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# Ethical leadership and environmental performance: The role of green IT capital, green technology innovation, and technological orientation

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ABSTRACT

Drawing upon the resource-based perspective, we develop and test a serial mediation model of CEO ethical leadership and environmental performance. Specifically, we propose that ethical leadership enhance environmental performance and this link is explained by green IT capital and green technology innovation, with a particular focus on the moderating role of firm technological orientation. The hypothesized relationships were tested in structural equation modeling with survey data from 303 Saudi small and medium-sized enterprises (SMEs). The results illustrate that the indirect effect of CEO ethical leadership on environmental performance is serially mediated by green IT capital and green technology innovation. The results also show that firm technological orientation moderates the relationship between CEO ethical leadership and green IT capital. This study offers practical insights and suggests that SMEs leadership focus on the creation and implementation of green infrastructure for successful implementation of green practices that can contribute to improved environmental performance.

## 1. Introduction

Environmental management is important for both large enterprises and small and medium-sized enterprises (SMEs). Understanding its drivers and implications has been the focus of much research over the last two decades (Pham et al., 2020; Renwick et al., 2013; Torrent-Sellens et al., 2023). The growing concern for environmental issues, such as the depletion of natural resources, high energy consumption, greenhouse gas emissions, and the generation of waste from production processes and products (Ainou et al., 2023; Doh et al., 2019), has prompted the individuals and organizations to prioritize environmental sustainability policies (Kazemeini and Swei, 2023; Renwick et al., 2013). Consequently, it is becoming increasingly important for organizational leaders to implement environmental initiatives that can help them respond to various stakeholders' pressures and enhance the firm's environmental performance (Hsu and Chen, 2023; Ren and Jackson, 2020; Singh et al., 2020; Ullah et al., 2022). Since environmental performance is a source of competitive advantage (Ren and Jackson, 2020), it can help organizations address environmental concerns and develop skills and capabilities to improve their environmental performance (Ren and Jackson, 2020; Singh et al., 2020).

Environmental performance refers to an organization's ability to satisfy society's expectations regarding environmental issues (Judge and Douglas, 1998). Previous studies have examined various factors that influence firm environmental performance, such as green human resource management (GHRM) practices (Ren and Jackson, 2020), green knowledge acquisition (Sahoo et al., 2023), and environmental management accounting (Bresciani et al., 2023). Furthermore, recent studies have identified the influence of leadership on firm environmental performance, such as responsible leadership (Rehman et al., 2021), green transformational leadership (Riva et al., 2021; Singh et al., 2020), ethical leadership (Ren et al., 2021), and women leadership (Glass et al., 2016). While studies have demonstrated a positive association between ethical leadership and green and non-green outcomes at

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the individual and team levels (Eisenbeiss et al., 2015; Huang and Paterson, 2017; Martin et al., 2022; Naeem et al., 2019; Rasheed et al., 2023), research on firm-level green outcomes remains limited. A recent review by Saha et al. (2020a) highlighted the need for further investigation into how ethical leadership influences firm-level environmental outcomes. Thus, to bridge this literature gap, this research examines the effect of CEO ethical leadership on SMEs environmental performance. We argue that CEO, holding key position in the organizational hierarchy, have the power to influence and drive environmental performance within the organization. Through their ethical leadership, CEOs can shape decision-making processes and strategies to prioritize sustainability, develop capabilities, allocate resources, set goals, and implement initiatives supporting sustainable practices.

Given that a firm's environmental performance is a source of competitive advantage (Ren and Jackson, 2020), we argue that top leadership of SMEs (Eisenbeiss et al., 2015), develop green IT capital (GITC) (Chuang and Huang, 2015), to create and support environmentally friendly technological capabilities necessary for green technology innovation (GTI) (Sahoo et al., 2023), to achieve environmental performance (Sahoo et al., 2023; Singh et al., 2020). Thus, our study seeks to answer two key research questions: (a) how does CEO ethical leadership develop SMEs' GITC for GTI and environmental performance? and (b) how does CEO ethical leadership, supported by firms' technological orientation (TO), enhance GITC to achieve GTI and environmental performance?

We believe that the leadership can improve environmental performance by using information communication technologies (ICTs) is essential for developing the internal capabilities and competencies necessary for sustainable-business operations in SMEs (Chuang and Huang, 2015). The impact of ICT on sustainable-business operations may occur at three stages: first, the direct environmental impact of ICT on manufacturing, consumption, recycling, and disposition of waste; second, the indirect impact on the ecosystem, such as in transportation process, which can either increase or decrease environmental effects; and third, the medium- to long-term changes in economic structures or user behavior resulting from changes in consumption patterns (Hilty et al., 2006; Zhang et al., 2022). Therefore, we propose that leaders who prioritize environmental sustainability, set goals, allocate resources, and implement eco-friendly practices (Hameed et al., 2021b) and GITC that apply green concepts to IT infrastructure, IT personnel, and IT management (Chuang and Huang, 2015), could best predict GTI and environmental performance in SMEs. We believe that senior management of the SMEs should practice ethical leadership (Tian et al., 2015) and invest in GITC (Chuang and Huang, 2015) to develop and support the technological competencies required for GTI (Sahoo et al., 2023), and thus achieve environmental performance.

We employed the resource-based view (RBV) framework (Barney (1991) to examine the role of CEO ethical leadership as a strategic resource in fostering the development of green IT capital, an invaluable resource that can encourage SMEs to adopt GTI (Hart, 1995; Sahoo et al., 2023). Drawing on the RBV, we propose that GITC and GTI, as firm's resources and capabilities help SMEs to uncover technologies that contribute to eco-friendly product creation, energy conservation, emissions reduction, and overall sustainable development (Benabdellah et al., 2021). Our study suggests that such innovation may lead to improved environmental performance. Additionally, we anticipate that GITC and GTI are two intervening factors that may amplify the effect of CEO ethical leadership on SMEs' environmental performance. The relationships between CEO ethical leadership, GITC, GTI, and environmental performance have received limited attention within the context of manufacturing SEMs. These research gaps underscore the need for further exploration to uncover the mechanisms by which leadership can foster innovative approaches to address ecological and environmental challenges. Additionally, we propose that SMEs' technological orientation (TO), a part of firms' strategic orientation, moderates the relationship between CEO ethical leadership and GITC. SMEs with a TO are more likely to develop GITC by encouraging a capacity and desire to learn and apply technological knowledge in creating eco-friendly products and services. This, in turn, strengthens the relationship between CEO ethical leadership and the firm's environmental performance through the use of GITC and the development of GTI.

