

Linking internal environmental capabilities to sustainable competitive advantage in manufacturing SMEs: The mediating role of eco-innovation

Highlights

- Developing environmental capabilities is key to fostering eco-innovation among SMEs
- Eco-innovation is a smart business strategy for sustaining competitiveness
- Capabilities alone do not boost competitiveness but require eco-innovation
- Eco-innovation links green absorptive capacity to competitiveness among SMEs
- Eco-innovation also links environmental orientation to SMEs' competitiveness

Abstract

With the world's growing emphasis on environmental issues and the increased pressure on small and medium-sized manufacturing enterprises (SMEs) to address such issues, sustaining competitiveness has become a critical concern for SMEs. Their organisational resources and capabilities must be configured to align with environmental requirements to sustain their competitiveness. While mounting research has highlighted the importance of environmental capabilities in facilitating proactive environmental practices, it remains unclear how these capabilities can improve manufacturing SMEs' sustainable competitive advantage (SCA). This study, therefore, has investigated how; green absorptive capacity, organisational capabilities and strategic environmental orientation have affected firms' SCA, along with exploring the mediating effect of eco-innovation in such relationships. Using a sample of 176 manufacturing SMEs in Egypt, a cross-sectional survey approach was adopted to collect data on the research variables. The data were analysed using the Smart-PLS software application, and the results demonstrated the significant roles of; green absorptive capacity and strategic environmental orientation in facilitating eco-innovation, which in turn have helped SMEs sustain their competitive advantage. On the other hand, organisational capabilities did not appear to directly or indirectly affect firms' SCA. Hence, this study may pique the interest of SME managers as it has emphasised the importance of strategic environmental orientation and green absorptive capacity in fostering eco-innovation and sustaining competitive advantage.

1. Introduction

Environmental sustainability has been prominently featured on the UN's 2030 agenda for sustainable development, which represents an urgent call for the international community to accelerate pro-environmental initiatives and combat environmental degradation (Aboelmaged and Hashem, 2019; Lopez-Torres, 2022). As much of the environmental footprint has been attributed to manufacturing operations and the consumption of products produced by businesses, the business world has recently been urged to assume greater responsibility for environmental matters (Demjanovicová and Varmus, 2021; Zhu *et al.*, 2013). Concerning these businesses, many prior studies have emphasised the importance of including small and medium-sized enterprises (SMEs) due to their crucial role in environmental sustainability, as such firms are responsible for up to 70% of industrial pollution annually (Johnson, 2017; Mady *et al.*, 2022a). Moreover, SMEs encounter sustainability issues that pose significant challenges to their strategic and economic performance, such as; rising energy and raw material costs (Johnson, 2017) and a lack of environmental knowledge and orientation (Tanco *et al.*, 2021).

As societal expectations regarding environmental issues continue to grow and manufacturing SMEs face increasing pressures, sustaining competitiveness has become a pressing concern for them. To achieve this goal, SMEs must reconfigure and combine their resources and capabilities to align with environmental requirements while maintaining competitiveness (Mishra and Yadav, 2021). However, the ability of SMEs to achieve an equilibrium between environmental and economic objectives has been a matter of dispute in the existing literature. Due to limited resources, it has been argued that SMEs often face significant challenges in developing sustainability capabilities that may incur additional costs, making it difficult to sustain their competitiveness (Hockerts and Wüstenhagen, 2010). Chang and Chen (2013) concluded that, due to their inability to develop relevant capabilities, SMEs often faced challenges in seizing green business opportunities compared to large enterprises. On the contrary, other empirical studies have argued that SMEs can simultaneously develop the necessary organisational capabilities to attain environmental and economic objectives (Eikelenboom and de Jong, 2019). Hence, further research is needed to understand better the challenges, opportunities, and strategies available to SMEs to maintain their competitiveness while achieving sustainability objectives.

According to the "Natural Resource-based View" (NRBV), environmental resources and capabilities can serve as the main source of competitiveness for firms facing environmental concerns (Hart, 1995). Based on the Resource Based View (RBV), which is the foundation of the NRBV, the competitive power of resources and capabilities depends on the extent to which the resources and capabilities can fulfil the VRIN test for SCA, namely, valuable, rare, imperfect imitability, and non-substitutability (Barney *et al.*, 2001; Hesterly and Barney, 2008). For firms to sustain their competitive advantage, success hinges not only on possessing the appropriate environmental capabilities but also on the ability of these capabilities to translate proactive environmental conduct into eco-advantages (Mishra and Yadav, 2021). Extensive research has shown that firms facing growing environmental pressure should adopt proactive environmental conduct by; developing, configuring, and renewing their internal environmental capabilities, which can enhance their business competitiveness simultaneously (Mady *et al.*, 2022b; Salim *et al.*, 2019). However, there has been a dearth of empirical studies on firm-specific environmental capabilities through which firms can attain sustainable competitive advantage (SCA) (Portillo-Tarragona *et al.*, 2018; Zameer *et al.*, 2020). Hence, the question of what and how environmental

capabilities can enable manufacturing SMEs to sustain their competitive advantage still needs to be explored fully.

Thus, this study has made two key contributions to the existing knowledge regarding sustainability management. Firstly, based on the NRBV, the present study presented a theoretical framework suggesting four environmental capabilities enabling manufacturing SMEs to enhance their SCA: organisational capabilities (i.e., technical and organisational environmental capabilities), strategic environmental orientation, green absorptive capacity, and eco-innovation. These suggested capabilities have frequently been utilised in the existing literature as internal drivers to improve firms' environmental performance (e.g. Albort-Morant *et al.*, 2018; Cai and Li, 2018), with little attention given to their effects on firms' competitiveness. Even those studies investigating the effects of these environmental capabilities on business performance have overlooked that SCA has commonly been regarded as a leading indicator of firms' success. Firms' SCA has indicated a higher predictive power than business performance, typically seen as a lagging indicator (Nadarajah and Kadir, 2014). Secondly, the present study also attempted to advance the existing knowledge by exploring the mediating role of eco-innovation on the relationship between internal environmental capabilities and SCA. Based on the competence-based view, SCA is attained through the coordination and integration of several capabilities, which are seen as the outcome of collective learning from individual assets (competency) (Foon, 2011; Hafeez *et al.*, 2002). Eco-innovation is a win-win competency, achieved by using and combining appropriate resources, enabling firms to align with environmental goals and sustain their competitiveness (Cui and Jiao, 2011; Munodawafa and Johl, 2019). Based on the competence-advantage view, eco-innovation provides firms with ample opportunities to develop eco-friendly products that offer new value to customers and, in turn, sustain competitive advantage (Cheng *et al.*, 2014). In other words, the present paper raises two main questions that need to be addressed, as follows:

RQ1: How do environmental capabilities, including; organisational capabilities, green absorptive capacity, and strategic environmental orientation, affect SCA among manufacturing SMEs?

RQ2: How does eco-innovation mediate the link between these environmental capabilities and SCA?

Moreover, the findings from the present study could have several practical implications for; SME executives, policymakers and practitioners. SMEs that integrate environmental capabilities into their operations are often better placed to exploit emerging market opportunities, such as; the growing demand for environmentally friendly products and services. Therefore, comprehending the role of environmental capabilities in achieving SCA is crucial for firms seeking to maintain their competitiveness and relevance in today's rapidly evolving business environment.

This paper proceeds as follows; Section 2 delves into the underpinning theory, the natural resource-based view (NRBV). Section 3 reviews relevant literature concerning the research variables, while Section 4 develops the research hypotheses. Section 5 addresses the research methodology, and Section 6 depicts the statistical techniques used in the study and the empirical results. Section 7 discusses the research findings. Section 8 concludes the study, delineates the implications for theory and practice, and provides suggestions for future research venues.

