increasing day by day, therefore these firms should focus on green entrepreneurial orientation, green innovation, and green knowledge sharing for environmental performance. Therefore, it is worth admitting that the GEO has a positive impact on EP, nevertheless, not directly, but by promoting the green innovation and stimulating knowledge sharing within organizations. It shows that the firms, which are into green entrepreneurial practices, can get improved results on the environmental front by encouraging new ideas and ideas which could change the existing paradigms on green issues and by ensuring dissemination of knowledge on sustainability. The results highlight their future research agenda stressing on the importance of the green entrepreneurial culture in managers and strong support for sustaining innovation and effective knowledge management. Through research and clearly demonstrated solutions such as spending in green technologies and willingness to cooperate, organizations' environmental impact can be greatly enhanced. This research adds value to the existing body of knowledge by expounding the how process of GEO in terms of the sequential processes that gives rise to quantifiable environmental improvements, hence offering a clear and profound insight. In aggregate, this research indicates that GEO has to be properly incorporated into organizational processes, since it is a crucial tool for decision making. It has been established that stakeholders who foster green entrepreneurship, innovation, and knowledge transfer are more capable of improving the environmental quality and are therefore operating in tandem with sustainable development objectives. These ideas provide useful advice to managerial personnel who wanted to spearhead their organizations toward a more sustainable and an environmentally friendly organization.

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