Unveiling the Path to Green Innovation: The Interplay of Green Learning Orientation, Knowledge Management Capability, and Manufacturing Firm's Capability to Orchestrate Resources

Abstract

Purpose: Amidst the increasing global emphasis on environmental sustainability, manufacturing firms seek to integrate eco-conscious practices into their innovation processes. This study explores the intricate relationships between green learning orientation, knowledge management capability, resource orchestration capability, and two dimensions of green innovation: green product innovation and green process innovation.

Design/methodology/approach – Partial least squares structural equation modelling (PLS-SEM) and moderated mediation techniques were employed to investigate the relationships among the constructs using data gathered from a survey of 167 manufacturing firms in the UAE.

Findings: This study indicates that green learning orientation significantly influences green product innovation and green process innovation. Although knowledge management capability mediates the relationship between green learning orientation and process innovation, it does not mediate the green product innovation relationship. Moreover, resource orchestration capability significantly strengthens the links between green learning orientation, knowledge management capability, and both the aspects of green innovation.

Practical implications: This study emphasises the importance of fostering a green learning culture and integrating it into product development without complex knowledge management systems. This study also highlighted the role of effective resource allocation in maximising environmental learning benefits for sustainable innovation. Organisations can achieve environmental progress by integrating green knowledge into product and process development and by investing in sustainable practices.

Originality/value – By examining various mechanisms involving moderation and mediation, this study has made a notable contribution to advancing the field of knowledge-based view (KBV) theory. It also offers enhanced insights into the interconnections among green learning orientation, knowledge management capability, resource orchestration capability, and a firm's capacity for green innovation.

1. Introduction

In the contemporary industrial context, the adoption of sustainable practices is paramount because of the rapidly evolving dynamics (Shahzad et al., 2020). Contemporary manufacturing sectors, predominantly in emerging nations, are increasingly focusing on green innovation (GI), the development and application of eco-friendly technologies, processes, and strategies (Rehman et al., 2021; Wang and Juo, 2021). The imperative drives this shift to curtail carbon emissions, minimize waste, and optimize resource utilization, thereby transitioning to ecologically conscious practices (Wang et al., 2022; Abbas and Sağsan, 2019). GI not only ensures compliance with stringent environmental regulations but also fosters economic benefits through enhanced operational efficiency, technological innovation, and leveraging the growing consumer preference for green products (Wang et al., 2020a; Shehzad et al., 2023).. Consequently, exploring the determinants, challenges, and impacts of GI within the manufacturing sector of the emerging world is of significant scholarly and practical relevance and offers insights into sustainable developmental trajectories.

The urgent need to address resource depletion and unsustainable industrial practices requires a paradigm shift towards environmentally sustainable approaches. Green Innovation (GI) plays a crucial role in enabling manufacturing entities to prioritise sustainability, address ecological concerns, enhance competitiveness, promote technological advancements, adhere to regulations, and optimise resource utilisation (Idrees et al., 2023; Zhang et al., 2020; Shehzad et al., 2022d). By embracing GI, which encompasses green product Innovation (GPDI) and process innovation (GPCI), manufacturing firms can not only mitigate environmental degradation but also potentially drive economic and social growth (Awan et al., 2021). Research has demonstrated the capacity of GPDI and GPCI to tackle environmental challenges (Chen, 2008a; Shehzad et al., 2022c), further underscoring their importance in promoting environmental sustainability. Therefore, this study aims to comprehensively examine the key factors that stimulate GI in manufacturing firms in emerging economies, emphasizing the need for a strategic approach that balances social impact, ecological benefits, and competitive advantage (Abbas and Sağsan, 2019; Wang et al., 2020a; Shehzad et al., 2022c).

First, the green learning approach is emphasised as a key element of GI for several reasons. Manufacturing companies require a learning-oriented strategy to keep up with environmental regulations and resource-effective technologies, reduce waste, and conserve energy owing to the complexity of environmentally friendly procedures and regulatory requirements (Wang et al., 2020a). Because of this strategy, they can plan and comply with the environmental standards properly. Second, as customer demand for environmentally friendly goods and processes develops, a green learning orientation (GLO) assists businesses in aligning their innovation strategies by changing their sustainability preferences (Fong and Chang, 2012). Finally, green learning can give firms a competitive edge by differentiating their products, improving operational efficiency, positioning them as leaders in compliance and sustainability, and establishing them for achievement within a changing business landscape (Wang et al., 2022). Although researchers have studied the antecedents of GI, including green intellectual capital (Wang and Juo, 2021; Shehzad et al., 2022d), quality management (Li et al., 2018), environmental regulation (Zhang et al., 2018), leadership and management support (Idrees et al., 2023), and green entrepreneurial orientation (Shehzad et al., 2023), there is little research on the link between GLO and specific aspects of GI (GPDI and GPCI). According to Wang et al. (2020a), GLO significantly accelerated GI. However, it is not yet known how GLO influences the GPDI and GPCI.

Second, knowledge management capability (KMC) is crucial in innovation, helping bridge knowledge gaps and integrate internal and external information, making it accessible for necessary use (du Plessis, 2007). It not only acts as a precursor to organizational creativity but also as an intermediary mechanism between elements such as GLO and innovation outcomes (Tan and Nasurdin, 2011; Albort-Morant et al., 2018b). It serves as a conduit for transferring knowledge throughout a business (Lei et al., 2021), and translates green learning ideas into practical green innovations (Riaz et al., 2023). KMC effectively transfers and integrates knowledge, bridging the gap between academic and practical applications. However, its role as a mediating mechanism in manufacturing enterprises in emerging countries remains understudied. In such contexts, the interplay between KMC, GLO, and green innovation may differ because of mature technologies, business practices, and regulatory frameworks (Albort-Morant et al., 2016). Recent studies have focused on the mediating mechanisms influencing the GLO-GI link, such as green knowledge acquisition (Wang et al., 2020a) and knowledge sourcing (Khedhaouria et al., 2017), but not on KMC. Our study seeks to address this gap by identifying the processes through which KMC might stimulate the transition of GLO insights into building GI capabilities within the technologically emerging and well-resourced settings of manufacturing firms in advanced countries.

Finally, resource orchestration capability (ROC) refers to a company's ability to strategically integrate and employ numerous physical and intangible resources (Sirmon et al., 2007). According to Teece (2007), resource orchestration is essential for reducing internal conflict and boosting resource complementarity within a company. This dynamic capability helps businesses transform new knowledge to promote green innovation (Albort-Morant et al., 2018b; Hashim et al., 2015). Although the importance of GLO, KMC, and GI in promoting ecologically sound practices among manufacturing firms in emerging countries is increasingly acknowledged, there is still a glaring research gap regarding the moderating role of ROC in these intricate relationships. However, few studies have examined how resource orchestration capability—the effective allocation, integration, and alignment of diverse resources— may facilitate or impede the transformation of green learning orientation and knowledge management capability into tangible GI (Wang et al., 2020b). In the context of emerging economies with complex resource landscapes, studying how ROC interacts with these important factors may provide surprising new perspectives on processes that promote or impede the implementation of environmentally friendly approaches. This study intends to fill this gap in the literature by providing a more comprehensive and nuanced understanding of the aspects that drive the effective incorporation of sustainable practices inside manufacturing organisations, with important implications for academics and practitioners.

This study addresses the following research questions in light of the previous arguments.

RQ1. Does GLO affect GPDI and GPCI, and if so, by what mechanism?

RQ2. To what extent does ROC strengthen or weaken the relationship between GLO, KMC, and GI?

In response to the aforementioned research questions, this study used PLS-SEM and a moderated mediation technique to evaluate the association between variables in a survey of 408 respondents from 167 manufacturing firms in the UAE. This study used a quantitative research approach using cross-sectional data to address these knowledge gaps and put an integrated model linking GLO, KMC, and ROC to test for GI. This study intends to provide theoretical and practical advances by shedding light on the roles of GLO and KMC in encouraging GPDI and GPCI in firms.

The remainder of this paper is organised as follows. To gain deeper insight into the connections among the constructs within the conceptual research model, an initial exploration of the KBV theory and relevant existing literature was conducted. Subsequently, the research methodology used to assess the proposed model was delineated. Following the analysis of the collected data, the empirical results are presented. Finally, a discussion, implications, limitations, and conclusions are provided.

2. Literature review and hypotheses

2.1. Knowledge-based view

The theory of the Knowledge-Based View (KBV) places significant emphasis on the importance of knowledge as a vital resource inside enterprises, enabling them to attain a competitive advantage. According to Donate and Sánchez de Pablo (2015), within the context of the interplay between learning orientation, KMC, and innovation, the application of KBV theory offers valuable insights. Specifically, it suggests that the combined presence of a robust GLO and strong KMC within an organisation contributes significantly to the advancement of GI. According to Xie et al. (2019a), strategic management and the use of environmental information may significantly boost an organisation's potential to develop sustainable solutions and achieve a competitive advantage in an ever-changing green economy. Robust knowledge management capacity enables efficient and uninterrupted dissemination of information and insights throughout a company (Shehzad et al., 2022c). The availability of a wide range of information sources contributes to an organisation's ability to produce and execute environmentally friendly innovations (Abbas and Sağsan, 2019). According to Xie et al. (2019b), employees can use the information acquired, derive lessons from previous experiences, and expand on current ideas to facilitate the development of environmentally sustainable innovations.

Current research in economics and management has made significant contributions to the advancement of the knowledge-based theory of business. This theory posits that the major rationale for the existence of organisations lies in their ability to generate, integrate, and use knowledge (Grant, 1996). The theoretical framework known as the knowledge-based view (KBV) is derived from the resource-based view (RBV) of an organisation, which places strategic assets at the forefront as the primary driver of competitive advantage (Amit and Schoemaker, 1993). In contrast, the Knowledge-Based View (KBV) posits that knowledge is the primary strategic resource. When effectively managed, knowledge enables an organisation to generate value through production (DeCarolis and Deeds, 1999). According to this argument, an organisation may represent a knowledge-based entity that effectively oversees its knowledge assets using combinative-dynamic capabilities (Kogut and Zander, 1992). However, Argote and Ingram (2000) highlight the challenges that individuals face in establishing a competitive advantage for their organisations. In business strategy, there has been greater emphasis on recognising knowledge as the foundation of competitive advantage than on elucidating how organisations can cultivate, maintain, and disseminate this knowledge. According to Abbas and Sağsan (2019), the use of knowledge management (KM) methods, often using information and communication technology, has been shown to results in favourable organizational outcomes, including improved organizational performance and increased competitive advantage. However, in contemporary sectors where the capacity of enterprises to consistently innovate new goods or processes is crucial for gaining a competitive edge, geographical indication (GI) has emerged as the primary obstacle to knowledge management and collaboration (Abbas and Sağsan, 2019; Shehzad et al., 2022c; Shahzad et al., 2020).