Our research contributes to the literature on CEO ethical leadership, GITC, GTI, and environmental performance in the Saudi SME sector. First, our study advances the RBV framework by investigating how CEO ethical leadership and GITC can improve a firm's internal capabilities to engage in GTI for sustainable environmental performance. Second, our research provides an empirical rationale for why and how GITC is essential to improve SMEs' GTI and environmental performance. Third, this study underscores the complex interplay of the antecedents of environmental performance in manufacturing SMEs by conceptualizing the serial mediation effect of GITC and green GTI between the relationship of CEO ethical leadership and environmental performance. By doing so, our study answers to calls for more research on ethical leadership and firm-level environmental outcomes (Saha et al., 2020b). Finally, we propose that the firms' TO is an important moderator that strengthens the positive relationship between CEO ethical leadership and GITC. Moreover, our research aligns with the primary goal of the Technological Forecasting and Social Change journal. It combines social, environmental, and technological aspects to illuminate and forecast SMEs' environmental sustainability.

## 2. Hypotheses development

### 2.1. Theoretical background

We use RBV as a theoretical framework to investigate the link between CEO ethical leadership, environmental performance, GITC, and GTI in the context of manufacturing SMEs. RBV is a dominant theoretical framework in the domain of strategic management. It shifts the firms' focus from the importance of external factors (e.g., industry position) to internal resources (leadership, knowledge, and dynamic capability) in explaining the competitive advantage, thereby adding more value to strategic management (Ren and Jackson, 2020). RBV suggests that firms can gain competitive advantage and superior performance by utilizing their strategic resources, which are valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991). Furthermore, superior performance depends on the availability of necessary resources and their effective orchestration across all organizational levels and activities.

When applying RBV to the CEO ethical leadership- environmental performance link, we consider CEO ethical leadership as a critical strategic resource like other firm resources. The primary goal of CEO ethical leadership is to motivate and inspire organizational members and mobilize the resources necessary to develop the firm's green IT capabilities. Previous research suggests that green IT enables the firm to apply ICT to minimize overall resource consumption and waste production (Chuang and Huang, 2018). Hence, GITC can satisfy the growing demand from customers for environmental sustainability while gaining a competitive advantage. Based on RBV, research suggests that firms should expand their portfolio of available resources by capitalizing on their current resources (Wernerfelt, 2011). GITC is a resource that firms can invest in to gain GTI (applying ICT to novel ideas in developing new functional processes and eco-friendly products), leading to better environmental performance. We utilize the same RBV theory perspective to explain the moderating role of TO on CEO ethical leadership-GITC link. TO as part of a firm strategic orientation, is concerned with how a firm identifies, evaluates, and implements technology in its business processes and practices. Therefore, we argue that SMEs with high TO are more likely to take IT initiatives. This may help the firm gain a competitive advantage through increased investment in GITC and GTI in creating eco-friendly products and services.

### 2.2. Ethical leadership and GITC

The CEO is responsible and authorized to define the company's strategic direction and goals, including environmental aims and policies. The CEOs can use their abilities and knowledge to discover and explore opportunities for green innovation that improve the company's competitive advantage and sustainability (Adomako et al., 2021). A firm can sustain its competitive advantage by investing in core business resources and capabilities, such as intangible assets, i.e., knowledge, technology, and human resources (Barney, 1991; Chuang and Huang, 2015). Research suggests that among the various forms of intellectual capital, investment in ICT and its applications is one method to produce intangible value because it can provide both visible and invisible benefits for businesses (Chuang and Huang, 2018; Nayak et al., 2021; Zhang et al., 2023). However, using ICT can challenge the environment through electronic waste production, the energy consumption of data centers, raw material extraction, and increased carbon emissions from online activities. Owing to these environmental challenges, firms need to enhance their GITC- the capability and asset that applies green philosophy to IT infrastructure, IT personnel, and IT management (Chuang and Huang, 2015). This would lessen the negative environmental consequences and help businesses comply with international environmental sustainability standards. Chuang and Huang (2015) highlighted three dimensions of GITC: (1) *green IT human capital,* which refers to green IT personnel's competence and expertise, which includes professional knowledge as well as energy-saving technologies, capability, and experience; (2) *green IT structural capital,* which refers to basic green IT infrastructure, that includes hardware, software, networks, and IT systems based on green concepts; and (3) *green IT relational capital,* which refers to green IT management and relationships, that include users who use eco-friendly products or services and maintain good cooperative ties throughout the partnership to create value and consumer loyalty.

We reason that CEO ethical leadership is instrumental in shaping firm green IT capabilities; however, limited research attention has been paid to how ethical leadership can contribute or constrain the effectiveness of the firm's green IT capabilities. Despite increasing concerns about the ethical position of modern businesses due to various scandals and systemic social problems, we found no studies that looked at the CEO's ethical leadership and the firm GITC. We argue that a leader holds a formal position in the organizational hierarchy and can develop and promote a culture of ethics, which can help the organizations to invest in green IT capabilities. CEO ethical leadership can be referred to as the display of normatively appropriate behavior in both personal and interpersonal contexts, actively promoting socially responsible behaviors at all organizational levels, and encouraging a moral ethos through two-way communication and ethical decision-making (Brown et al., 2005). Ethical CEOs demonstrate human orientation, integrity, equality, responsibility, and moderation (Kalshoven et al., 2011), which will help them to prioritize sustainability and environmentally responsible practices.

Moreover, an ethical leader can create a shared sense of purpose among employees, emphasizing the importance of reducing the company's carbon footprint and contributing to a sustainable future. This can lead to a greater willingness to invest in GITC and to prioritize the implementation of sustainable technologies and practices. Based on the RBV, we argue that CEO ethical leadership serves as a strategic organizational resource that can develop the capabilities and experiences of green IT employees, foster the development of green IT infrastructure based on green concepts, and maintain ties with corporate partners or users that support eco-friendly products or services. Thus, we propose the following hypothesis:

**H1**. CEO ethical leadership is positively related to the firm GITC.

### 2.3. GITC and GTI

Previous research has defined innovation as a firm's ability to address current issues and meet stakeholders' expectations (Ashrafi et al., 2019). Rehman et al. (2021) suggest that an organization's ability to innovate is influenced by the business environment in which it operates, and adapting to and embracing responsible and sustainable business practices, and acquiring green competencies becomes crucial for businesses due to immense pressure from stakeholders (Jiao et al., 2020; Pekovic and Bouziri, 2021). The increase in pollution and the depletion of natural resources have motivated governments and communities to advocate for GTI. Previous research has highlighted various factors that contribute to GTI, such as corporate social responsibility (CSR) (Chuang and Huang, 2018), a firm's green knowledge acquisition (Sahoo et al., 2023), and the assimilation of big data (El-Kassar et al., 2019). Previous literature generally recognizes that an organization's potential in terms of green human capital is one of the significant drivers of green innovation (Wang and Juo, 2021). Asiaei et al. (2023) suggest that firms with higher green structural capital, manifested by better pro-environmental structure and modern environmental technology and tactics, are more likely to thrive in green innovation. Similarly, firms with more green relational capital may collaborate with their business partners and product or service users to generate green innovation (Asiaei et al., 2023). Therefore, we argue that SMEs can improve GTI by developing green IT human capital, structural capital, and relational capital. From the RBV perspective, we argue that GITC as an organizational resource (Melville et al., 2004) that may help SMEs to access and process diverse and complex environmental data from a variety of sources, including consumers, suppliers, rivals, regulators, and research institutes. This can assist the SMEs in identifying new possibilities and requirements for GTI (Khanra et al., 2022). Hence, based on the above arguments, we reason that GITC can lead to a firm's GTI by providing financial resources to invest in research and development of sustainable technologies. This can also encourage the adoption of energy-efficient practices within the organization, promoting a culture of sustainability and innovation. Thus, we propose:

