Green Knowledge Management as a Predictor of Green Innovation in Cement Industries: the role of Green Innovation Culture

Mr. Supuspa Bhattarai[1]

Abstract

The purpose of this research paper is to reveal the relationships among green knowledge management, green innovation, and green innovation culture. These relationships were assessed using correlation analysis and hays process macro. Data were gathered from full-time cement factory employees having designations officers and above (N: 260) in the Lumbini Dhakdhai industry corridor region of Nepal. The results indicate that green knowledge management has a positive effect on green innovation and green innovation culture. Accordingly, green knowledge management is an important determinant of green innovation and green innovation culture. In addition, green innovation culture acted as a complementary partial mediator of the effects of green knowledge management on green innovation. Specifically, green knowledge management predicted green innovation, which in turn predicted green innovation culture. Finally, considering that causal studies on green knowledge management, green innovation and green innovation culture in the cement industry are limited, this study may contribute to understanding how green knowledge management affects green innovation in the cement industry.

Key words: Green Knowledge Management (GKM), Green Innovation (GI), Green Innovation Culture (GIC)

I. Introduction

The industrial revolution of the 19th century helped millions of people escape poverty. However, this prosperity has unintentionally led to the depletion of the environment's resources (Abbas & Dogan, 2022). Natural resources and their susceptibility to the effects of global warming threaten the growth of the economy of emerging regions (Alkaraan et al., 2022). Over the years, authorities from all over the world have been eager to create standards and regulations for products and services that are almost environmentally safe (Kumar & Barua, 2022).Governments were asked to create reasonable targets for lowering greenhouse gas emissions by COP 26. (UNCOP26, 2021; Wyns & Beagley, 2021). The United Nations also introduced the Sustainable Development Goals (SDGs) to protect and improve society and the environment (UNDP, 2021). Businesses started appreciating the importance of a green environment as a result, which motivated them to concentrate on rethinking their operations and management structure (Ahmed et al., 2022). Dynamic firms regard using knowledge, quality, and environmentally friendly methods as competitive advantages in today's corporate environment (Al-Qudah et al., 2022).

Mr. Supuspa Bhattarai is an assistant professor at Lumbini Banijya Campus. He can be reached at bhattarai.supuspa@gmail.com .

Success or failure of a business is correlated with its capacity to acquire and retain knowledge (Zhang et al., 2022a). Organizations use knowledge to boost customer satisfaction and gain an advantage over rivals (Mohan et al., 2022). Knowledge

management (KM) has become increasingly popular with businesses over the past few years. It has been viewed as being an essential element in developing strategies, coming up with new goods and services, and managing operational procedures (Pham et al., 2022). An efficient KM system can increase an organization's productivity (Ahmed et al., 2022). Dynamic businesses have, however, broadened the scope of knowledge management and begun incorporating the environment into it in light of the environmental challenges (Ahmed et al., 2022).According to Yu et al. (2022), green knowledge management (GKM) has become a crucial strategic resource for many companies, giving them a competitive advantage in achieving the Sustainable Development Goals (SDGs) of the UN (Dang &Wang, 2022).

An innovative approach to knowledge management (KM), known as "green knowledge management" (GKM), aims to include environmental or green factors into all facets of KM. How GKM practices effect corporate green performance and how they can assist the environment is one of the essential criteria for a firm commitment to GKM. Eco-friendly methods and information are available to all parties in the present worldwide economy, as advised by the United Nations, beyond a single organization (UNDP, 2021).Green innovation (GI), a crucial component of sustaining environmental management (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013; Arenhardt et al., 2016; Chen, 2008; Chen et al., 2012; Yang et al., 2016), is crucial for organizations and communities. Investigations in this area have primarily seen an upward trend in recent years.Furthermore, environmental deterioration is becoming a serious threat to human survival. Many groups and communities have turned to GI as a means of achieving environmental conservation and economic development. In addition to being extremely important, economic profitability and environmental sustainability are also very important (Fliaster & Kolloch, 2017). GI can guide firms toward achieving sustainable competitive advantages (Hur et al., 2013). GI is now a crucial instrument that companies may use to grow their market share and sustain themselves over time. A successful GI enhances the market position, draws clients, offers eco-friendly services, and gains a competitive edge. Due to these advantages, GI is a topic of discussion among researchers and administrators of numerous enterprises.

Examination of the management literature reveals a rise in interest in green innovation and associated ideas such as environmental innovation, sustainable innovation, and eco-innovation (Tietze et al., 2011). Product and process innovation are both aspects of green innovation. It focuses on enhancing product design and implementing industrial procedures that conserve energy, reduce pollution, and take environmental impact into account (Woo et al., 2013).

Given the foregoing explanation, the current study seeks to ascertain:

- The impact of green knowledge management on the green innovation ability of firms.
- The mediating role of green innovation culture in the relationship between green knowledge management and green innovation.

Academics and academicians in the related field, cement industrialists, ecologists, environmental pressure groups, and other interested parties will be better prepared to employ green innovation and green innovation culture to advance ecological sustainability objectives by leveraging the GKM system as a consequence of this research. The study's theoretical underpinnings are discussed in the following parts, which are followed by discussions of the literature, the methodology's explanation, data analysis, and findings, a discussion of the results and their implications, and a conclusion with suggestions for further research.