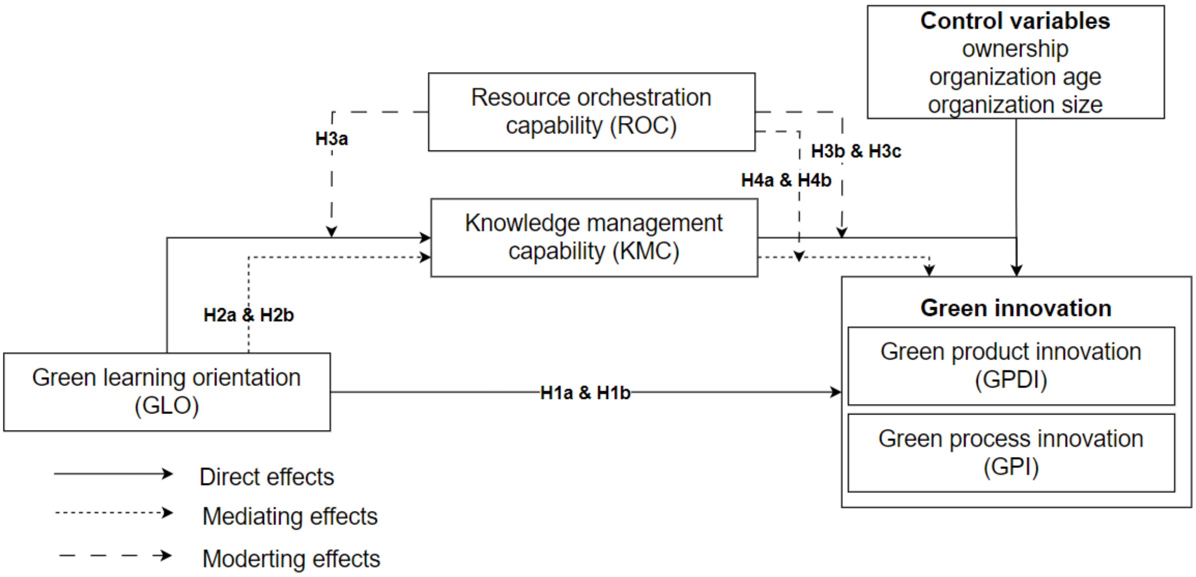

Figure 1. Research model

2.2. Green learning orientation and green innovation

Innovation is key to economic, environmental, and social prosperity (Cillo et al., 2019). Various terms describe innovation across business sectors, including environmental, eco-sustainable, and sustainable innovation (Franceschini et al., 2016). Studies indicate that ecological innovation, eco-innovation, environmental innovation, and GI are interchangeable (Schiederig et al., 2012). The concept of GI, as outlined by Chen et al. (2006), encompasses both hardware and software advancements that pertain to environmentally friendly products or procedures.It encompasses energy conservation technology, pollution prevention, waste recycling, green product design, and corporate environmental management. Additionally, GI aims to reduce environmental degradation and achieve market success, financial benefits, and knowledge acquisition during innovation (Albort-Morant(Cancino et al., 2018; Albort-Morant et al., 2018a). Key aspects of GI include technological advancements, pollution mitigation, recycling, eco-friendly designs, and ecological management (Li et al., 2017). GI is vital for businesses, aiding in value creation, competitive advantage, and performance enhancement. As Awan et al. (2021) highlight, developing environmentally friendly products and innovative processes is essential for addressing global warming. In line with a prior study by Awan et al. (2021), we categorised GI into two primary components: GPDI and GPCI. The GPDI refers to the development of sophisticated goods that incorporate environmentally friendly features, such as reduced levels of harmful substances, innovative packaging techniques, and the integration of recycled and remanufactured parts and components. On the other hand, GPCI refers to a company's commitment to improving its production processes, implementing resource-saving measures, reducing pollution, and lowering energy consumption.(Chen, 2008b).

The GLO revolves around an organisation's commitment to continuously learn and adapt its operations in line with sustainable practices. This involves creating a work environment that fosters environmental awareness and encourages employees and leaders to stay updated on the latest sustainability, eco-friendly technologies, and effective methods methodologies (Wang et al., 2020a). The GLO emphasises openness to feedback from all stakeholders regarding sustainability initiatives. In this context, the GLO represents a proactive and environmentally aware approach to education and skill development. Prior research highlights the importance of a learning-focused perspective in enhancing creativity (Hult et al., 2004; Singh et al., 2022), which boosts a company's innovation and ability to adapt to changing consumer preferences and market trends. The focus is on developing competencies, attitudes, and behaviours that promote environmental awareness, efficient resource use, and sustainable actions (Wang et al., 2020a). Fong and Chang (2012) note that GLO extends beyond conventional education by integrating sustainability principles into curricula, teaching methods, and institutional policies. This strategy leads to innovative problem-solving for global challenges, such as climate change, biodiversity loss, and resource scarcity. Effectively fostering GLO is crucial for equipping current and future generations with tools to contribute to a more sustainable and resilient planet. Consistent with previous research, the term "GLO" is defined as the set of principles that companies adopt to foster environmental awareness and understanding (D'Angelo and Presutti, 2019).

The literature highlights the crucial link between GLO and GI in organizational settings (Wang et al., 2020a). Studies show that organisations with a strong GLO are more capable of GI, as this orientation enhances environmental awareness, resource conservation, and sustainability mindsets among employees (Fong and Chang, 2012; Shehzad et al., 2022c). This orientation also creates a ripe environment for the development of eco-friendly products and sustainable operations. A key mediator in this relationship is knowledge management capabilities, which allow organizations to effectively use green knowledge for sustainable innovation (Fong and Chang, 2012; Albort-Morant et al., 2018b). Further research by D'Angelo and Presutti (2019) and Wang et al. (2020a) support the idea that a heightened GLO leads to increased creativity and stronger commitment to GI initiatives. This culture promotes collaboration and information exchange, which are essential for integrating environmentally conscious ideas across an organisation. Additionally, studies by Huang and Li (2018) and Baker and Sinkula (1999) find that GLO boosts environmental awareness among employees, fostering enthusiasm for GI activities and promoting organizational communication and cross-functional collaboration. Integration of diverse perspectives is crucial for successful GI outcomes. Wang et al. (2020a) define GLO as a firm's dedication to sustainability, which leads to ambidextrous GI through various strategies. Firms with strong GLO commitment inspire their staff towards environmental education and reduce the uncertainties associated with GI, thus increasing the likelihood of success (Song and Yu, 2018; Leal-Rodríguez et al., 2018). In summary, embracing GLO enables businesses to integrate current environmental insights and novel knowledge, thereby fostering effective GI.

Despite GLO's undeniable importance, there is a lack of studies examining how GLO affects both GPDI and GPCI. Based on the above considerations, the following hypothesis is proposed.

H1a. GLO positively influences a firm's GPDI capability.
H1b. GLO positively influences a firm's GPCI capability.

2.3. Mediating role of knowledge management capability

KMC refers to an organisation's capacity to acquire, store, share, and apply knowledge to accomplish its goals, including sustainability objectives (Sun et al., 2020). This entails successfully managing and sharing knowledge of green practices, technology, laws, and innovations within the framework of sustainability (Shehzad et al., 2023). Robust KMC ensures that useful insights into sustainable practices are gathered, structured, and available to the organisation's relevant stakeholders. KMC helps an organisation to identify, evaluate, and regulate necessary and accessible knowledge to increase knowledge assets and meet corporate goals (Chawla and Joshi, 2010). Most scholars agree that knowledge management refers to the process of acquiring, sharing, and applying knowledge (Lee et al., 2016; Shehzad et al., 2022b), whereas knowledge acquisition refers to a firm's ability to seek and acquire new information and knowledge from existing knowledge (Jiménez-Jimenez et al., 2008; Albort-Morant et al., 2016). Knowledge sharing is the process of exchanging expertise and knowledge among individuals to complement and bring valuable and new knowledge/skills to each other (Le and Lei, 2019); knowledge application is the realization and application of knowledge values into practice to generate desired outcomes (Shehzad et al., 2022c).

GI commonly refers to the mastery of knowledge concerning modifications in utilising raw materials or components, and reconfiguring products or processes (Ben Arfi et al., 2018). Aligned with the knowledge-based perspective, GI exchanges and assimilates green knowledge (Kong et al., 2020). Enterprises must facilitate knowledge transfer across functions and collaborate with external supply chain partners to effectively execute GI. The GLO compels enterprises to prioritise acquiring green knowledge and skills, transforming this knowledge into GPDI and GPCI (Wang et al., 2020a; Alam et al., 2023). Building upon the resource advantage theory, knowledge transmission and diffusion are intricate processes (Grant, 1996). GLO stimulates enterprises to explore novel knowledge, exchange insights through social networks, and translate knowledge into operational endeavours. KMC facilitates mutual learning in organisations, fostering the dissemination of diverse knowledge and information among entities (Smith et al., 2005; Wang et al., 2022; Alam et al., 2022). Furthermore, KMC can convert knowledge into GI through internal mechanisms (Shehzad et al., 2022b; Albort-Morant et al., 2018b). According to Hult et al. (2004) and Atitumpong and Badir (2018), a learning-oriented organisation is better equipped to foster innovation, and knowledge management serves as the mechanism that facilitates the translation of eco-conscious insights into tangible products and processes with lower environmental impacts. D'Angelo and Presutti (2019) observed that companies with a significant focus on green learning tend to establish shared-value systems that promote the growth of green knowledge. When an organisation has a strong capacity to manage and utilise knowledge resources linked to sustainability, it is better positioned to innovate in environmentally aware ways (Wang et al., 2020a; Abbas and Khan, 2022). This mediation advances our knowledge of the processes through which learning orientation results in practical and environmentally friendly innovations, eventually promoting sustainability in organizational practices and output. The following are the research hypotheses put out in light of these arguments.

H2a. KMC mediates the effect of GLO on GPDI.

H2b. KMC mediates the effect of GLO on GPCI.

2.4. Moderating role of resource orchestration capability

In the context of sustainability, ROC embodies an organisation's proficiency in effectively aligning and maximising its diverse resources to attain economic prosperity and ecological and societal well-being (Wang et al., 2020b). This entails integrated decision-making that addresses triple bottom-line considerations, fosters innovative resource utilisation for efficiency, involves stakeholders, manages sustainability-associated risks, and upholds transparency in reporting. This capacity encompasses a forward-looking outlook, recognising the enduring implications of resource allocation decisions, and a dedication to continuous enhancement in support of sustainable objectives (Sirmon et al., 2007; Asiaei et al., 2022). Previous research underscores the significance of resource orchestration in adapting to evolving market dynamics and in enhancing innovation (Chadwick et al., 2015; Wales et al., 2013). Sirmon et al. (2007) highlight the role of internal capabilities in shaping, bundling, and leveraging a firm's resource portfolio. Scholars, such as Wales et al. (2013) and Teece (2014), underline the orchestration of resources. Chadwick et al. (2015) underscore how firms orchestrate resources that are essential for reducing internal conflicts and fostering resource complementarity (Teece, 2007). This dynamic capability helps firms convert new knowledge to facilitate GI (Wang et al., 2020b; Hashim et al., 2015; Shehzad et al., 2023). Building on the research by Sirmon et al. (2007); Sirmon et al. (2011); Shehzad et al. (2023)we define ROC aprocessternal pr amalgamating, configuring,g, configuring and deploying knowledge resources to foster both exploitative and exploratory GIs.