2. Underpinning theory: The natural resource-based view (NRBV)

The natural-resource-based view (NRBV) was proposed by Hart (1995) and later revised by Hart and Dowell (2011). It is a prominent theory in the field of sustainable operations. It has gained significant attention in academia due to its potential role in maximising sustainability and competitiveness and as a possible response to the growing need for ecological and societal development in business operations (McDougall *et al.*, 2019). The NRBV is grounded in the RBV theory, which posits that a firm's resources and capabilities can provide the foundation for achieving sustained competitive advantage. According to the RBV, a firm's resources should possess; valuable, rare, inimitable, and non-substitutable (VRIN) attributes to develop a new capability leading to competitive advantage. The RBV also acknowledges that resources can be tangible, such as; physical assets and human capital, and intangible, such as; organisational culture and reputation (Savino and Shafiq, 2018).

Similarly, the NRBV recognises sustainable practices and resources and demonstrates environmental stewardship as a source of SCA by appealing to environmentally conscious consumers and stakeholders. This convergence of environmental and business objectives can lead to a virtuous cycle where sustainability practices lead to improved performance, resulting in increased investment in sustainability initiatives (Makhloufi *et al.*, 2022). Drawing upon the NRBV, firms may endeavour to identify and capture business opportunities that result in the creation of SCA while simultaneously enhancing environmental performance (Rehman *et al.*, 2021). The following section elaborates more on the SCA concept.

3. Literature review

3.1. Sustainable competitive advantage (SCA)

Sustainable competitive advantage (SCA) has been widely discussed in strategic management and sustainability research as crucial for businesses' success and long-term survival. Amid intense global competition and rapidly changing environments, businesses must adopt sustainable business models that create long-term value and contributes to economic, social, and environmental sustainability. This concept dates back to the 1960s when researchers studied how firms with distinctive characteristics could stand out from their competitors (Hoffman, 2000). Later, scholars focused on building unique and durable advantages to help firms stay ahead of competitors during volatile market conditions (e.g., Porter and Van der Linde, 1995). According to Arsawan *et al.* (2022), SCA reflects a capability or resource that gives a firm an advantage over its competitors, leading to higher relative performance. It occurs when competitors cannot replicate the advantages that give a company an edge. From the perspective of the NRBV, the concept emphasises environmental practices, such as; recycling, waste management, and sustainable innovation, to create advantages that are; valuable, rare, inimitable, and non-substitutable.

The review of extant research summarised in Table 1 suggested that attaining SCA requires deploying unique and heterogeneous organisational resources building on the RBV and dynamic capabilities. Firms must effectively and efficiently mobilise resources to develop and maintain potential SCA, particularly in fiercely competitive markets. However, as shown in Table 1, the extant research has overlooked the role of the NRBV in maintaining SCA. While the importance of sustainable practices has been recognised over recent years (Sanchez-Planelles *et al.*, 2022), there remains a need for

additional research on how these practices can be linked to SCA. It is important to note that SCA is not a permanent advantage and may be challenged by unforeseen market changes. Rapid technological advancements, competitive market forces, and changing customer expectations can make it difficult for firms to develop and sustain long-term competitive advantage. Thus, firms with strategic environmental orientation and green absorptive capacity may be better positioned to cope with rapidly changing environments and maintain SCA (Mady *et al.*, 2022a).

Moreover, a firm's internal capabilities and resources (technical and managerial) appear essential for its capacity to innovate and maintain competitive dynamics (Chen *et al.*, 2021; Galliano *et al.*, 2019). Therefore, based on the NRBV, the present study posited that the combination of; (1) technical and non-technical environmental capabilities, (2) a strategic environmental orientation, (3) green absorptive capacity, and (4) eco-innovation could drive SCA in small and medium-sized manufacturing enterprises (SMEs). The following section discusses these capabilities.

3.2. Organisational capabilities

A company's innovation success depends on its ability to use its resources and capabilities to take advantage of business opportunities. Hart (1995) developed the concept of "green capabilities" to describe a combination of investments that can improve a company's environmental practices. Building on this concept, Cai and Li (2018) and Cai and Zhou, (2014) identified two important internal capabilities as key drivers of SCA: technological, environmental and organisational capabilities. Technological capabilities refer to a company's ability to develop and implement new environmentally friendly technologies, including identifying, evaluating, and integrating new technologies into the company's operations. For example, a firm with strong technological capabilities might invest in eco-friendly technologies, energy-efficient machinery, biodegradable packaging materials, or renewable energy sources. On the other hand, environmental and organisational capabilities refer to a company's ability to manage and organise its environmental practices and policies, including implementing environmental management systems (EMSs) and the development of green strategies. For example, a company with strong environmental and organisational capabilities might establish a comprehensive EMS that includes regular monitoring and reporting of environmental performance metrics, as well as training and awareness programs for employees (Cai and Li, 2018; Martín-de, 2021; Sumrin *et al.*, 2021).

3.3. Strategically environmental orientation

Rooted in environmentalism, strategic environmental orientation pertains to a firm's proactive perception of environmental issues and problems (Mady *et al.*, 2022b). The term was originally conceptualised by Banerjee (2002) as the managerial recognition of the relevance of environmental issues related to a firm's; operations, product development, supply chain, manufacturing, distribution, and services that may contribute to; and the perception; of a firm's impact on the environment. This recognition is fundamental to corporate environmentalism and is often integrated into corporate social responsibility (CSR) or strategic initiatives in large firms. Strategic environmental orientation involves actively incorporating environmental concerns into a firm's vision and processes and recognising the potential proactive measures that can be taken to address such issues (Chavez *et al.*, 2021). strategic environmental orientation is a proactive and innovative approach to environmental proactivity that

focuses on companies' internal values, missions, and commitments and their external awareness and responsibility towards stakeholders (Mariadoss *et al.*, 2016; Yu and Huo, 2019). Extant research regarding strategic environmental orientation has demonstrated its significant effect on firms' sustainable and economic performance, including; green competitive advantage (Zameer *et al.*, 2020), value creation (Palmié *et al.*, 2023), and green supplier management (Yu and Huo, 2019).

3.4. Green absorptive capacity

Building on the absorptive capacity view presented by Cohen and Levinthal (1990), green absorptive capacity refers to firms' abilities to; identify, incorporate, and utilise external green or environmental knowledge, which is crucial for integrating or strengthening existing knowledge (Gluch *et al.*, 2009). Developing such capabilities and routines dependent on the complex external environment can improve sustainable initiatives through; seeking and recognising new external knowledge, assimilating and transforming useful knowledge, and applying and commercialising absorbed knowledge (Chen *et al.*, 2015; Galbreath, 2019). Zahra *et al.* (2009) recognised that absorptive capacity was a critical determinant of business success, as it; enables firms to acquire new skills and knowledge, reduce cognitive barriers, and identify and capitalise on green business opportunities. In the same vein, green absorptive capacity has been shown to facilitate the diffusion of environmentally friendly knowledge within firms and assist in identifying and prioritising core environmental initiatives (Aboelmaged and Hashem, 2019; Cepeda-Carrion *et al.*, 2017). Relevant literature has also recognised that the successful implementation of sustainable practices has been highly dependent on green exploration, which reflects firms ability to acquire and process environmental knowledge (e.g., knowledge about clean energy and eco-friendly products) (Du and Wang, 2022; Qu *et al.*, 2022). In this respect, firms with high green absorptive capacity are better equipped to adapt to changing environmental conditions and regulations and can more easily capitalise on new opportunities for sustainable growth. These opportunities include; adopting new technologies, improving energy efficiency, reducing waste, and implementing environmentally conscious practices across the supply chain. However, developing a strong green absorptive capacity requires a long-term commitment to sustainability and an ongoing effort to stay abreast of the latest environmental trends and innovations. It involves; investing in employee training and development programs, collaborating with stakeholders to identify areas for improvement, and adopting a knowledge-based culture towards environmental sustainability.