II. Review of Literature

The "theory of knowledge management" and the "green theory" are the foundations of the current research. Knowledge is a concept that exists outside of the physical world and can be categorized into two types: tacit knowledge and explicit knowledge (Abbas & Kumari, 2021). Tactic knowledge is knowledge that people have but does not have a record of (Maravilhas & Martins, 2019). It is acquired through experience and social engagement with others. Compared to explicit information, tacit knowledge is more difficult to communicate to others because it is not written or spoken (Naqshbandi & Jasimuddin, 2022). Knowledge that has been expressed, articulated, shared, and codified is explicit and often recorded in manuals, books, and reports (Aamir et al., 2021; Zhao et al., 2022). Yang (2008) described KM as transforming implicit and explicit kinds of knowledge to enable seamless knowledge transfer inside an organization.In recent years, the debate on environmental issues has attracted much attention. Ecologists deserve credit for their ongoing efforts to raise awareness of dwindling natural resources (Kumar & Barua, 2022)and the damage done to the natural environment by the rapid resource consumption of corporations worldwide (Lehmann et al., 2022).Improved environmental information has increased pressure from stakeholders on the business community to protect non-human nature and integrate environmental concerns into their operations and human societies (Abbas, 2020a). With the publication of the report of the Brundtland Commission of the United Nations (UN, 1987), companies have started to shift their focus towards sustainable development. They try to integrate knowledge about nature and society into new concepts and theories (Songet al., 2020). Green knowledge is not just about information about a natural state; there is a wide range of how we should respond to this situation and consider a more sustainable environmental, social and economic development path.

Green knowledge is necessary for both a person's and an organization's creative green performance, according to Wang et al. (2020). Additionally, consumers' interest in green learning influences businesses to get new eco-knowledge, which in turn generates fresh concepts, ideas, and solutions that eventually result in novel goods, innovations in technology, and new services. A company must implement GKM as a system and involve all stakeholders if it wants to get the most value out of it. This will allow decisions to be made on what to keep, reject, and enhance.According to the literature review, GKM may be thought of as a system made up of five parts: green knowledge acquisition, green knowledge storage, green knowledge sharing, green knowledge application, and green knowledge creation. A company's acquisition, extraction, and organization of knowledge pertaining to environmental protection is referred to as "green knowledge acquisition" (Aboelmaged & Hashem, 2019). Consequently, ecological resources and technology can be improved to safeguard the environment (Wang et al., 2020). People can learn from both internal and external sources and apply it to various problems. However, Abbas and Sagsan (2019) assert that the majority of employees learn from coworkers and team members (internal sources). The appropriate authorities are instantly informed of the gained knowledge, or it is preserved for later use. The literature that is currently available makes it clear that when businesses learn by developing or obtaining knowledge, they also forget it because they lose track of some crucial components (Maravilhas & Martins, 2019). Because of this, businesses need a reliable system for organizing and storing knowledge so that it may be quickly accessed for use in the future. This phenomenon has been referred to in some research as organizational memory, which is crucial to good knowledge management (KM), like Zbuchea et al. (2019).

Green knowledge management and green innovation

The relationship between knowledge and innovation is enduring (Pineiro-Chousa et al., 2020). Green innovation can lessen or even eliminate the damaging effects that business operations have on the environment (Ahmed et al., 2022). Reduced resource consumption,

waste management, recycling promotion, and pollution reduction are some SDGs (UNDP, 2021). Environmental science and technology can be used by GTI to enhance or develop new goods or procedures (Lv et al., 2021). Additionally, it can lessen how much an organization's operations affect the environment (Rehman et al., 2021). GTI is broken down into two subcategories: innovation in green processes and innovation in green products. Making raw materials more effectively transform into useable products is the goal of innovation in green processes (Shahzad et al., 2020). Additionally, it attempts to reduce waste production, employ more renewable resources, and protect natural resources (Awan, 2020; Kumari et al., 2021). By adding renewable or non-toxic materials into current products or creating wholly new ones, green product innovation seeks to minimize the negative environmental effects of the manufacturing process (Qu & Liu, 2022; Zhang et al., 2019).

According to Chaithanapat et al. (2022) "GMI" refers to a business adopting a new management model or strategy to enhance its manufacturing processes. Businesses can benefit financially while reducing their environmental effect through GMI (Naqshbandi & Jasimuddin, 2022). Businesses can meet GMI objectives by implementing environmental management systems and procedures like ISO 14001. Companies who pioneer GTI and GMI typically see a rise in customer trust, loyalty, and profitability (Rehman et al., 2021). Businesses that are knowledge-focused are concerned about maximizing resource usage and reducing environmental effect (Muoz-Pascual et al., 2020). Regular consideration is given to how these businesses' operations affect the environment, and they also support and facilitate the creation of green products (Fu et al., 2022; Naqshbandi &Jasimuddin, 2022).Knowledge management underpins research and analysis and is crucial to the innovation process (Chaithanapat et al., 2022). Green knowledge improves organizational environmental performance (Gauthier & Zhang, 2020). Additionally, innovative activities mediate the link between organizational success and social sustainability, according to Guerrero-Villegas et al. (2018). Governments should aid companies in producing high-quality goods and services while utilizing the fewest amount of natural resources possible, according to Azhar & Yang (2021).Dynamic businesses provide mechanisms, such as infrastructure, resources, and information, that enable staff to produce knowledge and novel ideas in order to promote the production of new knowledge (Gauthier & Zhang, 2020; Habib et al., 2019). Environmental considerations must be incorporated into organizations' research and development efforts if they want to keep up with changing market needs (Abbas & Dogan, 2022). They must take part in initiatives that support the creation of high-quality goods using little resources, which are advantageous for the firm and the environment (Song et al., 2022). The following hypotheses are put out in light of the foregoing discussion of GKM and green innovation:

H1: Green knowledge management positively impacts green innovation.

Mediating role of green innovation culture

A company is said to have a "green culture" if its employees go above and beyond the goals of generating a profit to lessen its negative environmental effects (Sroufe et al., 2010). Therefore, a "green" innovation culture can be defined as an organization's employees' attitudes and actions toward enhancing the environment. Outstanding results can be reached not only by reworking the production process, goods, or raw materials, but also by working on the corporate culture in a way that the company has a sufficient attachment to sustainability, according to a solid foundation in (EM) Environmental Performance research.