Green learning orientation, an organizational approach that prioritises eco-aware learning and skill development, has repeatedly been related to improved knowledge management capacity. According to earlier studies by Hult et al. (2004) and Atitumpong and Badir (2018), a learning-focused strategy is an essential prerequisite for encouraging innovation in businesses. Organisations may efficiently create and manage their knowledge resources by committing to continual learning about sustainability concepts, green technology, and eco-friendly practices. Realising the full potential of green learning initiatives requires effective resource allocation and coordination throughout an organisation, including both material and intangible resources. According to Wang et al. (2020b), a business's capacity to strategically deploy resources to implement sustainable practices and innovative projects increases the effect of green learning orientation on knowledge management capabilities. ROC fosters an environment conducive to knowledge sharing, collaboration, and innovation. It ensures the availability of essential resources, including financial investments, technological infrastructure, and human expertise to support knowledge management in the realm of green learning. This aligns with Fong and Chang (2012) perspective that a comprehensive green learning approach transcends traditional educational methods by integrating sustainability into various organizational dimensions, such as curriculum design, teaching techniques, and institutional policies. However, it is important to acknowledge that the moderating role of ROC may vary according to organizational context. Factors such as organizational size, industry type, leadership commitment, and external influences can affect the extent and nature of this moderation effect. D'Angelo and Presutti (2019) stress the importance of common values within an organisation. These shared ideals, when paired with efficient resource management, have the potential to provide a synergistic impact, where green learning orientation improves knowledge management competency, while simultaneously fostering a more sustainable and creative corporate culture.

H3a. ROC positively moderates the impact of GLOs on KMC.

Earlier studies underscore the importance of comprehending how an organisation's capacity to manage information interacts with its capacity to coordinate resources, thus affecting its capacity for GI (Shahzad et al., 2020; Hult et al., 2004; Atitumpong and Badir, 2018). Effective knowledge management, encompassing the collection, sharing, and utilisation of knowledge, is pivotal in addressing environmental sustainability. This is further enhanced by a learning-oriented culture that fosters innovation and GI (Hult et al., 2004; Atitumpong and Badir, 2018). However, the dynamic element of resource orchestration–the strategic management of finances, technology, human capital, and partnerships–critically influences this relationship. Wang et al. (2020b) emphasize the role of resource orchestration in sustainability, asserting its influence on the effective implementation of green initiatives. This orchestration not only facilitates access to essential resources for eco-friendly products and process innovation but also potentially amplifies the impact of knowledge management on GI. D'Angelo and Presutti (2019) further suggested that competence in resource orchestration may moderate the efficacy of knowledge management in achieving GI. Organisations proficient in integrating knowledge management with strategic resource orchestration are likely to excel in GI, thus enhancing their sustainability and competitive edge. Consequently, the following hypothesis is proposed:

H3b. ROC positively moderates KMC's impact on GPDI.
H3c. ROC positively moderates KMC's impact on GPCI.

ROC is discussed as a potential moderator affecting KMC's mediation of GLO and GI interactions. Organisations with strong resource orchestration competencies may strategically distribute resources throughout the economic, social, and environmental domains, possibly improving KMC's role of KMC as a mediator. By ensuring that resources are utilised for innovation activities with a green emphasis, resource orchestration capacity might increase the effect of knowledge management. As a result, it is presumed that KMC acts as a mediator between GLO and GI (GPDI and GPCI) and that ROC may increase the connections between GLO, KMC, GPDI, and GPCI. According to this reasoning, GLO will have a more favourable impact on GPDI and GPCI through KMC when the ROC is high. In other words, the mediating effects of KMC on the effects of GLO on GPDI and GPCI were higher when ROC was high. Consequently, we propose the following hypothesis:

H4a. KMC has a stronger mediating effect on GLO and GPDI when ROC is high.

H4b. KMC has a stronger mediating effect on GLO and GPCI when ROC is high.

3. Research Method

3.1. Samples and procedures

This investigation employs a deductive research approach to systematically test hypotheses that are grounded in the theoretical framework suggested by extant literature (Bryman, 2007). Data collection was operationalized through a structured questionnaire designed to measure variables related to GLO, KMC, ROC, and GI. Following the prior study of (Singh et al., 2022),the focus of the study is narrowed to Small and Medium-sized Enterprises (SMEs) within the manufacturing sector of the United Arab Emirates (UAE), a selection predicated on the categorization criteria set forth by UAE Cabinet Resolution No. 22 of 2016. The choice of the UAE as the context for our study is motivated by its distinctive position as a high-income emerging economy that has made substantial strides. This unique blend of economic dynamics offers a rich setting for investigating, providing insights that are both regionally relevant and globally applicable. Moreover, the cabinet resolution delineates small enterprises as those employing 10 to 100 individuals with an annual revenue of no more than 50 million AED, and medium-sized enterprises as those employing 101 to 250 individuals with an annual revenue not exceeding 250 million AED (Singh et al., 2022). The manufacturing sector is specifically chosen due to its pronounced impacts on both social and ecological systems, characterized by intense resource consumption and significant environmental footprints (Shehzad et al., 2023; Abbas and Khan, 2022). In the context of the UAE's economic diversification efforts, this sector's propensity for high energy use and environmental impact necessitates a closer examination of corporate sustainability practices. Thus, the sample for this study consists of manufacturing firms located within the UAE, aiming to shed light on the interplay between GLO, knowledge management, ROC, and GI in a high-impact industry setting.

Following the prior study of Singh et al. (2022) to identify small and medium-sized enterprises (SMEs) in the manufacturing sector of the UAE that align with the criteria outlined in UAE Cabinet Resolution No. 22 (2016), the Yellow Pages search engine "https://www.yellowpages.ae/" was employed. From April to June 2023, 295 manufacturing enterprises were randomly selected from this directory for inclusion in the data collection process. Ultimately, out of these, only 167 were granted permission to participate in our research. For this study, individuals occupying managerial positions were selected using a non-probabilistic convenience sampling approach as they possess decision-making authority in strategising. These respondents were deemed suitable because of their capability to access crucial information and contribute significantly to information dissemination across various organizational segments (Shehzad et al., 2023). Drawing from prior work by Abbas and Sağsan (2019) and Ooi (2014), 647 questionnaires were distributed with official authorisation to individuals in top-, middle-, and lower-level management roles, inviting them to participate in the data collection process given their familiarity with organizational policies and practices. Data were collected using diverse methods including online surveys and self-administered procedures. Consequently, 473 questionnaires were returned, with 65 deemed incomplete or lacking necessary information. After removing incomplete responses, 408 valid questionnaires were retained, yielding a commendable response rate of 63.06 percent. Detailed demographic information on the respondents is presented in Table 1.

3.2 Measurements

This study employed items derived from previous studies to ascertain the reliability and validity of the measurement instruments. All items were assessed using a five-point Likert-type scale, with responses ranging from "1" (strongly disagree) to "3" (neutral) and "5" (strongly agree). Eight items were used to delineate the two components of GI, GPDI and GPCI. These items were drawn from earlier research conducted by Chen et al. (2006) and Awan et al. (2021). Similarly, the independent variable of the study is GLO, and it is measured with four items adapted from Wang et al. (2020a), Fong and Chang (2012), and Sheng and Chien (2016). Moreover, the study model's mediating variable is KMC, measured with seven items adopted from Lei et al. (2021) and Mao et al. (2016). To reflect the ROC, we adopted three items from Wang et al. (2020b).

Previous studies have shown that contextual variables such as ownership, age, and size affect KM and GI (Abbas and Sağsan, 2019; Shehzad et al., 2023). Consequently, organizational parameters such as firm ownership, age, and size were utilised as controlled variables to account for differences in GI among organisations.

3.3. Common method bias

Researchers have used Harman's single-factor test to assess the potential presence of common method bias (CMB), as outlined by Podsakoff et al. (2003). The results indicated that the cumulative variance accounted for by the five factors was 70.726%. Specifically, the initial factor contributed to 29.223% of the variance, falling below the critical threshold of 50%, as established by Williams et al. (1989). This outcome suggests that the common method bias was not a significant concern in this study. Furthermore, as a precaution against CMB, researchers employed full collinearity, a method supported by existing literature. As advocated by Kock (2015) and corroborated by multiple social science scholars (Shehzad et al., 2022a; 2022d), a full collinearity value or Variance Inflation Factor (VIF) below 3.3 signifies the absence of CMB issues within the dataset. The analysis revealed that all latent constructs displayed full collinearity values lower than 3.3, confirming the lack of CMB problems in the data.

Table 1. Respondents demographic profile

	Characteristics	Frequency	Percent
Ownership			
	Non-State Owned	188	46.1
	State owned	220	53.9
Organization_size			
	<100	96	23.5
	100-200	76	18.6
	201-500	85	20.8
	501-1000	64	15.7
	>1000	87	21.3
Organization_age			
	< 5 Years	69	16.9
	6-10 Years	85	20.8
	11-20Years	96	23.5
	21-40years	78	19.1
	>40Years	80	19.6

4. Data analysis

Structural equation modelling (SEM) using a Partial Least Squares (PLS) technique was used to evaluate the structural linkages of the theoretical model (Hair et al., 2017). PLS-SEM was chosen over co-variance-based techniques such as LISREL, Mplus, and AMOS because it is widely recognised as a causal predictive method within the SEM framework (Sarstedt et al., 2014) and has been successfully utilised in similar studies by other researchers (Alam et al., 2022; Usman Shehzad et al., 2022). The versatility of PLS-SEM in meeting the needs of both confirmatory and exploratory research projects is a major factor in its selection. It is especially preferable to further explore novel phenomena when theory development in the area is still in its infancy (Henseler et al., 2016) or when examining complex linkages in structural relationships. Specifically, the sample size was not too large and the measurement model was reflective in nature; therefore, consistent PLS is the preferred method because the estimation is based on variance rather than covariance matrices (Hair et al., 2016). PLS-SEM has recently become popular among editors, reviewers, and academics because of the availability of cutting-edge statistical measures for PLS path modelling and robustness tests for structural models (Shehzad et al., 2022d; Jamil et al., 2022). In light of these considerations and the advantages of PLS-SEM, SmartPLS 4 software was used for the data analysis in this study.