3.5. Eco-innovation

Scholars and practitioners have considered eco-innovation a crucial component in the shift towards a more sustainable future (Del Río *et al.*, 2015). Eco-innovation is a term used to describe; developing and implementing new or improved products, processes, or services that reduce environmental impacts while simultaneously creating economic value (Hojnik and Ruzzier, 2016a). According to Vieira and Radonjić (2020), eco-innovation is a multi-disciplinary concept encompassing different expressions, such as; sustainable, environmental, and green innovation. This concept has gained considerable attention over recent years due to the need for sustainable development and the growing recognition that environmental challenges, such as; climate change, resource depletion, and pollution, require innovative solutions (Zheng and Iatridis, 2022). Eco-innovation

encompasses a range of activities, including; developing new technologies, redesigning existing products and processes, and creating new business models that prioritise environmental sustainability. These activities have often been driven by a combination of internal capabilities (e.g., absorptive capacity) and external forces (e.g., institutional pressures and market demand) (Cheng and Shiu, 2020; Mady *et al.*, 2023). The benefits of eco-innovation include; reduced environmental impacts, increased efficiency, and enhanced competitiveness. By adopting more sustainable practices, firms can; reduce their environmental footprint, lower costs, and improve their reputation among; customers, employees, and investors.

Moreover, eco-innovation can help create new markets and growth opportunities, particularly in; renewable energy, resource efficiency, and the circular economy (Dogaru, 2020; Geng *et al.*, 2021). Despite its potential, implementing eco-innovation by firms remains a slow and multifaceted process fraught with challenges (Garcia *et al.*, 2019). Perl-Vorbach *et al.* (2014) indicated that eco-innovations were perceived to be more sophisticated than other forms of innovation. Besides, many factors, including; limited access to resources, ambiguous regulatory frameworks, and inadequate strategic orientation, have posed potential obstacles to adopting eco-innovation (Liao and Tsai, 2019).

4. Research Hypotheses

4.1. Internal environmental capabilities and sustainable competitive advantages

The alignment of organisational capabilities with the internal and external knowledge generated by firms is crucial for enhancing its sustainable competitive advantage (SCA) through organisational learning (Battour *et al.*, 2021; Shahzad *et al.*, 2020). This process involves developing absorptive capacity, a dynamic higher-order capability that enables firms to; generate, expand, and adapt organisational resources using knowledge management processes (Dzhengiz and Niesten, 2020; Ismail, 2022). Absorptive capacity can facilitate firms in sustaining competitive advantage and improving market position. Absorptive capacity can positively influence collaborative practices and capabilities, leading to significant business outcomes (Zacharia *et al.*, 2011). Moreover, absorptive capacity can encourage firms to adopt eco-friendly operations and routines, promoting environmental conscientiousness as a competitive edge (Chen and Chang, 2013). The environmental impact of absorptive capacity, involving the acquisition and utilisation of environmental knowledge, appeared to positively impact firms' SCA (Lin *et al.*, 2020).

Leveraging the concept of SCA requires a well-defined direction and objectives concerning the environmental impact established at the upper managerial echelons. An articulated strategic environmental focus can enable firms to adapt to changes in the environmental landscape and swiftly and proactively integrate environmental priorities into their decision-making processes with a strong commitment to sustainable practices (Yang *et al.*, 2020). Moreover, it helps elevate environmental practices and issues to a higher priority level while being receptive to instantaneous learning and development to manage inevitable changes in; technologies, preferences, and markets. Examining the sustainable practices of over 200 firms, Wang *et al.* (2020) established that a sustainability orientation at the top managerial level positively stimulated sustainable capabilities and environmental performance. Ateş *et al.* (2012) demonstrated that firms' strategic sustainable orientation influenced environmental performance through internal and external investments. Henri and Journeault's (2008) study of 1500 Canadian industrial firms concluded that those with a dynamic environmental strategy

and compliance level possessed a higher environmental advantage. Yu and Huo (2019) asserted that within the discourse regarding environmental management, environmental orientation is a crucial concept that guides firms in their environmental practices. Using structural equation modelling, Zameer *et al.* (2020) investigated the effects of green process innovation and environmental orientation on green competitive advantage and environmental performance using survey data from 308 managers. The results revealed that green process innovation and strategic environmental orientation were significant triggers of green competitive advantage in the equipment manufacturing sector in China. In line with the preceding, the following hypotheses have been proposed:

H1: Organisational capabilities positively influence SCA.

H2: Green absorptive capacity positively influences SCA.

H3: Strategic environmental orientation positively influences SCA.

4.2. Internal environmental capabilities and Eco-innovation

Eco-innovation denotes; novel or improved; products, services, or practices that eliminate or minimise adverse environmental impacts and generate business value (Aboelmaged, 2018b). This concept requires a comprehensive ecological approach to ensure firms' sustainability (Carrillo-Hermosilla *et al.*, 2010). In a business context, eco-innovation development is fuelled by organisational capabilities, such as; resource mobilisation, managerial practices, and synchronisation among departments and units (Peng and Liu, 2016). European SMEs with tangible and intangible resources were more likely to engage in environmental process innovations (Triguero *et al.*, 2013). Furthermore, research by Scarpellini *et al.* (2017) highlighted the positive influence of environmentally-oriented managers on innovative green entrepreneurship and green product development. Chen and Huang (2009) explained that organisational capabilities, such as; the knowledge and skills of human resources, enabled organisations to develop confidence in green innovations by positively changing their; behaviours and motivations towards innovation development.

Prior studies have emphasised the notion of path dependence, indicating that firms have been more likely to develop eco-innovations when they possess higher technological capabilities (De Marchi, 2012). Environmental capabilities have been defined as the ability of a firm to align with environmental changes and, hence, have become increasingly important in fostering eco-innovation practices. Consequently, implementing an environmental management system (EMS) has emerged as a crucial component of environmental capabilities (Kesidou and Demirel, 2012; Li *et al.*, 2019). Similarly, firms' ability to access external sources of knowledge can reward a lack of internal knowledge and stimulate innovation, particularly in uncertain and volatile market conditions (Ketata *et al.*, 2015). Such absorptive capacity can catalyse eco-innovation development to address environmental challenges (Mady *et al.*, 2022a). For instance, Galliano and Nadel (2015) discussed the relationship between eco-innovation and sectoral systems of eco-innovation for industries in France. They highlighted the crucial role of firms' capacity to absorb new knowledge from their environment to augment their eco-innovation intensity. Segarra-Oña *et al.* (2014) found that Spanish automotive firms that leveraged market knowledge from external sources, such as; suppliers, clients, competitors, and consultants, were more likely to succeed in their green innovation efforts. In this respect, absorptive capacity can facilitate the transformation and diversification of eco-knowledge, leading to radical and transformative green innovations (Albort-Morant *et al.*, 2018).

Research has also suggested that the development of eco-innovation is influenced by firms' environmental orientation and regulatory factors (Kesidou and Demirel, 2012). Building on the NRBV, Aboelmaged (2018) examined the direct and indirect influences of environmental orientation on eco-innovation and performance in the hotel sector in the United Arab Emirates. The results captured the dynamic influence of environmental orientation on eco-innovation practices and hotel performance. Additionally, Martínez-Pérez *et al.* (2015) found that a knowledge exploration strategy fully mediated managers' use of social capital to create eco-friendly practices. Proactive environmental awareness of firms has also been crucial in advancing product development and driving eco-friendly outcomes (Nidumolu *et al.*, 2009). These findings were supported by Tsai and Liao (2017), who studied the relationship between environmental orientation and eco-innovation using data from 2955 Taiwanese firms. Based on these findings, the present study hypothesised that:

H4: Organisational capabilities positively influence eco-innovation adoption.

H5: Green absorptive capacity positively influences eco-innovation adoption.

H6: Strategic environmental orientation positively influences eco-innovation adoption.