Green innovation, also known as eco-innovation, focuses on eco-design, waste prevention and recycling, and energy conservation. According to Chen (2008) and Chiou et al. (2011),

green innovation has become a crucial strategy for high tech companies to achieve sustainability as a response to the current trends in environmental awareness, pressure from regulatory bodies and environmentally conscious consumers, and extensive engagement on (EM)Environmental Performance (Cai & Zhou, 2014). Green innovation is being used in research today to demonstrate what firms should do to achieve sustainability and maintain their competitiveness. Regardless of whether the effect was predicted, a green innovation is one that promotes environmental sustainability (Cai & Zhou, 2014).Businesses should advance their quest for sustainability by adhering to global ecological conventions and implementing new technical advancements in a way that fosters green innovation (Chiou et al., 2011). According to a recent study by Guo et al. (2020), green innovation was crucial to the organization's performance in terms of sustainability.Green innovation and sustainability have a beneficial link, according to a study by Saunila et al. (2017). Cai and Li (2018) contend that a firm's green innovation is influenced by both internal resources (HR included) and external pressures. In order to preserve the environment at any point in a product's life cycle, green innovation comprises developing green products and green processes that change the present product design.Green process innovation relates to energy conservation, pollution prevention, and waste recycling (Chen, 2008). According to Eisenhardt and Martin (2000), innovation is seen as a key component that increases the firms' capacity to keep a competitive edge. Green innovation includes both product and process innovation. It focuses on enhancing product design and implementing industrial processes that are energy-efficient, environmentally conscious, and responsive to the firm's level of pollution. The (EP) environment performance factor is a top priority for the management of the majority of businesses since they want to adhere to regulations and even appeal to the general public in order to get a competitive edge (Ali et al., 2019). Environmental degradation drives green product and process innovation, which also gives businesses a competitive edge (Chiou et al., 2011). Management teams create a similar set of ideals, principles, and values known as a "organizational culture" in order to influence organizational behavior and attitude toward accomplishing common corporate goals (Al-Swidi et al., 2021; Wang, 2019). An organization's green culture (OGC) can be characterized as one in which environmental preservation is valued highly. Thus, the mission statement of the company incorporates an employee value, making each team member feel accountable for the preservation of the environment (Abbas & Dogan, 2022). Employees are more concerned about environmental issues as a result of green culture, which benefits their job (Lee et al., 2022). Managers must display greater care for environmental protection if they want green culture to grow (Azhar& Yang, 2021).

Establishing a green culture inside a company fosters innovation and challenges the status quo (Cherian et al., 2021). Additionally, a strong green culture encourages workers to critically consider environmental challenges (Azhar & Yang, 2021). Eco-environmental principles, the cornerstone of a formal framework for green culture, can aid a company in implementing changes to its operations that are more environmentally friendly (Tahir et al., 2020). Through a company's green organizational culture, a pro-environment strategy can be transformed into green innovation (Cherian et al., 2021). On the other hand, businesses addressing environmental challenges might benefit from a green corporate culture (Al-Swidi et al., 2021). The capacity of an organization to absorb green waste increases its capacity to execute green innovations (Naqshbandi & Jasimuddin, 2022). Employees are more concerned about the environment when they work in a green atmosphere (Abbas & Dogan, 2022). Data show that an organizational green culture influences team members' attitudes and behaviors in a positive way toward environmental protection (Azhar & Yang, 2021; G€urlek & Tuna, 2018), which may further drive an organization's employees to protect the environment. As a result, employees will be more worried about the environment the more environmentally conscious the company's culture is. According to academics, businesses

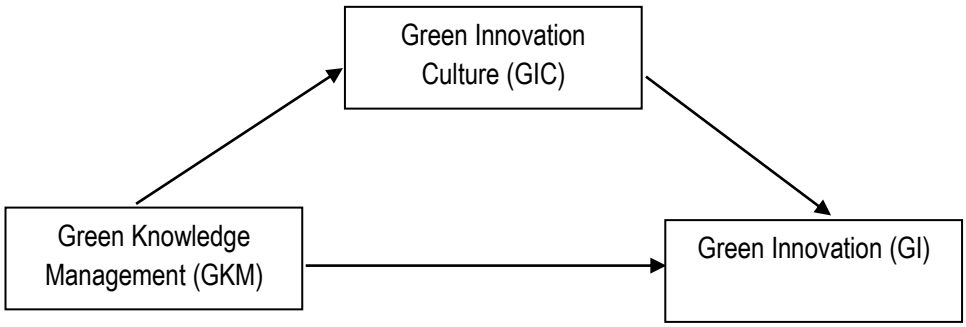
must adopt green organizational culture ideals in order to generate eco-friendly products (Banerjee et al., 2003). This study uses green culture as a mediating variable for defining the boundaries between GKM and green innovation because of the significance of culture and its influence on organizational activities. It asserts that because green culture is the boundary condition, the relationship between the stated variables is strengthened. Consequently, the following hypothesis is put forth:

H2: Organizational green culture mediates the relationship between green knowledge management and green innovation.

The current study asserts that an organization's ability to take advantage of green knowledge enables it to deliver environmentally friendly goods and services through green innovation, thus enhancing its environmental performance. An organization is more likely to innovate and take green actions the more successful its GKM system is. These actions are closely related to fulfilling sustainability objectives, which is the essence of the green theory (see Fig. 1).

Fig 1

Research Framework



III. Research Methodology

Target population and sampling procedure

The focus of this study is on cement manufacturing firms in Lumbini and Dhakkdai corridor region of Nepal. Implementing a non-probability convenience sampling technique collected the information from 14 companies' officers, managers and general managers and so on and so forth via personal visits on a 5-point Likert scale. Only those in directly involved in production and management positions could provide information because they have adequate and up-to-date knowledge of its policies and practices. Moreover, organizational policies are communicated and enforced within departments by managers. A total of 293 questionnaires were distributedi.e. the whole population number as was small therefore all the population participants were distributed the questionnaires. For collection of questionnaires a gap of 10 to 15 days were kept but at the end only 260 participant's responses were collected. In addition, 260 were all men participated in the study as there were no female employees working during the study period. The detailed demographics of the survey participants are shown in Table 1.