**H2**. GITC is positively related to GTI.

### 2.4. GTI and environmental performance

Environmental performance goes beyond essential compliance with regulations and aims to minimize adverse environmental impacts (Chen et al., 2015). This includes analyzing and addressing the environmental effects of firm processes, products, and resource consumption. By doing so, firms can identify ways to operate sustainably that meet or exceed legal requirements while reducing their carbon footprint and promoting a healthier planet. Previous studies have suggested that a firm's environmental performance depends on several factors, including the quality of eco-friendly products, the implementation of green processes and product innovation, as well as the incorporation of ecological sustainability in business operations and product development (Chen et al., 2015; Hameed et al., 2020; Oliva et al., 2018).

Green innovation enables firms to maintain market competitiveness while stimulating environmental performance (Lee et al., 2018; Singh et al., 2020). Furthermore, green innovation may inspire businesses to discover innovative methods of incorporating waste into marketable products and generate more revenue (Singh et al., 2020). By utilizing the RBV, we anticipate that eco-friendly processes in product development are essential organizational resources that businesses can use to improve their environmental performance and earn goodwill. This research argues that firms can boost their environmental performance by developing functional processes, eco-friendly products, and eco-technologies and transforming operational design to safeguard the natural environment by minimizing natural resource utilization, waste, and pollution. GTI in business operations to improve environmental performance may

help firms produce eco-friendly products and enhance competitiveness (Sahoo et al., 2023). Prior research has emphasized the significance of investigating GTI within the manufacturing industry (Chen, 2008a; Chen and Chang, 2013). Although recent studies have reported a positive relationship between GTI and environmental performance (Rehman et al., 2021; Sahoo et al., 2023); however, certain earlier studies have not established this relationship (Chen, 2008a; Chen and Chang, 2013). Therefore, this research attempts to examine this unclear relationship, particularly within manufacturing SMEs, as they may encounter greater problems and barriers than larger enterprises in adopting and implementing green practices (Sun et al., 2022). Thus, we propose:

**H3**. GTI is positively related to environmental performance.

### 2.5. Ethical leadership and GTI: Mediating role of GITC

When businesses undertake green energy-saving initiatives to meet their environmental obligations, they use industry-specific technology and skills efficiently, resulting in societal benefits (Chuang and Huang, 2018). According to Davern and Kauffman (2000), the intangible advantages of IT are more essential than tangible ones. When IT is combined with other organizational resources, it can develop new competencies and produce a unique competitive advantage. Chuang and Huang (2015) suggest combining organizational green goals with IT as part of a proactive environmental management approach and developing green technologies to tackle environmental challenges; firms must invest more in GITC to produce goods and services that meet societal and environmental expectations. Moreover, firms may gain a competitive advantage in the market by uncovering technologies that aid in energy saving, eco-friendly product development, emissions reduction, and overall sustainable development (Chen, 2008b). We have hypothesized that CEO ethical leadership positively affects GITC and that GITC positively predicts GTI. Therefore, it may logically be possible that GITC mediates the effect of CEO ethical leadership on GTI. Consistent with the RBV, this study posits that GITC mediates the link of CEO ethical leadership on GTI. Accordingly, CEO ethical leadership as a crucial strategic resource can develop SMEs' green IT capabilities; for example, ethical leadership uses green IT infrastructure to reduce energy consumption and carbon emissions, green IT employees to develop eco-friendly solutions, green IT partnership with business partners to share best practices, which in turn, affects GTI. Furthermore, higher investments in GITC can improve a company's green technological capabilities, allowing it to build a distinctive competitive advantage. This idea suggests that GITC could act as a transformational core platform for converting CEO ethical leadership into GTI. Thus we propose:

**H4**. GITC mediates the effect of CEO ethical leadership on GTI.

### 2.6. GITC and environmental performance: Mediating role of GTI

Companies that invest in sustainable IT infrastructure and processes are likely to have better environmental performance, as they are able to monitor and manage their environmental impact more effectively. Previous research has found different antecedents of firm environmental performance, such as green transformational leadership (Singh et al., 2020), green HRM (Ren and Jackson, 2020; Singh et al., 2020), environmental CSR (Chuang and Huang, 2018), and green innovation (Wang and Juo, 2021). However, limited attention has been given to GITC-environmental performance and the underlying mechanisms of this link in the manufacturing SMEs context, particularly when SMEs face rising pressure from stakeholders to engage in eco-friendly work practices. Therefore, we hypothesized that GITC positively affects GTI and that GTI positively predicts firm environmental performance. Thus, we argue that GTI mediates the effect of GITC on environmental performance. From the RBV perspective, our research posits GTI serve as a mediator between GITC and firm environmental performance. Accordingly, GITC (as a core competency) will affect GTI by investing in IT capabilities, which, in turn, affect environmental performance of the firm. This idea suggests that GTI will mediate the GITC and environmental performance link.

Based on the above discussion, it is possible that the development and implementation of GITC and GTI meditate the link between CEO ethical leadership and environmental performance. Previous research has confirmed the mediating effect of green intellectual capital on leadership styles and firm-level outcomes (Mansoor et al., 2021; Xi et al., 2022; Zhu et al., 2005), for example, the degree of business greening and business competitiveness link (Chuang and Huang, 2015), and the relationship between environmental CSR and firm environmental performance (Chuang and Huang, 2018). Recent research has also confirmed the mediating role of GTI in the relationship between green knowledge acquisition and corporate environmental performance (Sahoo et al., 2023). Furthermore, Singh et al. (2020) confirmed the mediating role of green innovation on leadership and firm environmental performance. This evidence supports our anticipation of GITC and GTI as possible intervening factors between CEO ethical leadership and environmental performance. We propose that CEO ethical leadership develops GITC that enables GTI, which improves SME environmental performance. Thus, we anticipate not only the individual mediating effects of GITC and GTI but also their serial mediation effect.