4.3. *Eco-innovation and sustainable competitive advantages*

The adoption of eco-innovation is widely recognised in the existing literature as an effective way for firms to mitigate the negative impacts of their operations on the environment and enhance environmental competitiveness (Carrillo-Hermosilla *et al.*, 2010). Scholars have posited that firms that adopt eco-innovations can leverage their SCA by adopting environmental practices, such as; reducing waste and pollution. For example, hybrid vehicles offer significant sustainability benefits, including; reduced energy consumption and the emission of harmful pollutants (Porter and Kramer, 2006). Besides, eco-innovations present an array of strategic opportunities for both manufacturing and service firms. By setting sustainability performance objectives, these firms can achieve a competitive advantage and distinguish themselves from their rivals (Y. S. Chen *et al.*, 2006).

Moreover, eco-friendly products contribute to environmental diversification and facilitate cost-oriented competitive advantages for firms (Dunk, 2011). Mady *et al.* (2022a) proposed that eco-innovation encompassed two crucial elements that can enhance the competitiveness of SMEs. The first aspect involves creating an eco-friendly image for SMEs and distinguishing them from their rivals by providing eco-friendly products and services. The second element pertains to the significant advantage of cost reduction that eco-innovation can offer, such as; increasing resource efficiency and recycling waste. Similarly, Tu and Wu (2021) concluded that eco-innovation could sustain competitive advantages by aligning with customers' growing demand for eco-friendly products. Thus, the present study posited the following hypothesis:

H7: The adoption of eco-innovation positively influences SCA.

4.4. *The mediating effect of eco-innovation*

The current body of research has suggested that the connection between environmental drivers and performance is not direct (Aboelmaged, 2018b; Ben Amara and Chen, 2020). Future studies should consider possible mediating effects (Blanco *et al.*, 2009). Similarly, López-Gamero *et al.* (2009) suggested that organisational practices and

capabilities contributed to developing innovative strategies to enhance companies' SCA. One such strategy is eco-innovation, which has the potential to influence how companies' practices are connected to environmental competitiveness (Grekova *et al.*, 2013). For example, Eiadat *et al.* (2008) found that a green innovation strategy completely mediated the relationship between managers' environmental orientation and overall business performance. Wang *et al.* (2020) confirmed that eco-innovation mediated the relationship between organisational capability and various dimensions of competitive advantage in the hospitality industry in China.

Additionally, Sánchez-Medina *et al.* (2015) demonstrated that environmental compliance was linked to environmental performance by completely mediating green innovation based on a survey of 186 small businesses in Mexico. The present study has highlighted that adopting eco-innovation strategies can enable companies to leverage their internal capabilities to develop environmentally innovative products and processes that align with customer demand, resulting in sustained competitive advantage. As a result, this study proposed the following hypotheses:

H8: Eco-innovation adoption mediates the association between organisational capabilities and SCA.

H9: Eco-innovation adoption mediates the association between green absorptive capacity and SCA.

H10: Eco-innovation adoption mediates the association between strategic environmental orientation and SCA.

The research model and hypothesised paths are illustrated in Figure 1.

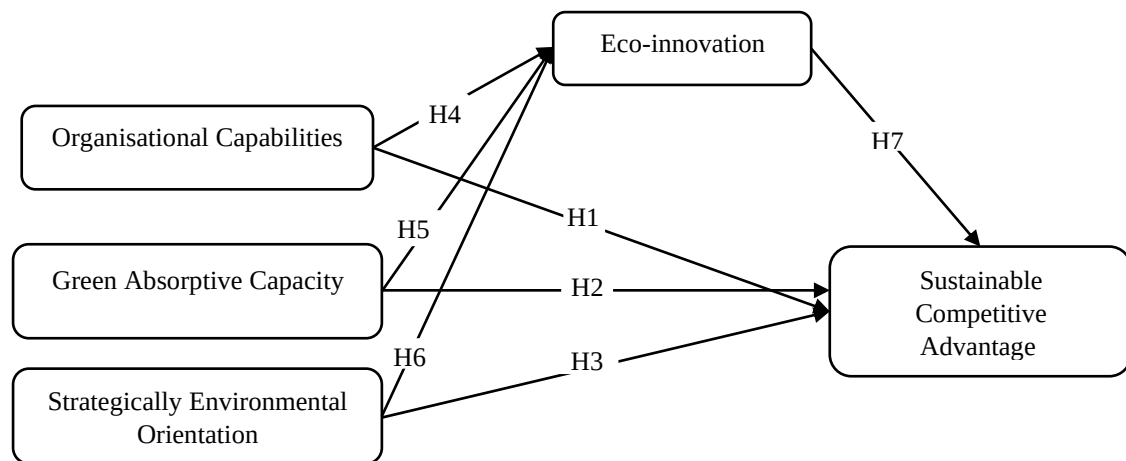


Fig. 1. Theoretical Framework.

Table 1. Extant research on sustainable competitive advantage (SCA)

Study	Aim	Method & Sample	Theory	Findings	Research Gap
Bobe and Kober (2015)	Developing a framework to measure the organisational capabilities of university schools	Survey data from 166 Heads of Australian schools	Resource-based view	Effective management of Schools' organisational capabilities in the areas of research, teaching, and networking was the key to success and achieving SCA	The study only focused on public universities, limiting the application to the service context
Breunig and Skjølsvik, (2020)	Conceptualising how organisational capabilities are linked to recent developments in the innovation field	Literature review	Strategy and innovation theories	Limited research addressed both strategy and innovation. Five main themes were identified	The study was limited to a literature review. Further empirical research could be conducted to investigate the link between strategy and innovation in specific contexts in an era of disruptions
Crick (2022)	Integrating threshold capabilities into dynamic capabilities	Conceptual paper	Resource-based view	The article sheds light on the importance of intangible capabilities in securing market-level survival	There was a lack of attention given to intangible capabilities in the existing literature, which can lead to SCA
de Guimarães <i>et al.</i> (2021)	Examining the role of management methods in the development of sustainable product innovation	Survey data of 1025 responses from automotive metal mechanic firms in Brazil	Complementary effects perspective	End-users adopted project management and product development processes as antecedents of sustainable product innovation.	The study focused on the automotive metal mechanic sector, and the generalisability of the findings to other contexts and industries remains uncertain.

Ed-Dafali <i>et al.</i> (2023)	Exploring the link between strategic orientation, organisational ambidexterity, and SCA	Survey of 144 SMEs from various sectors	Resource-based view	Market and entrepreneurial orientation positively impacted Industry 4.0 readiness and SCA.	A need for further research on SCA in emerging markets was determined.
Lee and Yoo (2021)	Identifying an integrated model of firms' SCA and market orientation	Survey data of 312 top South Korean managers	Resource-based view	Market and technological resource input and marketing and innovative capabilities mediated the impact of market orientation on firms' SCA	The study focused only on small enterprises. Managers should consider the role of other internal capabilities to increase the competitive advantage of firms
Lesmana <i>et al.</i> (2022)	Formulating a competitive advantage model for Indonesian tourist destinations	Mixed-method comprising 190 responses from the supply side and 808 responses from the demand side	Resource-based view	Providing 63 indicators in 12 dimensions of competitive advantage for Indonesian tourist destinations	Lack of a competitive advantage model that considers unique contextual characteristics
Maçada <i>et al.</i> (2020)	Assessing the effect of Information Management Capability on SCA	Multiple-case study of three Brazilian companies	Dynamic capabilities	The study found connections between information system capacities and organisational capacities (flexibility, reconfigurations, and agility)	There is a need for further research on the impact of other organisational resources and capabilities on SCA