The measurement instrument

The measurement instrument was divided into four sections. The first section of the questionnaire contained demographic data about the participants. Green knowledge management (GKM) was measured using 26 items adapted from Yu et al. (2022). Green innovation (GI) practices of firms were measured using 10 items taken fromKammerer (2009)and Murphy and Gouldson (2000). Six items from Chen et al. (2006)studies were used in the fourth section, which dealt with two aspects of green innovation culture, i.e., green product innovation culture (GPIC) and green process innovation culture (GPRI). All of the components in the pilot survey had internal consistency scores between 0.827 which satisfied the 0.7 criterion established by Hair et al. (2010). On the basis of this, the researcher started an extensive investigation.

Tools for Analysis

SPSS version 20.0 is used for the data analysis. Statistical tools including frequencies, percentage, mean, standard deviation, linear regression, and regression by process macro have been used as developed by Andrew F. Hayes to tabulate and analyze the quantitative data. Based on a model developed for analysis by Hair et al. (2009), the examination of mediating influence is conducted.

IV. Results and Analysis

Table 1 depicts the demographic profile of the respondents, which includes information of age groups, gender, marital status, designation, experience and educational qualification. As the age of respondents is concerned, 1.2% of the respondents are 25 and younger, 22.7% of the respondents are between 26-35, 35.8% of the respondent are between 36-45 and 33.8% of the respondents are between 46-55 and 6.5% of the respondents are 56 and above. Gender wise, 100% of the respondents are all male and 0 % is female. Similarly, education level of 17.7% of the respondents isintermediate, 49.2% of respondents are under-graduate and master's level is 33.1%. Likewise, 93.1% of the respondents are married and remaining 6.9% are unmarried. Moreover, 4.2% of respondents has experience of under 2 years, 21.5% of employees has experience of 3-10 years, 21.5% of employees has experience of 11-20 years, 18.5% of employees has experience of 21-30 and 3.5% of employees has experience of 31 years and above. Finally, 5% of respondents are general managers (GM), 6.9% of respondents are deputy general managers (DGM), 23.1% of respondents are Manager/In-charge/HOD, 32.3% of respondents are Officer/Engineer, 7.3% of respondents are chief chemist 6.9% of respondents are Chemist/Lab Officer, 6.9% of respondents are Chemist/Lab Officer, 9.2% of respondents are Foreman/Storekeeper and 9.2% of respondents are supervisor.

Table 2 shows the regression effect of green knowledge management on green innovation. Based on the coefficients table, since the p value is less than 1% i.e. ($p<0.001$) it can be said that there is significant impact of green knowledge management on green innovation which supports the hypothesis formulated above as H1. Furthermore, since R square calculated is 0.158 it can be said that green knowledge management explains green innovation by 15.8%.

Table 1

Respondents' Demographic Profile

Attributes	Items	Response	Percentage
Age	25 and Younger	3	1.2
	26-35	59	22.7
	36-45	93	35.8
	46-55	88	33.8
	56 and Older	17	6.5
	Total	260	100
Gender	Male	260	100
	Female	0	0
	Total	260	100
Marital Status	Married	242	93.1
	Unmarried	18	6.9
	Total	260	100.0
Education	Intermediate	46	17.7
	Bachelors	128	49.2
	Masters	86	33.1
	Total	260	100.0
Experience	Under 2 Years	11	4.2
	3-10	56	21.5
	11-20	136	52.3
	21-30	48	18.5
	31 and Above	9	3.5
	Total	260	100.0
Designations	GM	13	5.0
	DGM	18	6.9
	Manager/Incharge/HOD	60	23.1
	Officer/Engineer	84	32.3
	Chief/Chemist	19	7.3
	Chemist/Lab Officer	18	6.9
	Foreman/Storekeeper	24	9.2
	Supervisor	24	9.2
	Total	260	100.0

Regression

Table 2

Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.398[a]	.158	.155	.29081

a. Predictors: (Constant), Green Knowledge Management

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.109	1	4.109	48.591	.000[b]
	Residual	21.819	258	.085		
	Total	25.928	259			

a. Dependent Variable: Green Innovation

b. Predictors: (Constant), Green Knowledge Management

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.290	.255		8.986	.000
	Green Knowledge Management	.430	.062	.398	6.971	.000

a. Dependent Variable: Green Innovation

Mediating role of green innovation culture

The mediating effect of the GIC was analyzed by following the two-step procedure, which is proposed by Hair et al. (2016). In the first step, this study assessed the indirect effect of GKM to GI through GIC. Further, in the second step, we evaluated the direct impact of GKM on GI without the removal of the mediator (GIC). The study assessed the mediating role of green innovation culture (GIC) on the relationship between green knowledge management (GKM) and green innovation (GI) based on Hair et al. (2016) the two step procedure. The results revealed a significant indirect effect of impact of GKM on GI (b=.0619, t=6.1888). Furthermore, the direct effect of GKM on GI in presence of the mediator was also found significant (b=.3677, p<0.001). Hence, GIC partially mediated the relationship between GKM and GI. Moreover, we observed the positive sign of these indirect and direct effects; it might be concluded that GI has complementary partial mediation. Thus, H2 is supported by complementary partial mediation. Mediation analysis summary is presented in Table 3.