4.1 Measurement model results

A comprehensive array of tests was conducted to ensure reliability and validity of the measurement constructs. Examination of the individual scale reliability revealed that all retained item factor loadings, exceeded the threshold of 0.700, with the highest loading at 0.891. This outcome underscores the robustness of individual item reliability as all retained items exhibited strong connections with their corresponding constructs. In terms of evaluating the reliability of each variable, three indices were employed: Cronbach's alpha ($C\alpha$), Dijkstra-Henseler's rho (ρA), and composite reliability (ρc), with the predefined threshold of ≥ 0.70 in accordance with Hair et al. (2017). Notably, the values of Cronbach's alpha for all constructs surpassed the 0.7 benchmarks, indicating their appropriateness. Furthermore, both ρA and ρc values for all latent constructs exceeded the recommended threshold of 0.7, confirming satisfactory construct reliability and internal consistency of the measurement model. To assess convergent validity, the average variance extracted (AVE) was scrutinised, adhering to the criterion of ≥ 0.50, as suggested by Fornell and Larcker (1981) and Hair et al. (2017). The analysis of AVE in Table 2 revealed that all five latent variables comfortably surpassed the recommended cutoff of 0.5. This robust performance underscores the measurement model's commendable convergent validity, affirming that the variables adequately encapsulated the shared variance among their respective indicators.

Table 2. Measurement validation

Constructs and Items		Loadings	VIF	Ca	rho a	rho c	AVE
Green learning orientation				0.839	0.843	0.892	0.674
GLO1	Employees think learning ability is important to ensure our firm survival and competitive advantage	0.806	2.200				
GLO2	Employees identify organizational goals and vision, and are willing to accept green new knowledge	0.851	2.465				
GLO3	Our firm's organizational structure is help for sharing and creating green knowledge	0.800	1.819				
GLO4	Top managers encourage employees to share and create green knowledge.	0.827	1.832				
Knowledge management capability				0.875	0.879	0.914	0.727
KMC1	Our firm has processes to gain knowledge on our suppliers, customers and partners	0.836	2.140				
KMC2	Our firm can generate new knowledge from existing knowledge	0.891	3.126				
KMC3	Our firm has processes in place to distribute knowledge throughout the organization	0.830	2.388				
KMC4	Our firm holds periodic meetings to inform employees about the latest innovations	0.852	2.011				
KMC5	Our firm has formal processes to share the best practice among the different fields of activities	Removed					
KMC6	In our firm, knowledge is accessible to those who need it	Removed					
KMC7	Our firm has processes for using knowledge to develop new products or services	Removed					
Green Product Innovation				0.854	0.872	0.901	0.694
GPDI1	Using less or non-polluting/toxic materials (using environmentally friendly material),	0.844	1.905				
GPDI2	Improving and designing environmentally friendly packaging (e.g.: Less paper and plastic material used) for existing and new products.	0.780	1.753				
GPDI3	Recovery of company's end-of-life products and recycling	0.870	2.152				
GPDI4	Using eco-labelling.	0.835	2.072				
Green Process Innovation				0.825	0.856	0.882	0.651
GPCI1	Recycle, reuse, and remanufacture material.	0.865	1.852				
GPCI2	Low energy consumption such as water, electricity, gas, and petrol during.	0.823	2.286				
GPCI3	Production/use/disposals of cleaner technology to make savings and prevent pollution (such as energy, water, and waste).	0.782	2.107				
GPCI4	Lessor no toxicity in the manufacturing process.	0.754	1.462				
Resource orchestration capability				0.780	0.807	0.869	0.689
ROC1	our firm has capability to absorb all kinds of knowledge resources.	0.846	1.557				
ROC2	our firm has capability to integrate all kinds of knowledge resources	0.788	1.665				
ROC3	our firm has capability to utilize all kinds of knowledge resources.	0.855	1.633				

Note (s): VIF = Variance inflation factor; Cα = Cronbach's alpha; ρA = Dijkstra-Henseler's rho; ρc = composite reliability

Next, according to the Fornell-Larcker criterion, the findings presented in the lower-left section of Table 3 reveal that the square root of each variable's Average Variance Extracted (AVE) surpassed the corresponding inter-construct correlations observed in the latent variable correlation matrix, which maps the associations between variables and other constructs within the structural model. This outcome implies that the constructs established within the measurement model exhibit satisfactory discriminant validity. Discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio of correlations criterion, which is known for its superiority in estimating unattenuated correlations among variables compared to alternative methods (Henseler et al., 2015; Franke and Sarstedt, 2019). The outcomes, featured in the upper-right quadrant of Table 3, demonstrate that the HTMT values were notably lower than the recommended benchmark of 0.85, according to the guidelines set by Henseler et al. (2015). This validation corroborates that associations between disparate constructs are weaker than those within the same construct. These findings collectively provide robust evidence of the measurement model's acceptable discriminant validity, substantiating that the relationships between distinct constructs remain weaker than those within individual constructs.

4.2. Structural model

The structural model was estimated in accordance with the guidelines provided by Hair et al. (2017). While evaluating the structural model, the study employed specific threshold values to assess the significance of different aspects of the model.

Effect size (f2): The effect size f2 indicates the impact of an independent variable on a dependent variable in the model. According to Cohen (1988), the f2 value of 0.02 is small, 0.15 is medium, and 0.35 is large. These effect sizes help determine the strength of the relationships between latent constructs in the structural model.

The collinearity threshold (VIF) refers to the correlation between predictor variables in the regression model. When evaluating the structural model, a minimal threshold VIF value between 3.3 and five is deemed acceptable (Hair et al., 2017). This threshold ensured that collinearity did not affect the stability and interpretability of the model.

Predictive relevance (Q2): The Q2 value was used to assess the predictive performance of the model by blindfolding. For a model with good predictive relevance, the Q2 value should be greater than zero (Hair et al., 2017). A positive Q2 value indicated that the model had predictive power and could accurately predict future observations.

Coefficient of determination (R2): The R2 value indicates the proportion of the variance in the dependent variable explained by the independent variables in the model. According to the guidelines of Cohen (1988), R2 values of ≥ 0.25, ≥ 0.50, and ≥ 0.75 are considered weak, moderate, and substantial, respectively. These thresholds help assess the strength of the relationships between variables in the structural model.

The results presented in Table 4 offer compelling evidence supporting the reliability and predictive relevance of the structural model in this analysis following the guidelines provided by (Hair et al., 2016; 2017).

The f2 values in Table 4 indicate that the model's latent constructs exhibit effect sizes that range from small to high. This finding suggests that the relationships between the independent and dependent variables are meaningful and contribute to the variance in the model. The inner VIF values for all variables were less than 3.3, as shown in Table 4. This indicates that collinearity is not a concern between independent and dependent variables. The absence of collinearity ensures the stability and accuracy of the parameter estimates in the model. The Q2 values obtained by blindfolding for KMC (Q2= 0.286), GPDI (Q2= 0.089), and GPCI (Q2= 0.240) are significantly greater than zero. This indicates that the model has a predictive relevance in terms of out-of-sample predictions. The R2 values for the KMC (R2= 0.404), GPDI (R2=0.137) and GPCI (R2= 0.409). These R2 values are considerably large and acceptable for social science and behavioural research, as supported by Shehzad et al. (2022d) and Shehzad et al. (2022b). The substantial R2 values further confirm the structural relationship's predictive relevance in terms of out-of-sample predictions.

Moreover, the standardised root mean square residual (SRMR) values for both the saturated and estimated models were 0.075 and 0.080, respectively. These scores fell within the acceptable range (0 to 1), affirming the model's goodness of fit, as delineated by Hair et al. (2019) and Henseler et al. (2015). Consequently, this evidences the model's parsimony and plausibility (Henseler et al., 2016).

Table 3. Discriminant validity

Constructs	Mean	Std. Dev	GLO	GPCI	GPDI	KMC	ROC
GLO	4.100	0.850	**0.821**	0.549	0.288	0.629	0.061
GPCI	3.838	0.853	0.631	**0.807**	0.337	0.584	0.001
GPDI	4.166	0.713	0.331	0.384	**0.833**	0.233	0.198
KMC	4.138	0.554	0.724	0.646	0.255	**0.853**	0.034
ROC	3.997	0.879	0.103	0.105	0.237	0.085	**0.830**

Note(s): GLO=Green learning orientation; KMC=Knowledge management capability; GPDI=Green product innovation; GPCI=Green process innovation; ROC=Resource orchestration capability

Diagonal and bold values are the square roots of the AVE

Below the diagonal elements are the correlations between the construct's values;

Above the diagonal elements are the HTMT values

Table 4. F-square, VIF, R-square and Q-Square

	F-square			VIF			R-square	Q-Square		
	GPCI	GPDI	KMC	GPCI	GPDI	KMC		SSO	SSE	Q^2 (=1-SSE/SSO)
GLO	0.092	0.034	0.676	1.658	1.658	1.027				
KMC	0.162	0.006		1.655	1.655		0.404	1632.000	1165.892	0.286
GPDI							0.137	1632.000	1486.827	0.089
GPCI							0.409	1632.000	1240.081	0.240
ROC	0.001	0.039	0.000	1.004	1.004	1.014				
ROC x KMC	0.021	0.019		1.001	1.001					
ROC x GLO			0.015			1.035				

4.2.1 Hypotheses results

The study encompasses a comprehensive framework consisting of two direct, two mediating, and three moderating hypotheses, along with two hypotheses that focus on moderated mediation. These hypotheses were validated by analysing the path coefficients and their statistical significance. The outcomes of the analyses tabulated results in Table 5, provide insight into the results of the hypotheses.

Following the recommendations outlined by Hair et al. (2019), a bootstrapping approach involving 5,000 resamples was employed to assess the structural model thoroughly. Initially, direct relationships between the constructs were scrutinised. As indicated in the findings presented in Table 5, a robust and positive correlation was observed between GLO and GPDI ($\beta=0.221$, $p<0.001$) and between GLO and GPCI ($\beta=0.301$, $p<0.001$). These results support Hypotheses 1a and 1b, underscoring the affirmative and statistically significant associations.

Next, to assess the indirect hypotheses, the study followed the suggestions of Preacher and Hayes (2008) and bootstrapping of the indirect effect was performed. For H2a and H2b, Results revealed that GLO > KMC> GPDI ($\beta=0.059$, $p>0.05$) was insignificant, but GLO > KMC > GPCI ($\beta=0.256$, $p<0.001$) was significant. Additionally, it has already been confirmed that GLO has an apparent positive effect on GPCI. Consequently, it can be concluded that KMC partly mediates the association between GLO and GPCI; thus, the result does not support H2a, but supports 2b.