**H5**. GTI mediates the effect of GITC on environmental performance.

**H6**. GITC and GTI serially mediate the effect of ethical leadership on environmental performance.

### 2.7. Moderating role of TO

TO refers to a firm's capacity and willingness to acquire and use new technology to develop new products and services (Lichtenthaler, 2016). This concept describes a company's openness to new technologies and willingness to incorporate them into its products and services (Chen et al., 2014). It includes significant R&D investment and rapidly incorporating advanced technology into product innovation (Slater et al., 2007). TO, as a type of strategic orientation, reflects a company's beliefs regarding leadership actions and resource allocation (Haug et al., 2020). Drawing on the RBV framework, we argue that incorporating advanced technology into a company's decision-making and organizational processes through TO can be a firm's strategic orientation for developing green technological capabilities. For instance, technology-oriented businesses emphasize adopting new technologies and modern procedures (Zhou et al., 2005). Therefore, firms with a high TO capability may view GITC as a resource and are more likely to invest in green IT infrastructure, provide training and development to develop employees' green IT capabilities, and establish and maintain relationships with business partners and users who adhere to environmental concepts. Hence, a high level of TO can strengthen the influence of CEO ethical leadership on GITC. We propose that ethical leaders who inspire their followers to consider new viewpoints and challenge outdated concepts will transform processes and ensure increased communication and coordination among business units to fulfill environmental demands (Eisenbeiss et al., 2015). In other words, if a company has high TO, it may be easier for the followers to apply innovative technological methods to accomplish tasks (Capon and Glazer, 1987), all of which will contribute to the development of GITC. Thus, we propose:

**H7**. TO moderates the relationship between CEO ethical leadership and GITC such that this relationship will be stronger when the firm TO is high.

As illustrated above, firm GITC will serve as a bridge between CEO ethical leadership and GTI; moreover, these propositions suggest a moderated mediation link in which firm TO amplifies the indirect influence of CEO ethical leadership on GTI via GITC. The RBV framework supports this moderated mediation link, and we argue that for the CEO ethical leadership and GTI relationship, GITC may be viewed as an

underlying mediation factor linking CEO ethical leadership and GTI. Furthermore, we projected that a higher level of firm TO as an organizational capability (Zhou et al., 2005) strengthens the indirect influence of CEO ethical leadership on firm GTI via GITC. Thus, we posit:

**H8**. TO moderates the indirect relationship between CEO ethical leadership and GTI via GITC such that the indirect relationship will become stronger when the firm TO is high.

We provide our research framework in Fig. 1.

## 3. Methodology

### 3.1. Population and sampling

To test our hypotheses, we used a survey approach to reach out to 550 manufacturing SMEs located in Saudi Arabia. This research focuses on SMEs because previous research on environmental sustainability has mostly been limited to large organizations rather than SMEs (Fassin et al., 2011; Isensee et al., 2020). Our trained research assistants made phone calls to these SMEs to seek permission to participate in the study and to schedule an appointment for an in-person visit. Participation was voluntary, and we visited each SME to collect data from the environmental manager (who worked at the middle and senior levels) and the chief operating officer. The chief operating officer completed a survey on CEO ethical leadership, GITC, GTI, TO, and demographics (including CEO gender and education, firm age, size, and ownership); after one month of the first survey, the environmental manager completed a survey on the firm's environmental performance. The questionnaire was filled out anonymously by the participants. At the start of the survey, each participant was issued a unique code, and they were requested to provide the code when they participated so that we could match the chief operating officer and environmental manager surveys. As most of the participants were Arabic-speaking, we followed the recommendations of Brislin (1986) and employed a translation-back-translation technique, in which we translated the survey from English to Arabic and then back to English. Finally, we received 303 usable surveys. The demographic breakdown of our sample is as follows: 86.1 % of CEOs were male, while 13.9 % were female. Approximately 63 % of CEOs had at least a bachelor's degree. Finally, more than 43 % of the participating SMEs had 200 or more employees at the time of data collection for this research.

### 3.2. Measures

We measured all scale items using a seven-point Likert-type scale that ranged from 1 (strongly disagree) to 7 (strongly agree).

#### 3.2.1. CEO ethical leadership

We used a ten-item scale developed by Brown et al. (2005) to assess CEO ethical leadership. A sample item is "our leader discusses business ethics or values with employees."

#### 3.2.2. GITC

We used a ten-item scale to assess GITC developed by Chuang and Huang (2015), which includes green IT human capital (3-item), green IT structural capital (3-item), and green IT relational capital (4-item). Sample items are: "our company currently has allocated budgets to train green IT staff" (green IT human capital); "our company has continued to invest in IT infrastructure (such as storage, servers, and networks) aimed at improving efficiency in the use of energy" (green IT structural capital) and; "the top management of our company has listed green IT management as a priority issue" (green IT relational capital).

#### 3.2.3. GTI

A five-item scale adapted from Huang and Li (2017) and El-Kassar et al. (2019) was used to measure GTI. A sample item is "our company continuously optimizes the manufacturing and operational processes by using cleaner methods or green technologies to make savings."

*Environmental performance:* We used a four-item scale to measure environmental performance developed by Chen et al. (2015). A sample item is "our company complies with environmental regulations."

#### 3.2.4. TO

A four-item scale developed by Gatignon and Xuereb (1997) was used to measure firm TO, which has been used in recent research (e.g., Chen et al., 2014; Talke et al., 2011). A sample item is "our company use advanced technologies in our product development."

#### 3.2.5. Control variables

By following Bowen (2002), Darnall et al. (2010), and Haug et al. (2020), we used CEO gender and education, company size, age, and ownership as control variables in this study. This is because more extensive and older manufacturing organizations may have more resources to implement eco-friendly practices and achieve superior environmental performance. Company size was measured by the number of employees as follows: less than 50 employees, 2) 51–100 employees, 3) 101–150 employees, 4) 151–200 employees, and 5) 201–250 employees. Company age was measured by the number of years the participant company has been involved in the business. Additionally, we categorized firm ownership into two dummy variables: 1 for state-owned enterprises and 2 for non-state-owned enterprises.

### 3.3. Common method variance (CMV)

Podsakoff et al. (2003) have claimed that CMV can potentially threaten the validity of research findings. Therefore, we took both procedural and statistical measures to avoid the possible hazard of CMV in this study. As procedural remedies, we included a cover letter describing the study's aim and ensuring participants' complete confidentiality. Additionally, we collected data from a variety of sources,

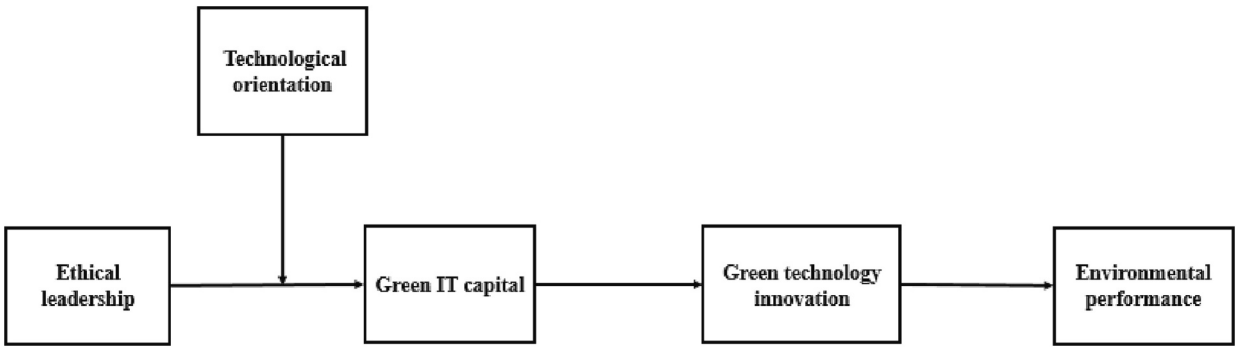


**Fig. 1.** Research framework.

including both the chief operating officer and the environmental manager. We employed Harman's single-factor test as a statistical remedy to verify that the questionnaire did not suffer from CMV. The findings revealed four components with eigenvalues larger than 1, and the results showed that the total variance was 72.80 %, with the first component producing 27.40 % of the variation, which is below 50 %. Therefore, CMV was not a severe issue in this study.