Table 3

Mediation Analysis

Relationship	Total Effect	Direct Effect	Indirect Effect	Confidence Interval		t-statistics	Conclusion
				Lower Bound	UpperBound		
GKM->GIC>GI	.4296	.3677	.0619	.0227	.1101	6.1888	Partial Mediation

V. Discussion

This study looked at how GKM affects GI and clarified the practices of GIC in achieving GI in the cement sectors, which strive to remain competitive in the face and times of evolving innovative processes. The results ofthe present research exposed that GKM has a positive impact on GI, and GIC has a partial moderating effect in the relationship between GKM and GI. With b 0.430 and 0.000 p-values, a substantial impact of GKM on green innovation was discovered. This backs up the findings of Song et al. (2020), who asserted that a company's capacity for resource management and environmentally friendly innovation is supported by green knowledge. This means that an organization's capacity for managing green knowledge is closely correlated with its capacity for green innovation; the better an organization can manage green knowledge, the more effective it will be able to innovate green. Through green innovation, businesses can reduce the damaging effects of their activities on the environment. However, in this regard, they must give managing green knowledge, including its production, application, and sharing, considerable attention. Similarly, the findings of this study correlate with the findings of the research conducted by Wang et al. (2022) where GKM was considered significant for the development of a green theory which ultimately will help in the creation of green innovation in firms.The research finding on the mediation analysis revealed that GIC partially mediates the relationship between GKM and GI. The findings of the study correlate with the findings of Muisyo& Qin (2021),who found that culture strengthens the relationship between the said variables i.e. green human resource practice and green organizational performance. Thus, it is fair to mention that green culture adequately facilitates firms to enhance their performance concerning green innovation by strengthening the relationship between GKM and green innovation.

VI. Conclusion and Implications

The current study concludes that green knowledge management is very important for green innovation in cement industries. Firstly, in order to promote green knowledge management with organization cement firms they have to focus on knowledge acquisition, knowledge storage, knowledge sharing, knowledge application and knowledge creation as the survey questionnaires were based on these criteria. Moreover, cement firm entrepreneurs and mangers must give keen interest in promoting green innovation culture for promoting green knowledge management and green innovation within organizations as these concepts are

very vital for sustainable development of organizations to compete in the future. Furthermore regarding implications of this study, policymakers should take a number of preventative measures to ensure the effective operations of GKM, as well as arrange for hands-on training and educational opportunities for staff members' growth to become a sustainable organization that increases revenue and reduces its impact on the environment. The current study underlines the value of green innovation in assisting businesses with sustainable development via green knowledge management. However, in this regard, senior management must support an eco-friendly culture to enhance personal capacity for green innovation and performance in line with green knowledge management objectives. By enhancing the standard of living, the environment, and society as a whole, such actions will ultimately be advantageous to society.

References

Aamir, A., Jan, S. U., Qadus, A., Nassani, A. A., & Haffar, M. (2021). Impact of knowledge sharing on sustainable performance: Mediating role of employee's ambidexterity. *Sustainability,* 13(12788). doi:10.3390/su132212788 Article 12788.

Abbas, J. (2020b). HEISQUAL: A modern approach to measure service quality in higher education institutions. *Studies in Educational Evaluation*, 67, 100933. doi:10.1016/j. stueduc.2020.100933.

Abbas, J., & Dogan, E. (2022). The impacts of organizational green culture and corporate social responsibility on employees' responsible behavior towards society. *Environmental Science and Pollution Research*. doi:10.1007/s11356-022-20072-w.

Abbas, J., & Dogan, E. (2022). The impacts of organizational green culture and corporate social responsibility on employees' responsible behavior towards society. *Environmental Science and Pollution Research.* doi:10.1007/s11356-022-20072-w.

Abbas, J., & Dogan, E. (2022). The impacts of organizational green culture and corporate social responsibility on employees' responsible behaviour towards the society. *Environmental Science and Pollution Research*. doi:10.1007/s11356-022-20072-w.

Abbas, J., & Dogan, E. (2022). The impacts of organizational green culture and corporate social responsibility on employees' responsible behaviour towards the society. *Environmental Science and Pollution Research*. doi:10.1007/s11356-022-20072-w.

Abbas, J., & Kumari, K. (2021). Examining the relationship between total quality management and knowledge management and their impact on organizational performance. *Journal of Economics and Administrative Sciences*. doi:10.1108/JEAS-03- 2021-0046.

Abbas, J., &Sa_gsan, M. (2019). Impact of knowledge management practices on green innovation and corporate sustainable development: A structural analysis. *Journal of Cleaner Production*, 229, 611–620. doi:10.1016/j.jclepro.2019.05.024.

Aboelmaged, M., & Hashem, G. (2019). Absorptive capacity and green innovation adoption in SMEs: The mediating effects of sustainable organisational capabilities. *Journal of Cleaner Production*, 220, 853–863.

Aguilera-Caracuel, J., Ortiz-de-Mandojana, N. (2013). Green innovation and financial performance: An institutional approach. *Organization & Environment*, 26(4), 365-385.

Ahmed, S., Naz, F., Abbas, Z., & Batool, K. H. (2022). Impact of green innovation on sustainable development with mediating effect of knowledge management. *Journal of Business Management Studies-JBMS*, 1(01), 1–16.

Ahmed, S., Naz, F., Abbas, Z., & Batool, K. H. (2022). Impact of green innovation on sustainable development with mediating effect of knowledge management. *Journal of Business Management Studies-JBMS*, 1(01), 1–16.

Ali, A., Wang, G., Jiang, X., Ali, A., 2019. How do firms adopt green strategies in emerging economies? An information processing perspective. Acad. Manag. Proc. 2019 (1), 16577. https://doi.org/10.5465/ambpp.2019.16577abstract.

Alkaraan, F., Albitar, K., Hussainey, K., & Venkatesh, V. G. (2022). Corporate transformation toward Industry 4.0 and financial performance: The influence of environmental, social, and governance (ESG). Technological Forecasting and Social Change, 175. doi:10.1016/j.techfore.2021.121423.

Al-Qudah, A. A., Hamdan, A., Al-Okaily, M., &Alhaddad, L. (2022). The impact of green lending on credit risk: Evidence from UAE's banks. *Environmental Science and Pollution Research*. doi:10.1007/s11356-021-18224-5.