Mamédio <i>et al.</i> (2019)	Studying the influence of strategic alliances on dynamic capabilities	Literature review from 36 articles	Resource-based view	Strategic alliances enabled firms to achieve SCA by developing capabilities to detect new opportunities and expanding their existing resource bases	The study pointed out that more research was needed to explore the role of organisational capabilities in facilitating SCA
Marco-Lajara <i>et al.</i> (2023)	Analysing the impact of international experience on green knowledge and eco-innovation	Survey data from 120 international Spanish agri-food firms	Learning theory	International experience had a positive influence on eco-innovation and green knowledge, which in turn enhanced economic performance	Environmental sustainability and the adoption of eco-innovation cannot be neglected in other firm types to enhance business performance
Olazo (2023)	To investigate the relationship between marketing capabilities, marketing innovation, and SCA	Mixed-method using a survey of 89 managers and interviews with ten managers in the Philippines	Resource-Based View	Marketing competency significantly influenced marketing innovation, which predicted SCA	The lack of panel data limited the investigation of causality. The proposed framework could be improved to provide meaningful insights in other contexts beyond the food sector
Pooe and Munyanyi (2019)	Investigating the effect of collaboration capabilities on supply chain competence	A cross-sectional survey of 388 SMEs in Zimbabwe	Dynamic capabilities	There was a significant relationship between collaboration-oriented capabilities and supply-chain competence	The study did not explore the specific mechanisms through which organisational capabilities influenced supply chain competence
Severo <i>et al.</i> (2020)	Analysing the relationships	Survey data from 226	NA	The effect of project management practices on	The concept of SCA determines the value of

	between project management practices, product and process innovation, and SCA	Brazilian enterprises		product and process innovations was significant, which in turn influenced SCA. The moderating effects of size and sector were also confirmed, except for the effect of product innovation on SCA	goods and services. Thus, further emphasis on the capabilities that promptly; identify, capture, and exploit new opportunities is essential for firms to stay ahead of their competitors.
Torjai <i>et al.</i> (2015)	Identifying organisational capabilities for supply chains to achieve SCA	Conceptual analysis and case study	Competitive priorities	The importance of competitive priorities in supply chain decision-making to attain SCA	The study was limited to using a single case study. As such, the results may not be generalisable to other contexts
Torres <i>et al.</i> (2018)	Examining the relationship between knowledge management capabilities and organisational SCA	Survey data from managers in Portuguese SMEs	Knowledge-based view	The study found that human capital and knowledge processes had a direct and significant impact on organisational SCA	The sample included mostly service firms. The study also did not address the potential role of strategic orientation in shaping SCA
Treviño and Cantú (2020)	Determining how dynamic capabilities influence small firms' performance	Survey of 213 CEOs in small firms in Mexico	Dynamic capabilities	A positive relationship was found between dynamic capabilities and firm performance	Dynamic capabilities in small firms have not been sufficiently studied.

5. Methodology

The positivist paradigm was chosen for this study to align with its goal of investigating how eco-innovation serves as a mediator between; organisational capabilities, strategic environmental orientation, and SCA. Positivism is a study paradigm that assumes knowledge can be acquired through empirical observation and measurement. In this instance, the study aimed to determine and measure the connections between the variables of interest. The study used the positivist paradigm to provide unbiased and empirical data to support its research theories. Additionally, a cross-sectional survey was used to survey a sample of 176 manufacturing SMEs in Egypt and gather information concerning the study variables. The survey approach enabled the researchers to collect information from a substantial sample of individuals at a specific time.

Mailed and online surveys in the form of a self-reported questionnaire were used to collect quantitative data for testing the proposed model. All questionnaire items were adapted from earlier studies. The questionnaire consisted of two sections. Section two of the survey collected demographic data from the respondents, whereas Section one included the survey's measuring instruments for each of the study's constructs. Given that the unit of analysis spoke Arabic, the "parallel translation technique" was used to prevent bias during the translation process, which may have affected the equivalency of conceptual meaning (Saunders *et al.*, 2009). To ensure the instrument's validity in this study, three professors in management and business and six senior managers from SMEs reviewed the questionnaire. With minor modifications around the wording and structure, the final questionnaire was developed to measure the research constructs.

Regarding the reliability of this instrument, a pilot study was conducted with 30 manufacturing SME managers in Egypt. The study checked the result's internal consistency using Cronbach's alpha coefficient, which ranges from 0 to 1, with 0 representing no internal reliability and 1 representing perfect internal reliability. According to Bryman & Bell (2015), a Cronbach's alpha coefficient score of 0.60 is deemed an acceptable indication of internal reliability for this measurement. The Cronbach's alpha values of all the research constructs exceeded the threshold of 0.60, indicating good internal consistency.

5.1. Measures

The sources of the measurement items are shown in Table 2. The present study used the concept of environmental capability to reflect any genuine capability that could enhance or maximise the efficiency of other resources, improving overall performance (Gabler *et al.*, 2015). The concept of eco-innovation was used in this study to reflect any innovation in either; products, processes, or managerial activities that aimed to improve a firm's environmental and economic performance. The interrelated concepts of sustainability and competitiveness, known as SCA, address the ability of firms to generate value over time consistently. The study had five main research constructs in the proposed theoretical framework; organisational capabilities (9 items), green absorptive capacity (5 items), strategic environmental orientation (6 items), eco-innovation (17 items), and SCA (5 items). Using a Likert scale with 5 points as "strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5)" were maintained.

Table 2. The measurement items, along with their sources.

Research constructs		items	Authors
1-Organisational Capabilities	Technological Capabilities	5	(Cai and Li, 2018; Mady, 2022a)
	Organisational Environmental Capabilities	4	
2-Green Absorptive Capacity	Green Absorptive Capacity	5	(Chen <i>et al.</i> , 2015; Mady <i>et al.</i> , 2022b)
3-Strategic Environmental Orientation	Strategic Environmental Orientation	6	(Gabler <i>et al.</i> , 2015; Mady <i>et al.</i> , 2022b)
4-Eco-Innovation	Eco-Process Innovation	4	(Cheng <i>et al.</i> , 2014; Chiou <i>et al.</i> , 2011; Hojnik and Ruzzier, 2016b)
	Eco-Product Innovation	7	
	Eco-organisational innovation	6	
5-Sustainable Competitive Advantage	Sustainable Competitive Advantage	5	(Mady <i>et al.</i> , 2022a; ; Pratono <i>et al.</i> , 2019)

5.2. Sample and Respondents' Profiles

For several reasons, the manufacturing SME context in Egypt was a good context to explore the relationships between; environmental capabilities, eco-innovation, and SCA. Firstly, the manufacturing sector is one of Egypt's most important economic sectors and contributes significantly to its GDP (Smair, 2016). Secondly, SMEs constitute a significant proportion of the manufacturing sector in Egypt, and their growth and sustainability are critical for the sector's development (Aboelmaged, 2018a). Thirdly, Egypt is facing environmental challenges, including; air pollution, water scarcity, and waste management, which make it imperative for SMEs to adopt proactive environmental practices to remain competitive and sustainable (Abdelnaeim and El-Bassiouny, 2021) (IISD, 2020)¹. Finally, while there has been some research on the topic, there remains a shortage of empirical evidence on the relationships between; environmental capabilities, eco-innovation, and SCA in the Egyptian context. Therefore, this study has provided valuable insights into how SMEs in the manufacturing sector in Egypt can improve their competitiveness by adopting eco-innovations through green absorptive capacity and strategic environmental orientation. A response rate of 34.55% was achieved with a total distribution of 550 surveys, and 190 returned surveys. However, after removing 14 unusable surveys, only 176 were suitable for the data analysis. According to the respondents' profiles, as shown in Table 3, male respondents accounted for the majority (89.20%). Seventy-two per cent of the respondents (72.73%) had more than 20 years of experience. Almost seventy per cent of the sample had at least a bachelor's degree. Small enterprises comprised more than 60% of the sample. Four industrial sectors, textiles, leather and apparel; food and drink;

¹ <https://www.iisd.org/sustainable-recovery/news/two-programs-support-green-recovery-in-egypt/>
13 November 2020: accessed 03/04/2022

furniture, wood, upholstery, chemicals, and allied products, accounted for 58.52% of total production. Therefore, it was concluded that no one industry dominated the sample.