## 4. Results

### 4.1. Confirmatory factor analysis (CFA)

We conducted CFA in AMOS 24 to test the validity of our constructs. To evaluate the accuracy of our data model's fit, we used several indices recommended by Byrne (2016): the root-mean-square error of approximation (RMSEA), the comparative fit index (CFI), Tucker-Lewis index (TLI), and $\chi 2/df$. According to Hair et al. (2010), an appropriate model should have an RMSEA value of less than 0.08 and CFI and TLI scores above 0.90. We tested five alternative models. Model 1 was the hypothesized five-factor model of this study, in which items of CEO ethical leadership, GITC (second-order latent factor), GTI, TO and environmental performance were loaded onto five separate factors. Model 2 was a five-factor model in which indicators for the three dimensions of GITC were combined and placed onto the first-order latent factor of GITC, while all other items were loaded onto their own factors. Model 3 was a seven-factor model in which all first-order latent elements of green IT human capital, green IT structural capital, green IT relational capital, CEO ethical leadership, GTI, TO, and environmental performance were loaded onto their separate factors. Model 4 was a four-factor model in which GTI and environmental performance indicators were loaded into a single factor. CEO ethical leadership, GITC (second-order latent factor), and TO were loaded onto their own factors. Finally, we conducted a one-factor solution in which items of all measures were placed onto a single factor (see Model 5 in Table 1 for further detail). Our hypothesized Model 1 demonstrated an acceptable fit with the data ($\chi^2/df$ = 2.06, CFI = 0.94, TLI = 0.93, RMSEA =0.06). However, all alternative models (Models 2–5) demonstrated poor fit statistics. Our comparative chi-square tests indicate that the proposed hypothesized Model 1 fits the data substantially better than any alternative models. See Table 1 for further details.

### 4.2. Measurement scale validation

We also examined the convergent and discriminant validity to ensure the construct validity of our study. According to the recommendations of Fornell and Larcker (1981), a construct exhibits convergent validity if the individual indicator loads on its related construct with standardized loading greater than 0.50 (Niemand and Mai, 2018), along with Cronbach's alpha and composite reliability (CR) of the construct above 0.70 and average variance extracted (AVE) above 0.50. Table 2 presents the results of our factor loadings of the study's constructs, indicating that all but one item of CEO ethical leadership exhibit standardized loading below 0.50, therefore we removed.[1] Results in Table 3 show that Cronbach's alpha and CR scores are above 0.70 and AVE is above 0.50, respectively, which indicates that all the study's constructs show acceptable convergent validity (Fornell and Larcker, 1981; Nunally and Bernstein, 1978). Subsequently, we examined the discriminant validity of our study's constructs. We found that the square root of AVE for the constructs was higher than the associations among the constructs in the study (see Table 3) (Fawcett et al., 2009). Therefore, the study's findings exhibited satisfactory discriminant validity. Table 3 shows the mean, standard deviation, bivariate correlation, and Cronbach alpha scores.

[1] The removed item of Ethical leadership was as follow: "Our leader listens to what employees have to say".

**Table 1**
Comparisons of the CFA results.

| Variables | $\chi^2$ | *df* | $\chi^2/df$ | CFI | TLI | RMSEA |
|---|---|---|---|---|---|---|
| Model-1: Five-factor model (second-order latent factor of GITC, first order latent factors EL, GTI, TO, and environmental performance) | 900.11 | 437 | 2.06 | 0.94 | 0.93 | 0.06 |
| Model-2: Five-factor model (the three dimensions of GITC were merged and loaded onto the first-order latent factor of GITC, the first-order latent factors EL, GTI, TO and environmental performance) | 1049.19 | 449 | 2.33 | 0.92 | 0.91 | 0.07 |
| Model-3: Seven-factor model (all first-order latent factors of green IT human capital, green IT structural capital, green IT relational, EL, GTI, TO, and environmental performance) | 1063.40 | 443 | 2.40 | 0.92 | 0.91 | 0.08 |
| Model-4: Four-factor model (second-order latent factor of GITC, EL, TO and the items of GTI and environmental performance loaded onto one factor) | 2054.95 | 442 | 4.64 | 0.79 | 0.63 | 0.10 |
| Model-5: One-factor model (all measures were loaded onto one factor) | 5654.06 | 464 | 12.18 | 0.33 | 0.28 | 0.19 |

$N$ = 303; EL = ethical leadership; GITC = green IT capital; GTI = green technology innovation; TO = technological orientation; CFI = Comparative-Fit Index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation.

### 4.3. Hypotheses testing

Structural equation modeling (SEM) was utilized in this study to examine the proposed hypotheses. Consistent with prior research (Hameed et al., 2021), SEM was employed to evaluate direct and indirect (mediation) hypotheses. The main advantage of using SEM in hypothesis testing is its ability to address the presence of a measurement model within a measurement model. Table 4 shows that CEO ethical leadership positively impacts a firm's GITC ($\beta = 0.152$, SE = 0.05, $p < .01$), supporting H1. The findings also support H2 by demonstrating the positive influence of GITC on GTI ($\beta = 0.217$, SE = 0.06, $p < .01$). Furthermore, our findings show that GTI positively influences a firm's environmental performance ($\beta = 0.169$, SE = 0.06, $p < .01$), supporting H3. Following Preacher and Hayes (2008), we used 5000 bootstraps resamples to assess the significance of the indirect effects in our SEM analysis. The results presented in Table 4 indicate that CEO ethical leadership has a positive and significant indirect effect on GTI ($\beta = 0.06$, bias-correct confidence interval (CI) [0.010, 0.131], supporting H4. These findings illustrate that GITC mediates the relationship between CEO ethical leadership and GTI, which is significant and positive. Similarly, the results in Table 4 demonstrate that GITC has a significant positive indirect effect on firm environmental performance ($\beta = 0.038$, bias correct confidence interval (CI) [0.010, 0.092]). This indicates that GTI mediates the effect of GITC on firm environmental performance, which supports H5. Specifically, in line with H6, our results indicate that the indirect effect of CEO ethical leadership on environmental performance was serially mediated by GITC and GTI (point of estimate =