Al-Swidi, A. K., Gelaidan, H. M., & Saleh, R. M. (2021). The joint impact of green human resource management, leadership and organizational culture on employees' green behavior and organizational environmental performance. *Journal of Cleaner Production*, 316, 128112.

Arenhart, R. A., Schunemann, M., Bucker Neto, L., Margis, R., Wang, Z. Y., &Margis-Pinheiro, M. (2016). Rice ASR1 and ASR5 are complementary transcription factors regulating aluminium responsive genes. Plant, cell & environment, 39(3), 645-651

Awan, U. (2020). Enhancing green product and process innovation: Towards an integrative framework of knowledge acquisition and environmental investment. *Business Strategy and Environment*, 1–13. doi:10.1002/bse.2684.

Azhar, A., & Yang, K. (2021). Examining the influence of transformational leadership and green culture on pro-environmental behaviors: Empirical evidence from florida city governments. *Review of Public Personnel Administration*. doi:10.1177/ 0734371X211027347 0734371£211027347.

Azhar, A., & Yang, K. (2021). Examining the influence of transformational leadership and green culture on pro-environmental behaviors: Empirical evidence from florida city governments. *Review of Public Personnel Administration*. doi:10.1177/ 0734371X211027347 0734371£211027347.

Banerjee, S. B., Iyer, E. S., & Kashyap, R. K. (2003). Corporate environmentalism: Antecedents and influence of industry type. *Journal of Marketing*, 67(2), 106–122. doi:10.1509/jmkg.67.2.106.18604.

Cai, W., Li, G., 2018. The drivers of eco-innovation and its impact on performance : evidence from China. J. Clean. Prod. 176 (110e118), 2008e2010.

Cai, W.G., Zhou, X.L., 2014. On the drivers of eco-innovation: empirical evidence from China. J. Clean. Prod. 79, 239e248. https://doi.org/10.1016/ j.jclepro.2014.05.035.

Chaithanapat, P., Punnakitikashem, P., KhinKhinOo, N. C., &Rakthin, S. (2022). Relationships among knowledge-oriented leadership, customer knowledge management, innovation quality and firm performance in SMEs. *Journal of Innovation & Knowledge*, 7,(1) 100162. doi:10.1016/j.jik.2022.100162.

Chen, Y. S. (2008). The driver of green innovation and green image–green core competence. *Journal of business ethics,* 81(3), 531-543.

Chen, Y. S., Chang, C. H., & Wu, F. S. (2012). Origins of green innovations: the differences between proactive and reactive green innovations. Management Decision.

Chen, Y., Lai, S., Wen, C., 2006. The influence of green innovation performance on corporate advantage in Taiwan. *J. Bus. Ethics* 331e339. https://doi.org/10.1007/ s10551-006-9025-5.

Chen, Y.S., 2008. The driver of green innovation and green image - green core competence. *J. Bus. Ethics* 81 (3), 531e543. https://doi.org/10.1007/s10551-007- 9522-1.

Chen, Y.S., 2008. The driver of green innovation and green image - green core competence. *J. Bus. Ethics* 81 (3), 531e543. https://doi.org/10.1007/s10551-007- 9522-1.

Cherian, J., Gaikar, V., Paul, R., &Pech, R. (2021). Corporate culture and its impact on employees' attitude, performance, productivity, and behavior: An investigative analysis from selected organizations of the United Arab Emirates (UAE). *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 1–28. doi:10.3390/ joitmc7010045.

Chiou, T.Y., Chan, H.K., Lettice, F., Chung, S.H., 2011. The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. Transport. Res. E Logist. *Transport. Rev*. 47 (6), 822e836. https://doi.org/10.1016/j.tre.2011.05.016.

Chiou, T.Y., Chan, H.K., Lettice, F., Chung, S.H., 2011. The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. *Transport. Res. E Logist. Transport. Rev*. 47 (6), 822e836. https://doi.org/10.1016/j.tre.2011.05.016.

Dang, V. T., & Wang, J. (2022). Building competitive advantage for hospitality companies: The roles of green innovation strategic orientation and green intellectual capital. *International Journal of Hospitality Management,* 102, 103161. doi:10.1016/j. ijhm.2022.103161.

Eisenhardt, K.M., Martin, J.A., 2000. Dynamic capabilities: what are they? *Strat. Manag. J*. 21 (10/11), 105e1121. https://doi.org/10.1108/ebr-03-2018-0060.

Fliaster, A., &Kolloch, M. (2017). Implementation of green innovations–The impact of stakeholders and their network relations. *R&D Management*, 47(5), 689-700.

Fu, Q., Abdul Rahman, A. A., Jiang, H., Abbas, J., &Comite, U. (2022). Sustainable supply chain and business performance: The impact of strategy, network design, information systems, and organizational structure. *Sustainability*, 14(3), 1080. doi:10.3390/ su14031080.

G€urlek, M., & Tuna, M. (2018). Reinforcing competitive advantage through green organizational culture and green innovation. *The Service Industries Journal*, 38(7−8), 467–491. doi:10.1080/02642069.2017.1402889.

Gauthier, J., & Zhang, Z. (2020). Green knowledge management and strategic renewal: A discursive perspective on corporate sustainability. *International Journal of Productivity and Performance Management*, 69(8), 1797–1811. doi:10.1108/IJPPM-10- 2019-0489.

Guerrero-Villegas, J., Sierra-García, L., & Palacios-Florencio, B. (2018). The role of sustainable development and innovation on firm performance. *Corporate Social Responsibility and Environmental Managemen*t, 25(6), 1350–1362.

Guo, Y., Wang, L., Chen, Y., 2020. Green Entrepreneurial Orientation and Green Innovation : the Mediating Effect of Supply Chain Learning. Sage Open. https:// doi.org/10.1177/2158244019898798.

Habib, M., Abbas, J., & Noman, R. (2019). Are human capital, intellectual property rights, and research and development expenditures really important for total factor productivity? An empirical analysis. *International Journal of Social Economics*, 46(6), 756–774. doi:10.1108/IJSE-09-2018-0472.