Table 3 Sample profile

Company profile			Individual's profile		
Industry	n	%	Gender	n	%
Textiles, apparel and leather	28	15.9	Female	19	10.8
Trailers, machinery and repairs	12	6.8	Male	157	89.2
Chemicals products	25	14.2	Education level		
Furniture and wood products	24	13.6	School (primary/secondary)	9	5.11
Food and beverages	26	14.7	Bachelor	124	70.5
Metals	16	9.1	Postgraduate	43	24.4
Electronics and optics	9	5.1	Position		
Rubber and plastics	9	5.1	Owner	90	51.1
Building materials and refractories	12	6.8	Manager - CEO	86	48.8
Pharmaceutical products	6	3.4	Years of experience		
Paper and printing	9	5.1	<5	19	10.8
Size			5-10	29	16.5
Small	107	60.8	> 20	128	72.7
Medium	69	39.2			

6. Data analysis and results

As Appendix A shows, the collected data did not follow a normal distribution. Since PLS-SEM is a non-parametric method, an assumption of normality is not required. The structural equation modelling method known as PLS-SEM can examine complex relationships between latent and observed variables. It is particularly useful in studies with; small sample sizes, non-normal data, or complex models. This study used PLS-SEM for statistical analysis of the proposed framework to investigate how; organisational capabilities, strategic environmental orientation, and green absorptive capacity affected SCA through the mediating effect of eco-innovation. The researchers examined the complex relationships between the important variables without assuming an inference of normality because of the use of PLS-SEM. Measurement model analysis and structural model analyses were the two stages that comprised the PLS analysis (Hair *et al.*, 2019). “Confirmatory factor analysis” (CFA) was used in the initial assessment to examine the validity and reliability of the latent variables. At the same time, the subsequent measurement put the hypotheses to the test by determining the path coefficients and their significance of the path coefficients.

6.1. The measurement model

The measurement model was used to assess the study variables'; reliability, convergent validity, and discriminant validity (Hafaz *et al.*, 2022). In the first analysis stage, the loading factors were examined using the PLS algorithm tool in the Smart-PLS software application. Gefen and Straub (2005) suggested that the cutoff point for loading factors

should be at least 0.6. Table 4 shows that the factor loadings ranged from 0.698 to 0.926, indicating that all items met the required standard and were eligible for further analysis. Composite reliability was also assessed, and the values ranged from 0.850 to 0.946, meeting the threshold value of 0.7 recommended by Hair *et al.* (2017), demonstrating the acceptable reliability of the study model. In the second stage, the average variance extracted (AVE) was used to assess convergent validity, which reflects the extent to which the same concept is measured consistently (Hair *et al.*, 2019). Table 3 indicates that all the AVE values for the model exceeded 0.5, the cutoff point recommended by Henseler *et al.* (2016), indicating acceptable convergent validity of the scales. These findings suggested that the study variables were reliable and valid.

Table 4 Reliability and validity measures

First-Order Construct	Second-Order Construct	items	Loadings	CR	AVE
Eco-Organisational Innovation (EI_Org)		EI_Org1	0.807	0.905	0.640
		EI_Org2	0.733		
		EI_Org3	0.758		
		EI_Org4	0.851		
		EI_Org5	0.762		
		EI_Org6	0.878		
Eco-Process Innovation (EI_Proc)		EI_Proc1	0.879	0.924	0.812
		EI_Proc2	0.926		
		EI_Proc3	0.913		
		EI_Proc4	0.886		
Eco-Product Innovation (EI_Prod)		EI_Prod1	0.773	0.907	0.638
		EI_Prod2	0.888		
		EI_Prod3	0.747		
		EI_Prod4	0.848		
		EI_Prod5	0.803		
		EI_Prod6	0.795		
		EI_Prod7	0.726		
Eco-Innovation (EI)		EI_Org	0.789	0.906	0.764
		EI_Proc	0.907		
		EI_Prod	0.920		
Technological Capabilities (TC)		TC1	0.808	0.841	0.610
		TC2	0.770		
		TC3	0.839		
		TC4	0.768		
		TC5	0.715		
Environmental Organisational Capabilities (EOC)		EOC1	0.852	0.832	0.651
		EOC2	0.831		
		EOC3	0.715		
		EOC4	0.821		
Organisational Capabilities (OC)		TC	0.923	0.921	0.921
		EOC	0.924		
		GAC1	0.784	0.850	0.618

First-Order Construct	Second-Order Construct	items	Loadings	CR	AVE
Green Absorptive Capacity (GAC)		GAC2	0.815	0.857	0.599
		GAC3	0.833		
		GAC4	0.769		
		GAC5	0.725		
Sustainable Competitive Advantage (SCA)		SCA1	0.817	0.888	0.654
		SCA2	0.711		
		SCA3	0.734		
		SCA4	0.846		
		SCA5	0.752		
Strategic Environmental Orientation (SEO)		SEO1	0.698	0.888	0.654
		SEO2	0.810		
		SEO3	0.886		
		SEO4	0.892		
		SEO5	0.740		

No item was excluded

This study also evaluated the discriminant validity of the model to ensure that the constructs were distinct and not overlapping. Discriminant validity was evaluated by comparing the square root of the average variance extracted (AVE) for each construct to the correlations between that construct and other constructs in the model. According to Fornell and Larcker's (1981) criterion, discriminant validity is achieved when the square root of the AVE is greater than the correlations between the construct and other constructs in the model. As presented in Table 5, the correlation coefficients between the constructs were lower than the square root of the AVE, indicating that the study model satisfied the requirements for discriminant validity. This outcome meant that the constructs in the model were distinct and not highly related.

Table 5 Discriminant validity

Research Construct	1	2	3	4	5
1. EI	0.719				
2. GAC	0.675	0.786			
3. OC	0.561	0.467	0.730		
4. SCA	0.758	0.496	0.556	0.774	
5. SEO	0.670	0.551	0.545	0.582	0.809

Note: Bold italic values on the diagonal line represent the square root of the AVE, while other values represent correlation coefficients

6.2. The structural model

The present study evaluated the structural model using the bootstrap resampling technique with 5000 iterations. Before this, the multi-collinearity problem was examined using the variance inflation factor (VIF) test, a commonly used diagnostic tool for detecting multi-collinearity in regression models. The model was based on 5000 iterations to increase the reliability and validity of the results. Bootstrap resampling is a non-parametric method that generates multiple samples from the original data, and each sample is used to estimate the model's parameters. The results are then aggregated

to obtain the final estimates and their standard errors. By using a large number of iterations (5000 in this case), more accurate estimates of the model parameters and their confidence intervals can be obtained, increasing the generalisability of the results to the population from which the sample was drawn. Therefore, using 5000 iterations in the analysis enhanced the precision and robustness of the results. As depicted in Table 6, the VIF values for all the variables in the model were below the cut-off point of 5, which indicates that multi-collinearity was not a significant issue in our analysis (Hair *et al.*, 2014). This situation meant that the independent variables in this study were not highly correlated and that each variable was making a unique contribution to the prediction of the dependent variable. Therefore, the robustness of our structural model results was assured.

Table 6 Lateral collinearity findings

Research Construct	EI VIF	SCA VIF
Eco-innovation (EI)		2.534
Green Absorptive Capacity (GAC)	1.522	1.916
Organisational Capabilities (OC)	1.509	1.595
Strategic Environmental Orientation (SEO)	1.693	2.008

In this section, the results of the hypothesis testing are presented, which evaluated the relationships between the constructs in the model. The results are summarised in Table 7 and Appendix C. It is important to note that the statistical significance of each relationship was assessed using a p-value cut-off of 0.05. In the cases of; H1, H2, H3, and H4, the findings indicated no statistically significant relationship between the independent and dependent variables. Specifically, organisational capabilities (OC), green absorptive capacity (GAC), and strategic environmental orientation (SEO) were not found to have a significant influence on SCA or eco-innovation adoption (EI). However, the analysis found support for H5, H6, and H7. Specifically, the results showed that green absorptive capacity (GAC) and strategic environmental orientation (SEO) had a positive effect on eco-innovation adoption (EI), which, in turn, positively affected SCA. These findings suggested that firms should focus on developing their absorptive capacity for environmental knowledge and adopting a strategic environmental orientation to promote eco-innovation adoption and, in turn, achieve sustainable competitive advantage.