Next, ROC significantly moderates the relationship between GLO and KMC ($\beta=0.090$, $p=0.027$). Similarly, ROC significantly and positively moderates the relationship between KMC and GPDI ($\beta=0.156$, $p=0.016$) and GPCI ($\beta=0.136$, $p=0.019$). Furthermore, we plot the moderating effects by applying Stone and Hollenbeck's (1989) suggestion. As shown in Fig. 2, the relationship between GLO and KMC was more positive when ROC was high. Similarly, Fig. 3 and 4 indicate that KMC has a stronger positive relationship with GPDI and GPCI when ROC is high. Therefore, H3a, H3b, and H3c are supported.

Table 5. Hypothesis results

Hypotheses	IV	→	Med/Mod	→	DV	Beta	STDEV	T statistics	P values	2.5%	97.5%	Conclusion
Control effects												
+Ve	Ownership	→			KMC	-0.025	0.055	-0.461	0.645	-0.134	0.083	Not Supported
+Ve	Organization size	→			KMC	-0.033	0.019	-1.763	0.079	-0.071	0.004	Not Supported
+Ve	Organization age	→			KMC	-0.009	0.020	-0.459	0.647	-0.049	0.031	Not Supported
+Ve	Ownership	→			GPDI	-0.030	0.071	-0.429	0.668	-0.170	0.109	Not Supported
+Ve	Organization size	→			GPDI	0.040	0.024	1.628	0.104	-0.008	0.088	Not Supported
+Ve	Organization age	→			GPDI	0.027	0.026	1.036	0.301	-0.024	0.078	Not Supported
+Ve	Ownership	→			GPCI	0.036	0.085	0.423	0.673	-0.131	0.202	Not Supported
+Ve	Organization size	→			GPCI	0.059	0.029	2.014	0.045	0.001	0.116	Supported
+Ve	Organization age	→			GPCI	-0.024	0.031	-0.782	0.435	-0.085	0.037	Not Supported
Direct effects												
Hypothesis H1a	GLO	→	GPDI			0.221	0.060	3.705	0.000	0.101	0.336	Supported
Hypothesis H1b	GLO	→	GPCI			0.301	0.056	5.363	0.000	0.185	0.407	Supported
Mediating effects												
Hypothesis H2a	GLO	→	KMC	→	GPDI	0.059	0.041	1.442	0.149	-0.018	0.143	Not Supported
Hypothesis H2b	GLO	→	KMC	→	GPCI	0.256	0.044	5.891	0.000	0.181	0.351	Supported
Moderating effects												
Hypothesis H3a	GLO	x	ROC	→	KMC	0.090	0.041	2.208	0.027	-0.001	0.158	Supported
Hypothesis H3b	KMC	x	ROC	→	GPDI	0.156	0.065	2.410	0.016	0.019	0.273	Supported
Hypothesis H3c	KMC	x	ROC	→	GPCI	0.136	0.058	2.343	0.019	0.004	0.232	Supported

Note(s): GLO=Green learning orientation; KMC=Knowledge management capability; GPDI=Green product innovation; GPCI=Green process innovation; ROC=Resource orchestration capability

Table 6. Moderated mediation results

Hypotheses	Conditional indirect effects at different level of AC	Estimate	S.E.	T-value	P-Value
Hypothesis 4a	KE→ KMC→ GPDI				
	- 1 SD	-0.057	0.053	-1.089	0.276
	+1 SD	0.239	0.065	3.667	0.000
	Difference	0.296	0.090	3.292	0.001
Hypothesis 4b	KE→ KMC→ GPCI				
	- 1 SD	0.132	0.048	2.747	0.006
	+1 SD	0.427	0.078	5.506	0.000
	Difference	0.295	0.089	3.315	0.001

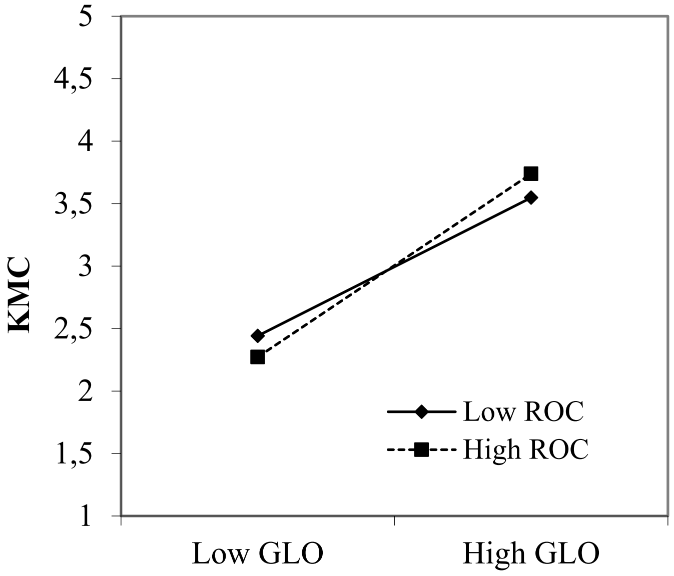

Figure 2. GLO*ROC on KMC

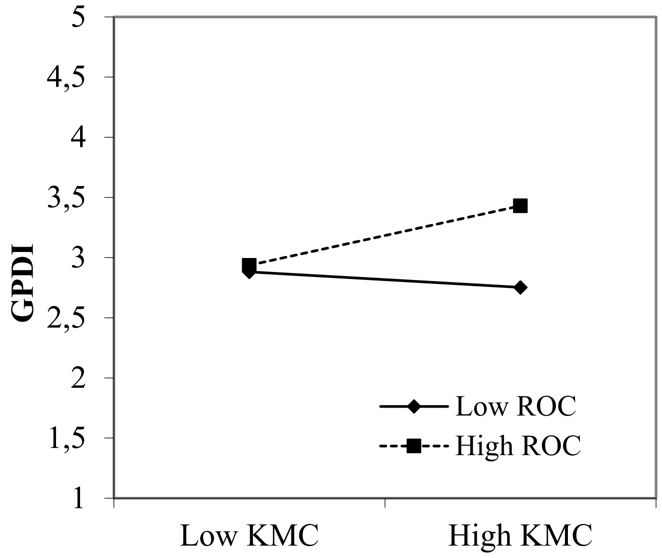

Figure 3. KMC*ROC on GPDI

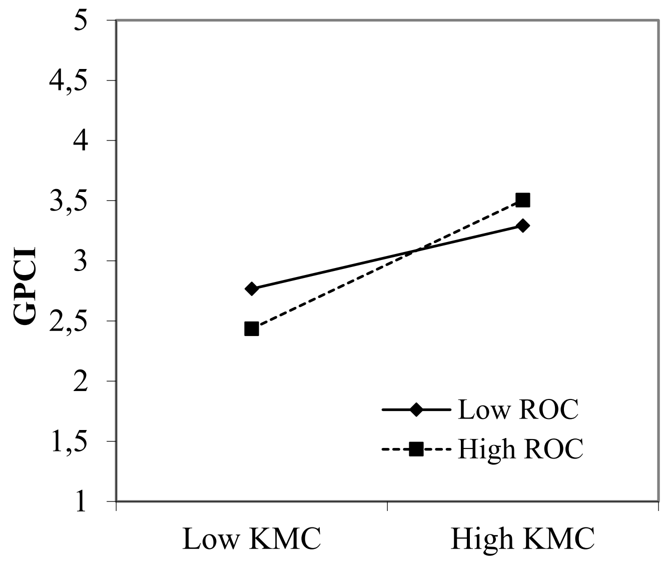

Figure 4. KMC*ROC on GPCI

4.2.2. Moderated mediation effects

Given the substantial mediating impact observed within the research framework, it is logical to explore the potential for a moderated mediation phenomenon involving ROC (Preacher and Hayes, 2008). As recommended by Edwards and Lambert (2007), we investigated the direct effects of research structure and gauging coefficient estimations for each instance of GLO influencing KMC. We subsequently conducted a selective analysis of conditional indirect effects, assessing the influence of GLO on both GPDI and GPCI through KMC and evaluated the straightforward impacts for different degrees of ROC (-1 SD, mean, +1 SD) through 5000 bootstrap samples. The outcomes, outlined in Table 6, reveal that the mediating impact of GLO on GPDI via KMC is notably more prominent at elevated ROC levels ($\beta=0.239$, $p<0.001$) than at lower levels ($\beta=-0.057$, $p=0.276$). The two impact coefficients also showed a significant disparity ($\beta=0.296$, $p=0.001$). Similarly, the mediating effect of GLO on GPCI through KMC was considerably amplified at elevated ROC levels ($\beta=0.427$, $p=0.000$) compared to reduced ROC levels ($\beta=0.132$, $p=0.001$), displaying significant differentiation between the two influence coefficients ($\beta=0.295$, $p=0.001$). Based on these findings, we can deduce that both H4a and H4b, which concern moderated mediation aspects, garner support. The results underscore that the mediating role of KMC within the GLO-GPDI/GPCI nexus varies according to the ROC level. This emphasises the noteworthy influence of the moderating factor ROC in shaping the potency and orientation of the mediation process, thus enriching our comprehensive comprehension of the foundational mechanisms within the research configuration.

5. Discussion

GI capability is regarded as one of the most effective solutions for assisting organisations in adapting to rapidly changing technological environments. Customers need competitive pressure, meet environmental regulations, and achieve long-term competitive advantages (Abbas and Khan, 2022; Shehzad et al., 2022d; Wang et al., 2020a). This study demonstrated the significant effects of GLO on KMC and, as a result, distinct elements of GI capacity, specifically GPDI and GPCI, by examining the novel route and mechanism leading to GI. This study makes substantial contributions to the theoretical and practical understanding of GLO, knowledge management, and GI through the following areas of research and the formulation of hypotheses.

First, the current study examined the connection between GLO and the two key components of GI: green product and GPDI. The results of this study add to the expanding body of evidence on the significance of organizational learning in encouraging environmentally friendly practices and innovation in enterprises. One of the most important studies is the significance of GLO in developing environmentally friendly novel products. Organisations that emphasise environmental issues, laws, and sustainable practices are better suited to generating creative solutions to environmental difficulties (S. Kraft and Bausch, 2016; Wang et al., 2020a). This finding supports the idea that a thorough understanding of green concepts and constant commitment to learning and adapting may lead to the creativity and development of new eco-friendly goods. In addition to GPDI, our findings show that GLO significantly affected GPDI. Organisations that create an environmental learning culture are more likely to find and implement creative approaches to minimise resource consumption, waste output, and carbon emissions across all operational activities. These findings are consistent with those of Wang et al. (2020a) that learning orientation substantially influences GI. This is consistent with the concept that an organisation's ability to learn and adapt to green practices may promote creative process changes, resulting in increased efficiency, less environmental impact, and long-term sustainability.