**Table 2**
The confirmatory factor analysis: scale items and factor loadings.

| Constructs and items | Loadings |
|---|---|
| ***Ethical leadership*** | |
| Our leader conducts his/her personal life in an ethical manner. | 0.762 |
| Our leader defines success not just by results but also the way that they are obtained. | 0.743 |
| Our leader disciplines employees who violate ethical standards. | 0.859 |
| Our leader makes fair and balanced decisions. | 0.817 |
| Our leader can be trusted. | 0.772 |
| Our leader discusses business ethics or values with employees. | 0.605 |
| Our leader sets an example of how to do things the right way in terms of ethics. | 0.796 |
| Our leader has the best interests of employees in mind. | 0.837 |
| Our leader, when making decisions, asks "what is the right thing to do?" | 0.659 |
| **Green IT capital** | |
| ***Green IT human capital*** | |
| Our company currently has allocated budgets to train green IT staff. | 0.699 |
| The employees of our company diligently use IT for conservation. | 0.779 |
| The IT staff of our company have professional knowledge of green IT technologies. | 0.792 |
| ***Green IT structural capital*** | |
| Our company currently has allocated budgets and resources for green IT. | 0.738 |
| Our company has concerned continually invested in IT infrastructure (such as storage, servers, and networks) aimed at improving efficiency in the use of energy. | 0.816 |
| Our company has considered an energy management system for desk computers and notebooks. | 0.769 |
| ***Relational IT structural capital*** | |
| The top management of our company has listed green IT management as a priority issue. | 0.823 |
| Our company has adopted green IT-related systems (such as server virtualization and an energy recycling system). | 0.875 |
| Our company is concerned about issues relating to the carbon footprint of its IT suppliers. | 0.792 |
| Our company is concerned about issues relating to the recycling of IT materials. | 0.760 |
| ***Green Technology innovation*** | |
| Our company continuously optimizes manufacturing and operational processes by using cleaner methods or green technologies to make savings. | 0.901 |
| Our company is actively involved in the redesign and improvement of products or services in order to comply with existing environmental or regulatory requirements. | 0.895 |
| Our company specializes in recycling practices to ensure that end-of-life products are recovered for reuse in new product manufacturing. | 0.875 |
| Our company is rigorously involved in "eco-labeling" activities to make our clients conscious of our sustainable management practices. | 0.861 |
| The research & development team at our company ensures that the current technical advancement is included in the development of new eco-products. | 0.855 |
| ***Environmental performance*** | |
| Our company is complying with environmental regulations. | 0.893 |
| Our company is preventing and mitigating environmental crises. | 0.790 |
| Our company is limiting environmental impact beyond regulatory compliance. | 0.952 |
| Our company is educating employees and the public about the environment. | 0.928 |
| ***Technological orientation*** | |
| Our company uses advanced technologies in product development. | 0.756 |
| Our products always contain the latest technology. | 0.835 |
| Our company is actively developing new technologically advanced products. | 0.837 |
| Technological innovation based on research is accepted without further ado in our company. | 0.850 |

0.058; 95 % CI = [0.003, 0.024]).

H7 asserts that the firm's TO moderates the CEO's ethical leadership and GITC link, such that the higher the TO, the stronger the relationship will be. Results in Table 4 show that the interaction term (CEO ethical leadership × TO) significantly predicts GITC. This indicates that a high TO strengthens the relationship between CEO ethical leadership and GITC. Thus, H7 was supported. Fig. 2 illustrates this relationship. The moderated mediation was assessed using the PROCESS macro for SPSS (Hayes, 2013) with 5000 bootstraps resamples, using Hayes' Model 7, which simultaneously assesses the moderation of the first-stage

**Table 3**
Descriptive statistics, correlations, validity and reliability analysis.

| Variables | M | SD | CR | AVE | MSV | ASV | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | α |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. CEO gender | – | – | – | – | – | – | – | | | | | | | | | | |
| 2. CEO education | – | – | – | – | – | – | −0.020 | – | | | | | | | | | |
| 3. Firm size | – | – | – | – | – | – | 0.065 | −0.060 | – | | | | | | | | |
| 4. Firm ownership | – | – | – | – | – | – | 0.083 | −0.086 | 0.080 | – | | | | | | | |
| 5. Firm age | – | – | – | – | – | – | 0.036 | −0.082 | 0.083 | 0.274 | – | | | | | | |
| 6. Ethical leadership | 3.74 | 0.932 | 0.92 | 0.58 | 0.15 | 0.09 | 0.044 | 0.037 | −0.052 | 0.008 | 0.253 | **0.76** | | | | | *0.89* |
| 7. GITC | 3.35 | 0.872 | 0.94 | 0.62 | 0.15 | 0.07 | −0.004 | −0.086 | 0.110 | 0.146 | 0.109 | 0.268 | **0.79** | | | | *0.94* |
| 8. GTI | 3.12 | 0.973 | 0.94 | 0.77 | 0.28 | 0.13 | −0.046 | −0.069 | −0.103 | 0.066 | 0.116 | 0.350 | 0.217 | **0.88** | | | *0.94* |
| 9. TO | 3.37 | 0.880 | 0.90 | 0.67 | 0.28 | 0.14 | 0.028 | −0.023 | −0.092 | −0.038 | 0.138 | 0.322 | 0.338 | 0.500 | **0.82** | | *0.90* |
| 10. Environmental performance | 3.84 | 1.12 | 0.94 | 0.80 | 0.04 | 0.02 | −0.040 | 0.008 | −0.020 | 0.002 | 0.041 | 0.091 | 0.121 | 0.169 | 0.048 | **0.89** | *0.93* |

Note: N = 303. GITC = green IT capital; GTI = green technology innovation; TO = technological orientation; Boldface numbers in the diagonal represent square root of the AVE of each construct; Pearson correlation are presented below the diagonal.