Hair, J. F. (2009.). Multivariate Data Analysis. Digital Commons @ Kennesaw State University. Retrieved January 10, 2023, from https://digitalcommons.kennesaw.edu/facpubs/2925

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). Multivariate data analysis: A global perspective (Vol. 7). NJ: Pearson Upper Saddle River.

Hair, J.F.J., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2016), A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM), 2nd ed., SAGE Publications New York, NY.

Hur, W. M., Kim, Y., & Park, K. (2013). Assessing the effects of perceived value and satisfaction on customer loyalty: A 'Green' perspective. *Corporate social responsibility and environmental management*, 20(3), 146-156.

Kammerer, D. (2009). The effects of customer benefit and regulation on environmental product innovation.: Empirical evidence from appliance manufacturers in Germany. *Ecological Economics*, 68(8-9), 2285-2295.

Kumar, S., & Barua, M. K. (2022). A modeling framework of green practices to explore their interrelations as a conduit to policy. *Journal of Cleaner Production*, 335, 130301. doi:10.1016/j.jclepro.2021.130301.

Kumar, S., & Barua, M. K. (2022). A modeling framework of green practices to explore their interrelations as a conduit to policy. *Journal of Cleaner Production*, 335, 130301. doi:10.1016/j.jclepro.2021.130301.

Kumari, K., Ali, S. B., Khan, N. N. K., & Abbas, J. (2021). Examining the role of motivation and reward in employees' job performance through mediating effect of job satisfaction: An empirical evidence. *International Journal of Organizational Leadership*, 10(4), 401–420.

Lee, C. C., Wang, C. W., & Ho, S. J. (2022). The dimension of green economy: Culture viewpoint. *Economic Analysis and Policy*, 74, 122–138.

Lehmann, C., Delbard, O., & Lange, S. (2022). Green growth, a-growth or degrowth? Investigating the attitudes of environmental protection specialists at the German Environment Agency. *Journal of Cleaner Production*, 336, 130306. doi:10.1016/j. jclepro.2021.130306.

Lv, C., Shao, C., & Lee, C. C. (2021). Green technology innovation and financial development: Do environmental regulation and innovation output matter? Energy Economics, 98. doi:10.1016/j.eneco.2021.105237.

Maravilhas, S., & Martins, J. (2019). Strategic knowledge management in a digital environment: Tacit and explicit knowledge in Fab Labs. *Journal of Business Research*, 94, 353–359. doi:10.1016/j.jbusres.2018.01.061.

Mohan, J., Rathi, R., Kaswan, M. S., & Nain, S. S. (2022). Green lean six sigma journey: Conceptualization and realization. In Proceedings of the materials today (pp. 1991 −1998). doi:10.1016/j.matpr.2021.09.338.

Mu~noz-Pascual, L., Galende, J., &Curado, C. (2020). Human resource management contributions to knowledge sharing for a sustainability-oriented performance: A mixed methods approach. Sustainability, 12(1), 161. doi:10.3390/su12010161.

Muisyo, P. K., & Qin, S. (2021). Enhancing the FIRM'S green performance through green HRM: The moderating role of green innovation culture. *Journal of Cleaner Production*, 289, 125720. doi:10.1016/j.jclepro.2020.125720.

Murphy, J., &Gouldson, A. (2020). Environmental policy and industrial innovation: integrating environment and economy through ecological modernisation. The Ecological Modernisation Reader, 275-294.

Naqshbandi, M. M., &Jasimuddin, S. M. (2022). The linkage between open innovation, absorptive capacity and managerial ties: A cross-country perspective. *Journal of Innovation & Knowledge*, 7,(2) 100167. doi:10.1016/j.jik.2022.100167.

Naqshbandi, M. M., &Jasimuddin, S. M. (2022). The linkage between open innovation, absorptive capacity and managerial ties: A cross-country perspective. Journal of Innovation & Knowledge, 7,(2) 100167. doi:10.1016/j.jik.2022.100167.

Pham, H. T., Pham, T., Truong Quang, H., & Dang, C. N. (2022). Impact of transformational leadership on green learning and green innovation in construction supply chains. Engineering, Construction and Architectural Management. doi:10.1108/ ECAM-05-2021-0379 ahead-of-print(ahead-of-print).

Pi~neiro-Chousa, J., L_opez-Cabarcos, M._A., Romero-Castro, N. M., &P_erez-Pico, A. M. (2020). Innovation, entrepreneurship and knowledge in the business scientific field: Mapping the research front. *Journal of Business Research*, 115, 475–485. doi:10.1016/j.jbusres.2019.11.045.

Qu, K., & Liu, Z. (2022). Green innovations, supply chain integration and green information system: A model of moderation. *Journal of Cleaner Production*, 339, 130557. doi:10.1016/j.jclepro.2022.130557.

Rehman, S. U., Kraus, S., Shah, S. A., Khanin, D., & Mahto, R. V. (2021). Analyzing the relationship between green innovation and environmental performance in large manufacturing firms. *Technological Forecasting and Social Change*, 163, 120481. doi:10.1016/j.techfore.2020.120481.

Rehman, S. U., Kraus, S., Shah, S. A., Khanin, D., & Mahto, R. V. (2021). Analyzing the relationship between green innovation and environmental performance in large manufacturing firms. *Technological Forecasting and Social Change*, 163, 120481. doi:10.1016/j.techfore.2020.120481.

Saunila, M., Ukko, J., Rantala, T., 2017. Sustainability as a driver of green innovation investment and exploitation. J. Clean. Prod. https://doi.org/10.1016/ j.jclepro.2017.11.211.

Shahzad, M., Qu, Y., Ur Rehman, S., Zafar, A. U., Ding, X., & Abbas, J. (2020). Impact of knowledge absorptive capacity on corporate sustainability with mediating role of CSR: Analysis from the Asian context. *Journal of Environmental Planning and Management*, 63(2), 148–174.