Second, the recent literature reveals that research on innovation in terms of GPDI and GPCI is thriving because of its theoretical significance and practical relevance (Shehzad et al., 2022b; Wang et al., 2022; Shahzad et al., 2020). Firms, on the other hand, find it difficult to follow GI capacity. Although scholars have focused on the interaction between GLO, organizational factors, and GI, the insights and causative mechanisms underlying these relationships are not yet thoroughly understood (Wang et al., 2020a). To address these concerns, this study built a model to examine the possible mediator of KMC between GLO and GI, GPDI, and GPCI. The results of this study add to a better understanding of the processes through which organizational learning influences innovation outcomes in the context of environmental sustainability. The study shows that knowledge management competency does not mediate the association between GLO and green product creation. This finding suggests that the impact of GLO on green product creation is independent of an organisation's ability to manage and distribute information. This means that enterprises can transfer their gained green knowledge directly into fresh product ideas without requiring an extra knowledge management layer. In contrast, the results highlighted the significance of knowledge management skills as a moderator in the association between GLO and GPDI. This implies that firms that emphasise learning about sustainable practices are more likely to establish knowledge management skills that promote the adoption of new green processes. In this context, knowledge management serves as a bridge that facilitates the incorporation of green information into concrete initiatives for process improvement. This highlights the need to harness and share learned green practices efficiently to promote systematic and operational advances, resulting in lower environmental impact and increased process efficiency.

Third, prior research has shown that the ability to orchestrate resources moderates GI fostering (Shehzad et al., 2023; Wang et al., 2020b). Existing research also emphasises the need to examine the possible moderating mechanism of organizational capacity characteristics on the relationship between organizational variables and GI practices (Wang et al., 2020b; Wang et al., 2022; Shehzad et al., 2023). To fill these theoretical gaps, the present study investigated whether ROC modifies the link between GLO, KMC, and the two components of GI, namely, GPDI and GPCI. The findings show that ROC moderates between GLO and KMC, and between KMC and two GI aspects: GPDI and GPCI. The study results show that the impacts of GLO on KMC and the function of KMC in driving GPDI and GPCI differ greatly, depending on the degree of ROC. This study's findings could provide a plausible explanation because organisations with the capacity to manage resources effectively are better positioned to take advantage of their knowledge management abilities and transform their archived green knowledge into cutting-edge green products and processes. Organisations that effectively coordinate resources may use their knowledge management skills to systematically improve operational processes, resulting in increased efficiency and decreased environmental impact. These firms may integrate their accumulated information into practical plans to promote long-term GI by dedicating resources to support process changes and deployments.

5.1. Theoretical implications

This study succinctly advances theoretical understanding in the sustainability domain by offering a comprehensive exploration of constructs such as GLO, KMC, ROC, GPDI, and GPCI. By integrating these constructs within the KBV theoretical framework, this research not only forges new theoretical connections, but also addresses a critical gap in the existing literature, particularly in the context of sustainability. While previous studies (Wang et al., 2023; Li et al., 2017; Shehzad et al., 2022c) have predominantly focused on the influence of external environmental regulations, green entrepreneurial orientation, and knowledge-oriented leadership on GI, they have not sufficiently explored the impact of internal strategies, such as GLO. Our study brings this aspect to the forefront, arguing that GLO is not just an operational choice, but a strategic imperative that significantly influences both GPDI and GPCI. This perspective is supported by recent research Wang et al. (2020a), which suggests that GLO are a key driver of organizational innovation. By highlighting the role of GLO, this study contributes to a more nuanced understanding of how internal organizational strategies can be leveraged to foster GI. This suggests that GLO, when effectively integrated with KMC and ROC, can lead to enhanced GI, particularly in product development and process innovation. This theoretical advancement underscores the importance of internal capabilities and strategies in achieving sustainable innovation goals, thereby extending KBV theory to encompass internal operational dynamics as critical to fostering an environment conducive to GI.

Second, In the realm of business and industrial marketing, the transition from GLO to GI is pivotal. While GLO is recognized for nurturing sustainable innovation capabilities within organizations (Wang et al., 2020a), the role of KMC as a bridge in this process has received scant attention. Evidence suggests that KMC is crucial in driving innovation, enabling businesses to effectively capture and utilize knowledge for innovation (Lei et al., 2021; Ben Arfi et al., 2018; Riaz et al., 2023). This study delves into KMC's mediating role between GLO and GI, confirming its significant influence. By doing so, it not only enriches the existing understanding of GLO's impact on GI but also highlights practical approaches for businesses to enhance their innovation strategies through effective knowledge management. This insight is particularly valuable for firms in the industrial sector, aiming to integrate sustainable practices into their marketing and innovation efforts, thereby broadening the scope of research in business applications and sustainability.

Thirdly, this study makes a significant contribution by investigating the moderating role of ROC in the relationships between GLO, KMC, and the two dimensions of GI, namely GPDI and GPCI. Previous research by Wang et al. (2020b) and Shehzad et al. (2023), has established that ROC plays a facilitating role in GI. This finding highlights the crucial role of ROC as a critical competence that effectively coordinates information and enables the realization of GI. By doing so, ROC helps firms effectively manage environmental knowledge and translate it into innovative practices. Additionally, the moderated mediation effect emphasizes the importance of KMC and ROC, shedding light on how GLO drives both GPDI and GPCI. These findings add to the existing body of research by providing a more comprehensive understanding of the function of ROC and illustrating how GLO, KMC, and ROC interact synergistically to promote the development of both GPDI and GPCI.

5.2. Practical implications

The results of this study have several practical implications. First, from a practical perspective, this research underscores the importance of fostering a culture of green learning within organisations to enhance their GI capabilities. By providing resources for ongoing education and training in environmentally conscious practices, businesses can empower employees to ideate and implement sustainable innovation. The link between GLO and GI emphasises the need for businesses to focus on technological advancements and enhance their workforce's understanding of environmental issues and solutions.

Second, the non-mediated relationship between GLO and GPDI implies that organisations should emphasise the direct translation of acquired green knowledge into tangible product innovations. This highlights the strategic importance of directly integrating environmentally conscious learning into the product development process, without relying overly on formal knowledge management mechanisms. Conversely, the mediated relationship between GLO and GPDI emphasises the need for organisations to develop strong knowledge management capabilities to effectively transform acquired green learning into operational enhancements. By implementing robust knowledge-sharing platforms, communication channels, and repositories, organisations can systematically disseminate and utilise green knowledge to drive process innovations that align with sustainability goals.

Third, In the context of business and industrial marketing, enhancing green innovation (GI) outcomes necessitates a strategic focus on the symbiotic relationship between resource management, knowledge sharing, and environmental learning. This strategy entails equipping firms with the tools to efficiently capture, organize, and disseminate information related to sustainability practices. By fostering an ecosystem where green knowledge is accessible through cross-functional teamwork and dedicated training, companies can effectively apply this intelligence to drive market differentiation and customer value. For manufacturers specifically, aligning environmental initiatives with comprehensive knowledge management strategies can substantially elevate their green product development and process innovations. This requires deep investments not just in research and development but also in crafting marketing strategies that highlight the environmental benefits of their offerings, appealing to the increasingly eco-conscious market. Investing in green R&D, along with enhancing green supply chain practices, positions firms to produce solutions that are both environmentally sustainable and commercially viable. Such an approach should extend to optimizing internal operations through resource allocation focused on reducing waste, saving energy, and adopting sustainable procurement practices. This operational ethos, supported by investments in cutting-edge technologies and employee training, not only enhances a firm's sustainability credentials but also its innovation prowess and market competitiveness. Ultimately, in the competitive landscape of industrial marketing, the deliberate fusion of sustainability with knowledge management practices offers a robust framework for businesses aiming to achieve sustainable growth and a strong market presence through eco-innovation.

5.3. Study limitations

This study has some limitations that point to areas for further investigation. First, the research was limited to a single sector and setting, which might make its results less applicable to other contexts. The unique qualities of the chosen sample may have affected the connections evaluated, and attention should be paid when extrapolating these results to various organizational environments. Second, a cross-sectional design was used to collect data at a specific time. This design limits the capacity to establish causation or infer the direction of the connection. Understanding the time dynamics among variables may be possible using longitudinal or experimental methods. Therefore, additional research techniques need to be considered in further investigations. Finally, while KMC and ROC were the primary areas of this study, additional variables (such as green absorptive capacity, green knowledge management, and environmental turbulence) may influence the relationships investigated. These unexplored factors may lead to a deeper understanding of operative mechanisms.

References

Abbas, J. and Khan, S.M. (2022), "Green knowledge management and organizational green culture: an interaction for organizational green innovation and green performance", *Journal of Knowledge Management,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JKM-03-2022-0156

Abbas, J. and Sağsan, M. (2019), "Impact of knowledge management practices on green innovation and corporate sustainable development: A structural analysis", *Journal of Cleaner Production,* Vol. 229, pp. 611-20. https://doi.org/10.1016/j.jclepro.2019.05.024

Alam, S., Zhang, J. and Shehzad, M.U. (2022), "The mechanism of knowledge management processes toward knowledge workers operational performance under green technology implementation: an empirical analysis", *Kybernetes,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/K-06-2022-0859

Alam, S., Zhang, J. and Shehzad, M.U. (2023), "The mechanism of knowledge management processes toward knowledge workers operational performance under green technology implementation: an empirical analysis", *Kybernetes,* Vol. 52 No. 12, pp. 6542-71. https://doi.org/10.1108/K-06-2022-0859

Albort-Morant, G., Leal-Millán, A. and Cepeda-Carrión, G. (2016), "The antecedents of green innovation performance: A model of learning and capabilities", *Journal of Business Research,* Vol. 69 No. 11, pp. 4912-17. https://doi.org/10.1016/j.jbusres.2016.04.052

Albort-Morant, G., Leal-Millán, A., Cepeda-Carrion, G. and Henseler, J. (2018a), "Developing green innovation performance by fostering of organizational knowledge and coopetitive relations", *Review of Managerial Science,* Vol. 12 No. 2, pp. 499-517. 10.1007/s11846-017-0270-z

Albort-Morant, G., Leal-Rodríguez, A.L. and De Marchi, V. (2018b), "Absorptive capacity and relationship learning mechanisms as complementary drivers of green innovation performance", *Journal of Knowledge Management,* Vol. 22 No. 2, pp. 432-52. 10.1108/JKM-07-2017-0310

Amit, R. and Schoemaker, P.J.H. (1993), "Strategic assets and organizational rent", *Strategic Management Journal,* Vol. 14 No. 1, pp. 33-46. https://doi.org/10.1002/smj.4250140105

Argote, L. and Ingram, P. (2000), "Knowledge Transfer: A Basis for Competitive Advantage in Firms", *Organizational Behavior and Human Decision Processes,* Vol. 82 No. 1, pp. 150-69. https://doi.org/10.1006/obhd.2000.2893