**Table 4**
Standardized path coefficients of the structural models.

| Model | GITC | GTI | Environmental performance |
|---|---|---|---|
| CEO gender | -0.201$^{ns}$ | -0.233$^{ns}$ | -0.127$^{ns}$ |
| CEO education | -0.102$^{ns}$ | -0.123$^{ns}$ | 0.039$^{ns}$ |
| Firm size | 0.129* | -0.115$^{ns}$ | -0.011$^{ns}$ |
| Firm ownership | 0.258** | 0.069$^{ns}$ | -0.029$^{ns}$ |
| Firm age | -0.06$^{ns}$ | 0.020$^{ns}$ | 0.028$^{ns}$ |
| Ethical leadership | 0.152** | 0.311** | 0.014$^{ns}$ |
| TO | 0.258** | – | – |
| Ethical leadership × TO | 0.176** | – | – |
| GITC | | 0.217** | 0.080$^{ns}$ |
| GTI | | – | 0.169** |
| $R^2$ | 0.249 | 0.160 | 0.112 |

| Bia-corrected bootstrap mediating effects | Effect | LLCI | ULCI |
|---|---|---|---|
| Indirect effect: EL➔GITC➔GTI | 0.060 | 0.021 | 0.108 |
| Indirect effect: GITC➔GTI ➔ EP | 0.038 | 0.013 | 0.073 |
| Indirect effect: EL➔GITC➔GTI➔EP | 0.058 | 0.003 | 0.024 |

Note. N = 303. EL = Ethical leadership; GITC = green IT Capital; GTI = Green information technology; TO = technological orientation; EP = Environmental performance. ** $p < .01$; *$p < .05$, ns = non-significant.

relationship. The PROCESS macro estimated the indirect influence of CEO ethical leadership on GTI via GITC at low and high levels of the moderator (TO). The results in Table 5 indicate that the conditional indirect effect of CEO ethical leadership on GTI via GITC was 0.05 with a 95 % CI of [0.004, 0.096] when the level of TO was high and 0.01 with a 95 % CI of [−0.020, 0.026] when the level of TO was low. Therefore, H8 was supported.

## 5. Discussion

The growing awareness of environmental issues arising from corporate operations puts pressure on business leaders to take responsibility for preserving and replenishing depleted natural resources. Therefore, environmentally responsible leadership is crucial for gaining a competitive advantage and upholding society's moral standards (Singh et al., 2020; Tian et al., 2015). In this context, our study examined the interplay of CEO ethical leadership, GITC, GTI, and environmental performance, with a focus on the moderating role of TO. The multi-source survey data from Saudi manufacturing SMEs support the hypotheses of this study. Our results indicate that CEO ethical leadership is positively related to GITC (H1), GITC positively predicts GTI (H2), and GTI, in turn, influences SMEs' environmental performance (H3). By doing so, this research extends and builds upon prior studies that demonstrate the impact of leadership on GITC (i.e., human, structural, and relational) (e.g., Albertini, 2021; Xi et al., 2022), which in turn influences GTI (Asiaei et al., 2023; Wang and Juo, 2021), and subsequently impacts environmental performance (Sahoo et al., 2023; Wang and Juo, 2021).

Our study findings confirm that GITC mediates the effect of CEO ethical leadership on GTI (H4). These results are consistent with prior research confirming green intellectual capital to mediate between leadership and organizational outcomes (Ullah et al., 2021). Furthermore, the results of this research also confirm the mediating role of GTI between GITC and environmental performance (H5), which are consistent with previous research (Asiaei et al., 2022; Wang and Juo, 2021). Moreover, our results also support the sequential mediation of GITC and GTI between CEO ethical leadership and environmental performance, a novel relationship that has not been previously examined. Prior research has examined the single mediators, such as ethical climate (Dey et al., 2022; Eisenbeiss et al., 2015) and procedural justice climate (Shin et al., 2015), between ethical leadership and firm performance. Our findings suggest that GITC and GTI sequentially account for the influence of CEO

**Table 5**
Moderated mediation effects of CEO ethical leadership on GTI (via green IT capital) across levels of firm TO.

| Independent variable | Mediator | Level of moderator | Conditional indirect effect | Lower bound | Upper bound |
|---|---|---|---|---|---|
| CEO ethical leadership | GITC | Low TO | 0.01 | −0.020 | 0.026 |
| | | High TO | 0.05 | 0.004 | 0.096 |

Note. N = 303. GTI = green technology innovation; GITC = green IT capital; TO = technological orientation.

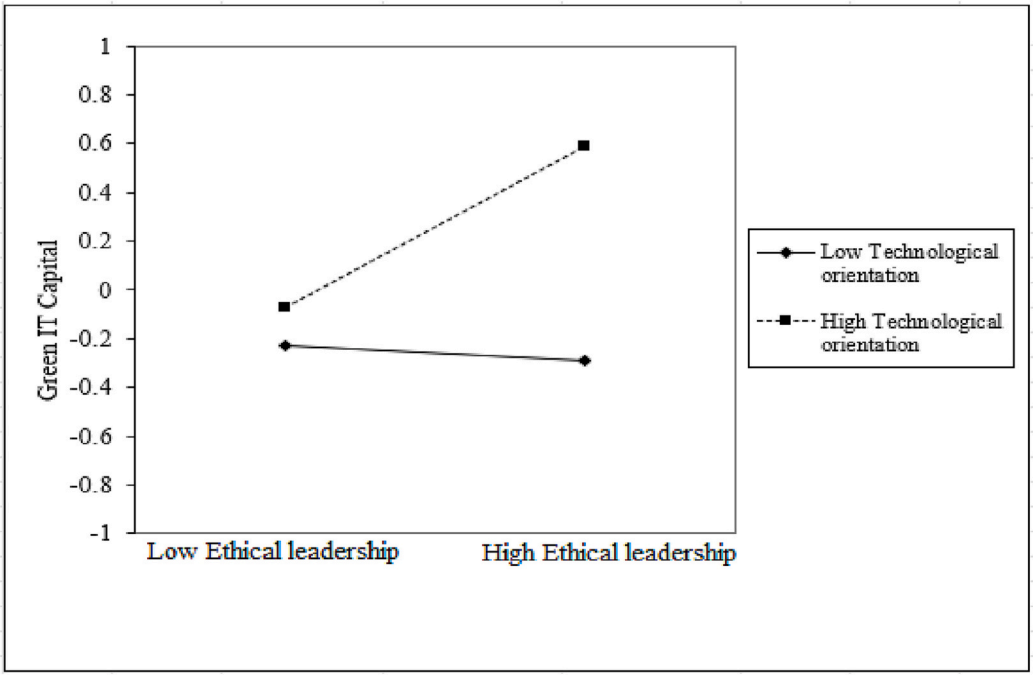


**Fig. 2.** The moderating effect of TO on the relationship between CEO ethical leadership and GITC.

ethical leadership on environmental performance. Finally, we found that firm TO moderates the relationship between CEO ethical leadership and GITC. These findings are also consistent with previous research (Haug et al., 2020). This research contributes to and enhances existing research findings highlighting the significance of CEO ethical leadership in developing GITC, influencing GTI, and firm environmental performance (Albertini, 2021; Xi et al., 2022). Our study validates all direct, indirect, sequential mediation, and moderation hypotheses, making several theoretical and practical implications.