Table 7 Path Coefficients and hypotheses significance

	Hypotheses	β	SE	<i>t</i>	<i>p</i>	Support
H1	OC → SCA	0.178	0.122	1.458	0.072	Not
H2	GAC → SCA	-0.075	0.090	0.827	0.204	Not
H3	SEO → SCA	0.093	0.102	0.913	0.181	Not
H4	OC → EI	0.184	0.122	1.502	0.067	Not
H5	GAC → EI	0.394	0.093	4.251	0.000	Yes
H6	SEO → EI	0.353	0.088	4.007	0.000	Yes
H7	EI → SCA	0.646	0.162	3.979	0.000	Yes

As seen in Table 8, The research model explained 60.5 % of the variations in eco-innovation (EI) and 60.6 % in SCA. The size of an effect could be substantial ($f^2 = 0.35$), medium ($f^2 = 0.15$), or small ($f^2 = 0.02$) (Cohen, 1988). It was concluded that

GAC and SEO demonstrated a medium effect on EI ($f^2 = 0.259, 0.186$, respectively), while OC had a small effect on EI ($f^2 = 0.057$). It was also concluded that GAC and SEO did not affect SCA ($f^2 = 0.007, 0.011$, respectively), while EI had a large effect on SCA ($f^2 = 0.418$), and OC had a small effect on SCA ($f^2 = 0.050$). Furthermore, the blindfolding feature in PLS-SEM was applied to assess the model's predicted accuracy. The Q2 statistic assesses a model's predictive relevance wherein a value higher than zero is acceptable. All of the statistical values (Q2) in Table 7 were found to be greater than zero. As a result, the model used in this research showed good predictive relevance.

Table 8 Findings of predictive power assessment

Research Construct		f^2	effect	R^2	Q^2
EI	GAC	0.259	Medium	0.605	0.551
	OC	0.057	Small		
	SEO	0.186	Medium		
SCA	EI	0.418	large	0.606	0.354
	GAC	0.007	no effect		
	OC	0.050	Small		
	SEO	0.011	no effect		

Table 9. reveals the results of the mediating role of eco-innovation in the link between internal environmental capabilities and sustainable competitive advantage. The results revealed that the association between organisational capabilities (OC) and SCA was not mediated by eco-innovations' (EI); indirect effect ($\beta = 0.119, t = 1.746, p > 0.05$). However, the results indicated that eco-innovation significantly mediated the impact of green absorptive capacity (GAC) and strategic environmental orientation (SEO) on SCA ($\beta = 0.255, t = 2.547, p < 0.05$; $\beta = 0.228, t = 2.778, p < 0.005$), respectively. Therefore, H8 was not supported, whereas H9 and H10 were supported.

Table 9. Results of the mediation analysis

	Hypotheses	β	SE	t	p	Decision
H8	OC $\rightarrow$ EI $\rightarrow$ SCA	0.119	0.068	1.746	0.050	Not Supported
H9	GAC $\rightarrow$ EI $\rightarrow$ SCA	0.255	0.100	2.547	0.005	Supported
H10	SEO $\rightarrow$ EI $\rightarrow$ SCA	0.228	0.082	2.778	0.003	Supported

7. Discussion

The main focus of this study was to explore and provide detailed evidence of how internal environmental capabilities (IEC) (including; organisational capabilities, strategic environmental orientation, and green absorptive capacity) affected SCA among manufacturing SMEs. Moreover, the study has expanded the investigation into examining the mediating role of eco-innovation in the IEC-SCA link. Therefore, this study has yielded two key findings of importance. First, internal environmental capabilities had an insignificant effect on SCA. Second, eco-innovation was shown to be a mediator between two elements of environmental capabilities (namely, green absorptive capacity and strategic environmental orientation) and SCA. Following the research hypotheses developed in this study, these findings will, in detail, be discussed.

First, the finding of no direct and significant impact of IEC on SCA was unexpected and suggested that these capabilities within manufacturing SMEs would not necessarily lead to attaining SCA. These findings contradicted an extensive body of earlier studies. For example, the studies of Mishra and Yadav (2021) and Khan *et al.* (2019) concluded that firms with major investments in initiating and developing environmental capabilities could enhance their competitiveness. As for green absorptive capacity (GAC), Lin *et al.* (2020) highlighted that acquiring and utilising environmental knowledge through absorptive capacity positively impacted firms' SCA. In terms of strategic environmental orientation (SEO), this study's findings also differed from earlier studies, such as; Zameer, Wang, Yasmeen, *et al.* (2020) which accentuated that environmental orientation should be viewed as a strategic capability that could lead to improving economic and environmental performance and ultimately result in SCA. These findings seem to be contradicted the NRBV which assumes that a firm's resources and capabilities can provide the foundation for achieving sustained competitive advantage (Hart & Dowell, 2011). However, the NRBV also accentuates the fact that the attainment of sustainable competitive advantage is not solely contingent on the presence of environmental capabilities. Rather, it primarily hinges on the creative use and idiosyncratic way by which a firm deploys and combines these capabilities to exploit opportunities (Galliano *et al.*, 2019).

Second, this study yielded no evidence indicating a significant impact of organisational capabilities on eco-innovation. This result conflicted with path dependence, suggesting that firms with superior technological capabilities are more inclined to innovate in environmental sustainability (De Marchi, 2012). Whereas this result contrasted with most prior studies (e.g. Chen and Huang, 2009; Salim *et al.*, 2019; Triguero *et al.*, 2013), it was somewhat aligned with the study of Mady *et al.* (2022a), which found that eco-innovation practices, such as; eco-process and eco-product innovation, are not incentivised by organisational capabilities. Nevertheless, the results revealed that GAC and SEO directly and significantly impacted eco-innovation. These results were in line with those of prior research. For example, Galliano and Nadel (2015) highlighted the crucial role of firms' capacity to absorb new knowledge from their environment to augment their eco-innovation intensity. In addition, Albort-Morant *et al.* (2018) accentuated that absorptive capacity could facilitate the transformation and diversification of eco-knowledge, leading to radical and transformative green innovations. As for SEO, Zameer, Wang, Yasmeen, *et al.* (2020) asserted that SEO represents a valuable capability that enables firms to develop and implement eco-innovation practices. Similarly, Mady *et al.* (2022b) contended that If companies integrated environmental orientation as a strategic priority into their policies and strategies, they were more likely to promote and develop eco-innovation practices.

Third, as prior studies have mentioned, the present study highlighted the significant impact of eco-innovation on SCA. It configures eco-innovation as a vital competency that helps firms; align with their environmental goals, recognise the values of customers, and in turn, sustain competitiveness (Cheng *et al.*, 2014). As Ardyan *et al.* (2017) accentuated, eco-innovation constitutes an essential capability driving SMEs to sustain their competitive advantage. Similarly, Tu and Wu (2021) concluded that eco-innovation could sustain a competitive advantage by aligning with customers' growing demand for eco-friendly products. As suggested by Mady *et al.* (2022a), there are two

main aspects by which it can be explained how eco-innovation can affect SCA. The first aspect involves establishing an environmentally friendly image for SMEs and setting them apart from their competitors by offering eco-friendly products and services. The second aspect relates to the substantial cost-reduction benefits that eco-innovation can provide, including; improved resource efficiency and waste recycling. Finally, the findings also supported the mediating role of eco-innovation in the link between GAC and SEO and SCA. This result supported the rationale that adopting an eco-innovation strategy could enable companies to leverage their internal capabilities to develop environmentally innovative products and processes that align with customer demand, resulting in sustained competitive advantage (Sánchez-Medina *et al.*, 2015). In this regard, Albort-Morant *et al.* (2018) noted that firms' internal environmental capabilities, such as; absorptive capacity and learning mechanisms alone, were insufficient to gain SCA. However, eco-innovation practices must accompany that. Furthermore, a firm's success in sustaining its competitive advantages depends on its strategic environmental direction and the translation of this direction into eco-innovation activities (Salim *et al.*, 2019). Similarly, Zameer, Wang, Yasmeen, *et al.* (2020) also concluded that managers could use an environmental strategy as a valuable capability to develop and implement eco-innovations to facilitate firms' paths towards a competitive edge.