Asiaei, K., Bontis, N., Alizadeh, R. and Yaghoubi, M. (2022), "Green intellectual capital and environmental management accounting: Natural resource orchestration in favor of environmental performance", *Business Strategy and the Environment,* Vol. 31 No. 1, pp. 76-93. https://doi.org/10.1002/bse.2875

Atitumpong, A. and Badir, Y.F. (2018), "Leader-member exchange, learning orientation and innovative work behavior", *Journal of Workplace Learning,* Vol. 30 No. 1, pp. 32-47. 10.1108/JWL-01-2017-0005

Awan, U., Arnold, M.G. and Gölgeci, I. (2021), "Enhancing green product and process innovation: Towards an integrative framework of knowledge acquisition and environmental investment", *Business Strategy and the Environment,* Vol. 30 No. 2, pp. 1283-95. https://doi.org/10.1002/bse.2684

Baker, W.E. and Sinkula, J.M. (1999), "Learning Orientation, Market Orientation, and Innovation: Integrating and Extending Models of Organizational Performance", *Journal of Market-Focused Management,* Vol. 4 No. 4, pp. 295-308. 10.1023/A:1009830402395

Ben Arfi, W., Hikkerova, L. and Sahut, J.-M. (2018), "External knowledge sources, green innovation and performance", *Technological Forecasting and Social Change,* Vol. 129, pp. 210-20. https://doi.org/10.1016/j.techfore.2017.09.017

Bryman, A. (2007), "Barriers to Integrating Quantitative and Qualitative Research", *Journal of Mixed Methods Research,* Vol. 1 No. 1, pp. 8-22. https://doi.org/10.1177/2345678906290531

Cancino, C.A., La Paz, A.I., Ramaprasad, A. and Syn, T. (2018), "Technological innovation for sustainable growth: An ontological perspective", *Journal of Cleaner Production,* Vol. 179, pp. 31-41. https://doi.org/10.1016/j.jclepro.2018.01.059

Chadwick, C., Super, J.F. and Kwon, K. (2015), "Resource orchestration in practice: CEO emphasis on SHRM, commitment-based HR systems, and firm performance", *Strategic Management Journal,* Vol. 36 No. 3, pp. 360-76. https://doi.org/10.1002/smj.2217

Chawla, D. and Joshi, H. (2010), "Knowledge management initiatives in Indian public and private sector organizations", *Journal of Knowledge Management,* Vol. 14 No. 6, pp. 811-27. 10.1108/13673271011084871

Chen, Y.-S. (2008a), "The Driver of Green Innovation and Green Image – Green Core Competence", *Journal of Business Ethics,* Vol. 81 No. 3, pp. 531-43. https://doi.org/10.1007/s10551-007-9522-1

Chen, Y.-S. (2008b), "The Positive Effect of Green Intellectual Capital on Competitive Advantages of Firms", *Journal of Business Ethics,* Vol. 77 No. 3, pp. 271-86. https://doi.org/10.1007/s10551-006-9349-1

Chen, Y.-S., Lai, S.-B. and Wen, C.-T. (2006), "The Influence of Green Innovation Performance on Corporate Advantage in Taiwan", *Journal of Business Ethics,* Vol. 67 No. 4, pp. 331-39. https://doi.org/10.1007/s10551-006-9025-5

Cillo, V., Garcia-Perez, A., Del Giudice, M. and Vicentini, F. (2019), "Blue-collar workers, career success and innovation in manufacturing", *Career Development International,* Vol. 24 No. 6, pp. 529-44. 10.1108/CDI-11-2018-0276

Cohen, J. (1988), *Statistical power analysis for the behavioral sciences,* Routledge.

D'Angelo, A. and Presutti, M. (2019), "SMEs international growth: The moderating role of experience on entrepreneurial and learning orientations", *International Business Review,* Vol. 28 No. 3, pp. 613-24. https://doi.org/10.1016/j.ibusrev.2018.12.006

DeCarolis, D.M. and Deeds, D.L. (1999), "The impact of stocks and flows of organizational knowledge on firm performance: an empirical investigation of the biotechnology industry", *Strategic Management Journal,* Vol. 20 No. 10, pp. 953-68. https://doi.org/10.1002/(SICI)1097-0266(199910)20:10<953::AID-SMJ59>3.0.CO;2-3

Donate, M.J. and Sánchez de Pablo, J.D. (2015), "The role of knowledge-oriented leadership in knowledge management practices and innovation", *Journal of Business Research,* Vol. 68 No. 2, pp. 360-70. https://doi.org/10.1016/j.jbusres.2014.06.022

du Plessis, M. (2007), "The role of knowledge management in innovation", *Journal of Knowledge Management,* Vol. 11 No. 4, pp. 20-29. 10.1108/13673270710762684

Edwards, J.R. and Lambert, L.S. (2007), "Methods for integrating moderation and mediation: A general analytical framework using moderated path analysis", *Psychological Methods,* Vol. 12, pp. 1-22. https://doi.org/10.1037/1082-989X.12.1.1

Fong, C.-M. and Chang, N.-J. (2012), "The impact of green learning orientation on proactive environmental innovation capability and firm performance", *African Journal of Business Management,* Vol. 6 No. 3, pp. 727

Fornell, C. and Larcker, D.F. (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", *Journal of Marketing Research,* Vol. 18 No. 1, pp. 39-50. https://doi.org/10.1177/002224378101800104

Franceschini, S., Faria, L.G.D. and Jurowetzki, R. (2016), "Unveiling scientific communities about sustainability and innovation. A bibliometric journey around sustainable terms", *Journal of Cleaner Production,* Vol. 127, pp. 72-83. https://doi.org/10.1016/j.jclepro.2016.03.142

Franke, G. and Sarstedt, M. (2019), "Heuristics versus statistics in discriminant validity testing: a comparison of four procedures", *Internet Research,* Vol. 29 No. 3, pp. 430-47. 10.1108/IntR-12-2017-0515

Grant, R.M. (1996), "Toward a knowledge-based theory of the firm", *Strategic Management Journal,* Vol. 17 No. S2, pp. 109-22. https://doi.org/10.1002/smj.4250171110

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2016), *A primer on partial least squares structural equation modeling (PLS-SEM). Sage*, Thousand Oaks, CA.

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2017), *A primer on partial least squares structural equation modeling (PLS-SEM),* Sage publications.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019), "When to use and how to report the results of PLS-SEM", *European Business Review,* Vol. 31 No. 1, pp. 2-24. 10.1108/EBR-11-2018-0203

Hashim, R., Bock, A.J. and Cooper, S. (2015), "The relationship between absorptive capacity and green innovation", *International Journal of Industrial and Manufacturing Engineering,* Vol. 9 No. 4, pp. 1065-72

Henseler, J., Hubona, G. and Ray, P.A. (2016), "Using PLS path modeling in new technology research: updated guidelines", *Industrial Management & Data Systems,* Vol. 116 No. 1, pp. 2-20. 10.1108/IMDS-09-2015-0382

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling", *Journal of the Academy of Marketing Science,* Vol. 43 No. 1, pp. 115-35. 10.1007/s11747-014-0403-8

Huang, J.-W. and Li, Y.-H. (2018), "How resource alignment moderates the relationship between environmental innovation strategy and green innovation performance", *Journal of Business & Industrial Marketing,* Vol. 33 No. 3, pp. 316-24. https://doi.org/10.1108/JBIM-10-2016-0253

Hult, G.T.M., Hurley, R.F. and Knight, G.A. (2004), "Innovativeness: Its antecedents and impact on business performance", *Industrial Marketing Management,* Vol. 33 No. 5, pp. 429-38. https://doi.org/10.1016/j.indmarman.2003.08.015

Idrees, H., Xu, J., Andrianarivo Andriandafiarisoa Ralison, N.A. and Kadyrova, M. (2023), "Does leadership and management support facilitate green knowledge acquisition and green innovation: a moderated mediation approach", *Business Process Management Journal,* Vol. 29 No. 4, pp. 1249-76. 10.1108/BPMJ-12-2022-0639

Jamil, K., Dunnan, L., Gul, R.F., Shehzad, M.U., Gillani, S.H.M. and Awan, F.H. (2022), "Role of Social Media Marketing Activities in Influencing Customer Intentions: A Perspective of a New Emerging Era", *Front Psychol,* Vol. 12, pp. 808525. https://doi.org/10.3389/fpsyg.2021.808525

Jiménez-Jimenez, D., Sanz Valle, R. and Hernandez-Espallardo, M. (2008), "Fostering innovation", *European Journal of Innovation Management,* Vol. 11 No. 3, pp. 389-412. 10.1108/14601060810889026

Khedhaouria, A., Montani, F. and Thurik, R. (2017), "Time pressure and team member creativity within R&D projects: The role of learning orientation and knowledge sourcing", *International Journal of Project Management,* Vol. 35 No. 6, pp. 942-54. https://doi.org/10.1016/j.ijproman.2017.04.002

Kock, N. (2015), "Common Method Bias in PLS-SEM: A Full Collinearity Assessment Approach", *International Journal of e-Collaboration (IJeC),* Vol. 11 No. 4, pp. 1-10. 10.4018/ijec.2015100101

Kogut, B. and Zander, U. (1992), "Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology", *Organization Science,* Vol. 3 No. 3, pp. 383-97. 10.1287/orsc.3.3.383

Kong, T., Feng, T., Huang, Y. and Cai, J. (2020), "How to convert green supply chain integration efforts into green innovation: A perspective of knowledge-based view", *Sustainable Development,* Vol. 28 No. 5, pp. 1106-21. https://doi.org/10.1002/sd.2062

Le, P.B. and Lei, H. (2019), "Determinants of innovation capability: the roles of transformational leadership, knowledge sharing and perceived organizational support", *Journal of Knowledge Management,* Vol. 23 No. 3, pp. 527-47. 10.1108/JKM-09-2018-0568

Leal-Rodríguez, A.L., Ariza-Montes, A.J., Morales-Fernández, E. and Albort-Morant, G. (2018), "Green innovation, indeed a cornerstone in linking market requests and business performance. Evidence from the Spanish automotive components industry", *Technological Forecasting and Social Change,* Vol. 129, pp. 185-93. https://doi.org/10.1016/j.techfore.2017.07.021

Lee, V.-H., Foo, A.T.-L., Leong, L.-Y. and Ooi, K.-B. (2016), "Can competitive advantage be achieved through knowledge management? A case study on SMEs", *Expert Systems with Applications,* Vol. 65, pp. 136-51. https://doi.org/10.1016/j.eswa.2016.08.042

Lei, H., Khamkhoutlavong, M. and Le, P.B. (2021), "Fostering exploitative and exploratory innovation through HRM practices and knowledge management capability: the moderating effect of knowledge-centered culture", *Journal of Knowledge Management,* Vol. 25 No. 8, pp. 1926-46