### 5.1. Theoretical implications

This study makes several theoretical contributions. First, this study employs the RBV framework to enhance theorizing on the relationship between CEO ethical leadership and GITC, which remains undertheorized in the strategic management literature (Alrowwad et al., 2020; Saha et al., 2020a; Yasin et al., 2022). Based on the findings of our study, we argue that CEO ethical leadership is a strategic resource that manufacturing SMEs should employ to develop and use GITC, which, in turn, improves GTI and environmental performance. While utilizing the RBV framework to explore the relationship between CEO ethical leadership and environmental performance, we argue that ethical leadership and GITC are essential resources, akin to any other enterprise resources, and thus should be considered in a way that makes it difficult for rivals to imitate (Barney, 1991; Barney and Wright, 1998). Therefore, our research uses the RBV framework to demonstrate how and why leaders develop and utilize GITC to enhance a firm's GTI and environmental performance (Barney and Wright, 1998; Chuang and Huang, 2018; Singh et al., 2020). By doing so, our study responds to the calls for further research on the theoretical development of ethical leadership, green intellectual capital, and firm environmental outcomes (Kucharska, 2021; Ren et al., 2022; Ren and Jackson, 2020; Saha et al., 2020a).

Second, our study shows that GITC mediates the link between CEO ethical leadership and GTI. Consistent with RBV, we argue that CEO ethical leadership plays a critical role in developing and using GITC by developing employees' green IT capabilities, building IT infrastructure based on green concepts, and developing strong ties with business partners and users who adhere to eco-friendly work practices (Chuang and Huang, 2018), to improve green innovation (Asiaei et al., 2023; Renwick et al., 2013). Third, our study examines the mediating effect of GTI between GITC and environmental performance in manufacturing SMEs. Our study introduces GTI as a mediating mechanism that offers direction to optimize the use of CEO ethical leadership and green IT resources to achieve sustainable environmental performance in manufacturing SMEs. Previous research examined green innovation as a mediator in the relationship between green intellectual capital and firm performance (Asiaei et al., 2023; Shehzad et al., 2022). However, little is known about GTI as a mediator between GITC and environmental performance in manufacturing SMEs. Thus, in light of the RBV framework, our study views GTI as a route through which a firm's resources and capabilities are mobilized more efficiently to improve the firm environmental performance.

Fourth, our research reveals a significant interaction effect of CEO ethical leadership and firm TO on GITC, which is a significant contribution to environmental sustainability research. By doing so, our study demonstrates that CEO ethical leadership can be a significant precursor to the development of GITC, GTI, and firm TO can also impact these relationships. Hence, this study adds to our understanding of the moderating influence of TO on the linkages between CEO ethical leadership, GITC, and GTI. Finally, our research adds at the methodological level by theorizing and examining a serial mediation to measure the sequential influence of GITC and GTI on the relationship between CEO ethical leadership and environmental performance. Previous research has established the mediation mechanism of ethical climate, GHRM, GTI, and procedural justice climate between leadership and firm performance in other industries (Eisenbeiss et al., 2015; Shin et al., 2015; Singh et al., 2020). Similarly, the existing work on the antecedents of environmental performance has focused solely on independent mediation effects (e.g., Adomako et al., 2021; Asiaei et al., 2023; Ren et al., 2021). By examining the sequential mediating impact of GITC and GTI, we highlight the joint role of crucial organizational resources (GITC) and organizational capacity (GTI) in driving the environmental performance of SMEs. No previous study has hypothesized and tested the sequential mediation of these factors on the relationship between CEO ethical leadership and environmental performance.

### 5.2. Practical implications

The findings of this study have several implications for managers and decision-makers from the manufacturing sector. First, investigating an SME's environmental management system may help create a favorable image in the minds of stakeholders. Firms should prioritize the promotion of ethical leadership in top management to develop and utilize GITC by emphasizing the significance of environmental sustainability and effectively communicating its benefits. Furthermore, when environmental sustainability is integrated into a firm's competitive strategy, businesses should focus on attaining sustainable advantages from environmental challenges. For example, firms should invest in green IT equipment, develop green IT personnel and build relationships with partners and users who adhere to green concepts to create value and loyalty. Second, given the different topologies associated with manufacturing operations, this study suggests that leaders should invest in cutting-edge IT infrastructure to improve SMEs' GTI capability (Sahoo et al., 2023). This investment might be beneficial if it coincides with an SME's strategic "mission and vision" statements, clearly shifting to an interconnected administration paradigm. To effectively utilize the firm's resources, such as leadership and GITC, manufacturing SMEs should consider synchronizing the organization's technological capabilities (Benzidia et al., 2021) to improve environmental performance. Therefore, leadership must know that effectively utilizing diverse organizational resources and capabilities is critical for assisting SMEs in developing and utilizing their GITC asset to promote GTI and environmental performance. Finally, this research reveals that a firm's TO significantly moderate the influence of CEO ethical leadership on GITC. Therefore, SMEs that want to develop GITC to enhance GTI capacity must have strong TO. These findings suggest that TO create the circumstances for the CEO's ethical leadership to be smoothly translated into the development of GITC and GTI. Therefore, SMEs should prioritize TO to optimize the utilization of ethical leadership to improve GITC and green innovation capabilities.

### 5.3. Limitations and future research directions

This study has several limitations that restrict its generalizability to other contexts, which we explain below, along with recommendations for future research. First, this study was conducted in Saudi manufacturing SME sector, limiting its generalizability. Therefore, further data from SMEs operating in other parts of the world, particularly in other emerging markets, would be useful in expanding the conceptual framework of this study. Second, this research examined the firm's internal factors influencing the adoption of environmental strategies in SMEs. Future research in SMEs should consider internal and external determinants to understand better how to develop, implement, and sustain proactive environmental strategies. Third, concerns about CMV may arise due to the cross-sectional research design used to examine the relationship between study variables. To address this issue, we used multi-source data and ensured participants' complete anonymity. We also conducted the Harman single-factor test to examine whether the first component explains an acceptable amount of variance, which indicates that CMV was not a severe issue in the present research. Future investigations could use longitudinal and experimental research designs to establish causality between study variables. Lastly, more

research is needed to move the focus from GITC and GTI toward other internal or external factors, such as organizational culture, market conditions, or regulatory frameworks, to better understand the mediating mechanisms by which firms might transform environmental activities into enhanced environmental performance. Additionally, in-depth case studies could be conducted to examine how specific organizational systems might interfere with the link between SMEs' environmental initiatives and environmental performance.

### 5.4. Conclusion

The present research uses RBV theory to test the multifaceted link between CEO ethical leadership and SMEs' environmental performance through two intervening variables, GITC and GTI. With the exception of a few studies pertaining to environmental management research, this study is unique and contributes to the growing literature on environmental performance. Two research questions raised in the introduction have been adequately answered. Concerning the first question, CEO ethical leadership in manufacturing SMEs has the ability to strengthen GITC, GTI, and environmental performance. Regarding the second research question, our research indicates that CEO ethical leadership has a stronger effect on GITC when TO is higher. Therefore, this study suggests that environmentally conscious firms with higher levels of TO may outperform their competitors.

## CRediT authorship contribution statement

All authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript.

## Data availability

Data will be made available on request.

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