Shahzad, M., Qu, Y., Zafar, A. U., Rehman, S. U., & Islam, T. (2020). Exploring the influence of knowledge management process on corporate sustainable performance through green innovation. *Journal of Knowledge Management,* 24(9), 2079–2106. doi:10.1108/JKM-11-2019-0624.

Song, M., Peng, L., Shang, Y., & Zhao, X. (2022). Green technology progress and total factor productivity of resource-based enterprises: A perspective of technical compensation of environmental regulation. Technological Forecasting and Social Change, 174. doi:10.1016/j.techfore.2021.121276.

Song, M., Yang, M. X., Zeng, K. J., & Feng, W. (2020). Green knowledge sharing, stakeholder pressure, absorptive capacity, and green innovation: Evidence from Chinese manufacturing firms. *Business Strategy and the Environment*, 29(3), 1517–1531. doi:10.1002/bse.2450.

Song, M., Yang, M. X., Zeng, K. J., & Feng, W. (2020). Green knowledge sharing, stakeholder pressure, absorptive capacity, and green innovation: Evidence from Chinese manufacturing firms. *Business Strategy and the Environment,* 29(3), 1517–1531. doi:10.1002/bse.2450.

Sroufe, R.P., Liebowitz, J., Sivasubramaniam, N., 2010. Are you a leader or a laggard? HR's role in creating a sustainability culture. People and Strategy 33 (1), 34e42. Retrieved from. https://tradingeconomics.comsri-lankamalnutritionprevalence- weight-for-age-percent-of-children-under-5-wb-data.html.

Tahir, R., Athar, M. R., & Afzal, A. (2020). The impact of greenwashing practices on green employee behaviour. Mediating Role of Employee Value Orientation and Green Psychological Climate. (No. 1). 7(1), Article 1 https://www.tandfonline.com/doi/full/ 10.1080/23311975.2020.1781996.

Tietze, F., Schiederig, T., Engineering, C.H.P., 2011. What is green Innovation ? e a quantitative literature review. Engineering _ Sustainable Technology EJournal 8e10. https://doi.org/10.15480/882.1002.

UN. (1987). Report of the world commission on environment and development: Our common future. (Environment) [Development and International Co-operation]. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf.

UNCOP26. (2021). COP26: Together for our planet. United Nations Climate Action. [United Nations] https://www.un.org/en/climatechange/cop26.

UNDP. (2021). Sustainable development goals. August 19, United Nations Development Programme. https://www.undp.org/sustainable-development-goals.

UNDP. (2021). Sustainable development goals. August 19, United Nations Development Programme. https://www.undp.org/sustainable-development-goals.

Wang, J., Xue, Y., Sun, X., & Yang, J. (2020). Green learning orientation, green knowledge acquisition and ambidextrous green innovation. *Journal of Cleaner Production*, 250, 119475. doi:10.1016/j.jclepro.2019.119475.

Wang, J., Xue, Y., Sun, X., & Yang, J. (2020). Green learning orientation, green knowledge acquisition and ambidextrous green innovation. *Journal of Cleaner Production*, 250, 119475. doi:10.1016/j.jclepro.2019.119475.

Wang, S., Abbas, J., Sial, M. S., Álvarez-Otero, S., &Cioca, L. I. (2022). Achieving green innovation and sustainable development goals through green knowledge management: Moderating role of organizational green culture. *Journal of Innovation and Knowledge*, 7(4). https://doi.org/10.1016/j.jik.2022.100272

Woo, C., Chung, Y., Chun, D., Han, S., Lee, D., 2013. Impact of Green Innovation on Labor Productivity and its Determinants: an Analysis of the Korean Manufacturing Industry. https://doi.org/10.1002/bse.1807. Business St.

Wyns, A., &Beagley, J. (2021). COP26 and beyond: Long-term climate strategies are key to safeguard health and equity. *The Lancet Planetary Health*, 5(11), e752–e754. doi:10.1016/S2542-5196(21)00294-1.

Yang, J. (2008). Managing knowledge for quality assurance: An empirical study. International Journal of Quality & Reliability Management, 25, 109–124. doi:10.1108/ 02656710810846907.

Yang, L. R., Chen, J. H., & Li, H. H. (2016). Validating a model for assessing the association among green innovation, project success and firm benefit. *Quality & Quantity*, 50(2), 885-899.

Yu, S., Abbas, J., _Alvarez-Otero, S., & Cherian, J. (2022). Green knowledge management: Scale development and validation. Journal of Innovation & Knowledge, 7,(4) 100244. doi:10.1016/j.jik.2022.100244.

Yu, S., Abbas, J., Álvarez-Otero, S., & Cherian, J. (2022). Green knowledge management: Scale development and validation. *Journal of Innovation and Knowledge*, 7(4). https://doi.org/10.1016/j.jik.2022.100244

Zbuchea, A., P^ınzaru, F., Busu, M., Stan, S.-. O., &B^arg_aoanu, A. (2019). Sustainable knowledge management and its impact on the performances of biotechnology organizations. Sustainability, 11(2), 359. doi:10.3390/su11020359.

Zhang, D., Rong, Z., & Ji, Q. (2019). Green innovation and firm performance: Evidence from listed companies in China. *Resources, Conservation and Recycling,* 144, 48–55. doi:10.1016/j.resconrec.2019.01.023.

Zhang, X., Meng, Q., & Le, Y. (2022b). How do new ventures implementing green innovation strategy achieve performance growth? *Sustainabilit*y, 14(4), 2299. doi:10.3390/su14042299.

Zhao, L., Gu, J., Abbas, J., Kirikkaleli, D., & Yue, X. G. (2022). Does quality management system help organizations in achieving environmental innovation and sustainability goals? *A structural analysis. Economic Research-EkonomskaIstra_zivanja*, 0(0), 1– 24. doi:10.1080/1331677X.2022.2100436.