Li, D., Zhao, Y., Zhang, L., Chen, X. and Cao, C. (2018), "Impact of quality management on green innovation", *Journal of Cleaner Production,* Vol. 170, pp. 462-70. https://doi.org/10.1016/j.jclepro.2017.09.158

Li, D., Zheng, M., Cao, C., Chen, X., Ren, S. and Huang, M. (2017), "The impact of legitimacy pressure and corporate profitability on green innovation: Evidence from China top 100", *Journal of Cleaner Production,* Vol. 141, pp. 41-49. https://doi.org/10.1016/j.jclepro.2016.08.123

Mao, H., Liu, S., Zhang, J. and Deng, Z. (2016), "Information technology resource, knowledge management capability, and competitive advantage: The moderating role of resource commitment", *International Journal of Information Management,* Vol. 36 No. 6, Part A, pp. 1062-74. https://doi.org/10.1016/j.ijinfomgt.2016.07.001

Ooi, K.-B. (2014), "TQM: A facilitator to enhance knowledge management? A structural analysis", *Expert Systems with Applications,* Vol. 41 No. 11, pp. 5167-79. https://doi.org/10.1016/j.eswa.2014.03.013

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology,* Vol. 88 No. 5, pp. 879

Preacher, K.J. and Hayes, A.F. (2008), "Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models", *Behavior Research Methods,* Vol. 40 No. 3, pp. 879-91. 10.3758/BRM.40.3.879

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

Riaz, M., Jie, W., Ali, Z., Sherani, M. and Yutong, L. (2023), "Do knowledge-oriented leadership and knowledge management capabilities help firms to stimulate ambidextrous innovation: moderating role of technological turbulence", *European Journal of Innovation Management,* Vol. ahead-of-print No. ahead-of-print. 10.1108/EJIM-08-2022-0409

S. Kraft, P. and Bausch, A. (2016), "How Do Transformational Leaders Promote Exploratory and Exploitative Innovation? Examining the Black Box through MASEM", *Journal of Product Innovation Management,* Vol. 33 No. 6, pp. 687-707. https://doi.org/10.1111/jpim.12335

Sarstedt, M., Ringle, C.M., Henseler, J. and Hair, J.F. (2014), "On the Emancipation of PLS-SEM: A Commentary on Rigdon (2012)", *Long Range Planning,* Vol. 47 No. 3, pp. 154-60. https://doi.org/10.1016/j.lrp.2014.02.007

Schiederig, T., Tietze, F. and Herstatt, C. (2012), "Green innovation in technology and innovation management – an exploratory literature review", *R&D Management,* Vol. 42 No. 2, pp. 180-92. https://doi.org/10.1111/j.1467-9310.2011.00672.x

Shahzad, M., Qu, Y., Zafar, A.U., Rehman, S.U. and Islam, T. (2020), "Exploring the influence of knowledge management process on corporate sustainable performance through green innovation", *Journal of Knowledge Management,* Vol. 24 No. 9, pp. 2079-106. https://doi.org/10.1108/JKM-11-2019-0624

Shehzad, M.U., Zhang, J., Alam, S. and Cao, Z. (2022a), "Determining the role of sources of knowledge and IT resources for stimulating firm innovation capability: a PLS-SEM approach", *Business Process Management Journal,* Vol. 28 No. 4, pp. 905-35. https://doi.org/10.1108/BPMJ-09-2021-0574

Shehzad, M.U., Zhang, J., Alam, S., Cao, Z., Boamah, F.A. and Ahmad, M. (2022b), "Knowledge management process as a mediator between collaborative culture and frugal innovation: the moderating role of perceived organizational support", *Journal of Business & Industrial Marketing,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JBIM-01-2022-0016

Shehzad, M.U., Zhang, J., Dost, M., Ahmad, M.S. and Alam, S. (2022c), "Knowledge management enablers and knowledge management processes: a direct and configurational approach to stimulate green innovation", *European Journal of Innovation Management,* Vol. ahead-of-print No. ahead-of-print. 10.1108/EJIM-02-2022-0076

Shehzad, M.U., Zhang, J., Dost, M., Ahmad, M.S. and Alam, S. (2022d), "Linking green intellectual capital, ambidextrous green innovation and firms green performance: evidence from Pakistani manufacturing firms", *Journal of Intellectual Capital,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JIC-02-2022-0032

Shehzad, M.U., Zhang, J., Dost, M., Ahmad, M.S. and Alam, S. (2022b), "Knowledge management enablers and knowledge management processes: a direct and configurational approach to stimulate green innovation", *European Journal of Innovation Management,* Vol. ahead-of-print No. ahead-of-print. 10.1108/EJIM-02-2022-0076

Shehzad, M.U., Zhang, J., Latif, K.F., Jamil, K. and Waseel, A.H. (2023), "Do green entrepreneurial orientation and green knowledge management matter in the pursuit of ambidextrous green innovation: A moderated mediation model", *Journal of Cleaner Production,* Vol. 388, pp. 135971. https://doi.org/10.1016/j.jclepro.2023.135971

Sheng, M.L. and Chien, I. (2016), "Rethinking organizational learning orientation on radical and incremental innovation in high-tech firms", *Journal of Business Research,* Vol. 69 No. 6, pp. 2302-08. https://doi.org/10.1016/j.jbusres.2015.12.046

Singh, S.K., Del Giudice, M., Chiappetta Jabbour, C.J., Latan, H. and Sohal, A.S. (2022), "Stakeholder pressure, green innovation, and performance in small and medium-sized enterprises: The role of green dynamic capabilities", *Business Strategy and the Environment,* Vol. 31 No. 1, pp. 500-14

Sirmon, D.G., Hitt, M.A. and Ireland, R.D. (2007), "Managing Firm Resources in Dynamic Environments to Create Value: Looking Inside the Black Box", *Academy of Management Review,* Vol. 32 No. 1, pp. 273-92. https://doi.org/10.5465/amr.2007.23466005

Sirmon, D.G., Hitt, M.A., Ireland, R.D. and Gilbert, B.A. (2011), "Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects", *Journal of Management,* Vol. 37 No. 5, pp. 1390-412. https://doi.org/10.1177/0149206310385695

Smith, K.G., Collins, C.J. and Clark, K.D. (2005), "Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms", *Academy of Management Journal,* Vol. 48 No. 2, pp. 346-57. https://doi.org/10.5465/amj.2005.16928421

Song, W. and Yu, H. (2018), "Green Innovation Strategy and Green Innovation: The Roles of Green Creativity and Green Organizational Identity", *Corporate Social Responsibility and Environmental Management,* Vol. 25 No. 2, pp. 135-50. https://doi.org/10.1002/csr.1445

Sun, Y., Liu, J. and Ding, Y. (2020), "Analysis of the relationship between open innovation, knowledge management capability and dual innovation", *Technology Analysis & Strategic Management,* Vol. 32 No. 1, pp. 15-28. 10.1080/09537325.2019.1632431

Tan, C.L. and Nasurdin, A.M. (2011), "Human resource management practices and organizational innovation: assessing the mediating role of knowledge management effectiveness", *Electronic journal of knowledge management,* Vol. 9 No. 2, pp. pp155-67

Teece, D.J. (2007), "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance", *Strategic Management Journal,* Vol. 28 No. 13, pp. 1319-50. https://doi.org/10.1002/smj.640

Teece, D.J. (2014), "A dynamic capabilities-based entrepreneurial theory of the multinational enterprise", *Journal of International Business Studies,* Vol. 45 No. 1, pp. 8-37. https://doi.org/10.1057/jibs.2013.54

Usman Shehzad, M., Zhang, J., Le, P.B., Jamil, K. and Cao, Z. (2022), "Stimulating frugal innovation via information technology resources, knowledge sources and market turbulence: a mediation-moderation approach", *European Journal of Innovation Management,* Vol. ahead-of-print No. ahead-of-print. 10.1108/EJIM-08-2021-0382

Wales, W.J., Patel, P.C., Parida, V. and Kreiser, P.M. (2013), "Nonlinear Effects of Entrepreneurial Orientation on Small Firm Performance: The Moderating Role of Resource Orchestration Capabilities", *Strategic Entrepreneurship Journal,* Vol. 7 No. 2, pp. 93-121. https://doi.org/10.1002/sej.1153

Wang, C., Zhang, X.-e. and Teng, X. (2022), "How to convert green entrepreneurial orientation into green innovation: The role of knowledge creation process and green absorptive capacity", *Business Strategy and the Environment,* Vol. n/a No. n/a. https://doi.org/10.1002/bse.3187

Wang, C., Zhang, X.-e. and Teng, X. (2023), "How to convert green entrepreneurial orientation into green innovation: The role of knowledge creation process and green absorptive capacity", *Business Strategy and the Environment,* Vol. 32 No. 4, pp. 1260-73. https://doi.org/10.1002/bse.3187

Wang, C.H. and Juo, W., Jr. (2021), "An environmental policy of green intellectual capital: Green innovation strategy for performance sustainability", *Business Strategy and the Environment,* Vol. 30 No. 7, pp. 3241-54. https://doi.org/10.1002/bse.2800

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

Wang, J., Xue, Y. and Yang, J. (2020b), "Boundary-spanning search and firms' green innovation: The moderating role of resource orchestration capability", *Business Strategy and the Environment,* Vol. 29 No. 2, pp. 361-74. https://doi.org/10.1002/bse.2369

Williams, L.J., Cote, J.A. and Buckley, M.R. (1989), "Lack of method variance in self-reported affect and perceptions at work: reality or artifact?", *Journal of Applied Psychology,* Vol. 74 No. 3, pp. 462

Xie, X., Huo, J. and Zou, H. (2019a), "Green process innovation, green product innovation, and corporate financial performance: A content analysis method", *Journal of Business Research,* Vol. 101, pp. 697-706. https://doi.org/10.1016/j.jbusres.2019.01.010

Xie, X., Zhu, Q. and Wang, R. (2019b), "Turning green subsidies into sustainability: How green process innovation improves firms' green image", *Business Strategy and the Environment,* Vol. 28 No. 7, pp. 1416-33. https://doi.org/10.1002/bse.2323

Zhang, Y., Sun, J., Yang, Z. and Wang, Y. (2020), "Critical success factors of green innovation: Technology, organization and environment readiness", *Journal of Cleaner Production,* Vol. 264, pp. 121701. https://doi.org/10.1016/j.jclepro.2020.121701

Zhang, Y., Wang, J., Xue, Y. and Yang, J. (2018), "Impact of environmental regulations on green technological innovative behavior: An empirical study in China", *Journal of Cleaner Production,* Vol. 188, pp. 763-73. https://doi.org/10.1016/j.jclepro.2018.04.013