8. Conclusion and implications

Although the growing body of sustainability literature has highlighted the importance of environmental capabilities in adopting proactive environmental conduct, the question of how these capabilities can enhance SCA among manufacturing SMEs remains unanswered. Thus, the present study aimed to explore the impact of environmental capabilities, namely; organisational capabilities, strategic environmental orientation, and green absorptive capacity, on sustaining competitive advantage through mediating eco-innovation. Using a sample of 176 manufacturing SMEs in Egypt, a cross-sectional survey technique was adopted to collect data related to the research variables. The hypothesised framework was statistically analysed using the PLS-SEM software application. The findings revealed that only green absorptive capacity and strategic environmental orientation were valuable capabilities that could be used to develop and implement eco-innovation practices, which may help SMEs sustain their competitive advantage. In contrast, organisational capabilities were found to have no direct or indirect impact on SCA.

8.1. Theoretical implications

The empirical results yielded by this study can enrich the existing literature by providing insights into how SMEs can develop competitive advantages that are both environmentally sustainable and profitable. First, this study validated the perspective of a stream of literature emphasising the ability of firms to develop relevant capabilities that enable them to achieve both environmental and business objectives. This research has furthered the existing literature by understanding the role of environmental capabilities in achieving SCA in a different context, the context of manufacturing SMEs in developing countries. The present study concluded that the ability of SMEs to implement innovative solutions and face circular market challenges depended on their ability to develop their environmental capabilities. Second, the present study has contributed to the theory of NRBV by investigating the role of a set of environmental

capabilities, including; organisational capabilities, strategic environmental orientation, and green absorptive capacity, in sustaining competitive advantage. The results reported in this study have shed light on the importance of green absorptive capacity to provide SMEs with environmental knowledge and environmental orientation as a strategic orientation reflecting their policies and strategies, such as; eco-innovation strategy, which leads to SCA.

Furthermore, by investigating the relationship between environmental capabilities and SCA, researchers can identify the strategies and approaches that SMEs can employ to enhance their competitiveness. The study proved that eco-innovation, as a win-win competency, explained the relationship between environmental capabilities and SCA. Although these results could be generalised to other manufacturing contexts, in either emerging or developed markets, it isn't easy to generalise these results to service other industries, such as high-tech industries.

8.2. Practical implications

Numerous practical implications may be of interest to SME managers. The present study empirically validated how adopting eco-innovation enhances a firm's SCA. To achieve SCA, managers of manufacturing SMEs need to cultivate an eco-innovation-oriented culture and adopt different eco-innovation practices, such as; eco-management innovations, eco-process innovations, and eco-product innovations. Producing environmentally friendly products can be an important choice to appeal to environmentally oriented customers to gain a differentiation-based competitive advantage (Chen *et al.*, 2006; 2015). Furthermore, implementing innovations related to production processes, such as; those associated with energy and raw material consumption, can allow manufacturing SMEs to acquire a low-cost advantage (Ben Amara and Chen, 2022).

The present study has provided empirical evidence that green absorptive capacity and environmental orientation are valuable capabilities that can enhance SCA for manufacturing SMEs if these capabilities are exploited in initiating and developing eco-innovations. In practice, manufacturing SMEs should work on developing their green absorptive capacity in a way that helps them cooperate with different partners, such as; customers, suppliers, and regulatory entities, to bring and facilitate valuable knowledge necessary to implement eco-innovation. In addition, fostering environmental orientation was key to adopting eco-innovation. Therefore, SMEs should cultivate environmental orientation among their employees.

As for policymakers, it is necessary to implement policies that incentivise SMEs' environmental orientation and green absorptive capacity. Governmental authorities can offer economic incentives for SMEs implementing proactive environmental practices and initiatives, such as; tax credits and subsidies. Additionally, establishing environmental partnerships between various stakeholders and institutions, including; NGOs, regulatory entities, and other private sector organisations, can allow SMEs to acquire environmentally related knowledge and build awareness of environmental issues.

8.3. Limitations and future research directions

Certain limitations should be acknowledged along with the contributions and insights yielded in this study. First, only manufacturing SMEs from a developing country were included in this study. Therefore, further research could examine the same research

framework using large-scale companies or other industries, such as service industries. Second, based on NRBV, the study developed and examined a research framework suggesting that SCA could be triggered by only internal environmental capabilities without including external factors. Following the institutional theory, institutional pressures could be examined to see how they affect SMEs' SCA. Third, the current study has not provided evidence of how eco-innovation affected SCA. Thus, further study could be carried out by categorising eco-innovation into different types to understand which substantially enhances SCA among SMEs. Finally, the study failed to provide empirical evidence on the role of organisational capabilities in SCA. As such, further research could be conducted to examine the impact elements of organisational capabilities, such as; green human resources, technological capabilities, and environmental management systems in SCA.

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Appendices

Appendix A: Multivariate normality test by using WebPower software

Output of skewness and kurtosis calculation

```
Sample size: 176
Number of variables: 5

Univariate skewness and kurtosis
```

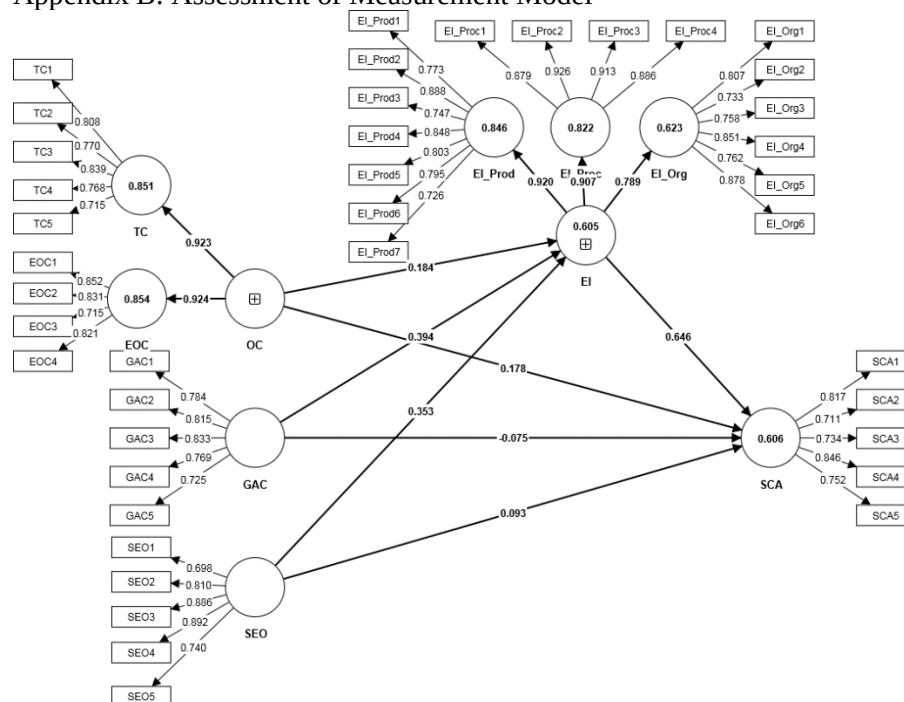
	Skewness	SE_skew	Z_skew	Kurtosis	SE_kurt	Z_kurt
Eco_Innovation	-1.078	0.183	-5.890	1.886	0.364	5.180
OC	-0.802	0.183	-4.381	0.107	0.364	0.293
GAC	-0.751	0.183	-4.103	0.863	0.364	2.370
SEO	-0.782	0.183	-4.270	0.038	0.364	0.103
SCA	-0.986	0.183	-5.386	0.997	0.364	2.737

```
Mardia's multivariate skewness and kurtosis
```

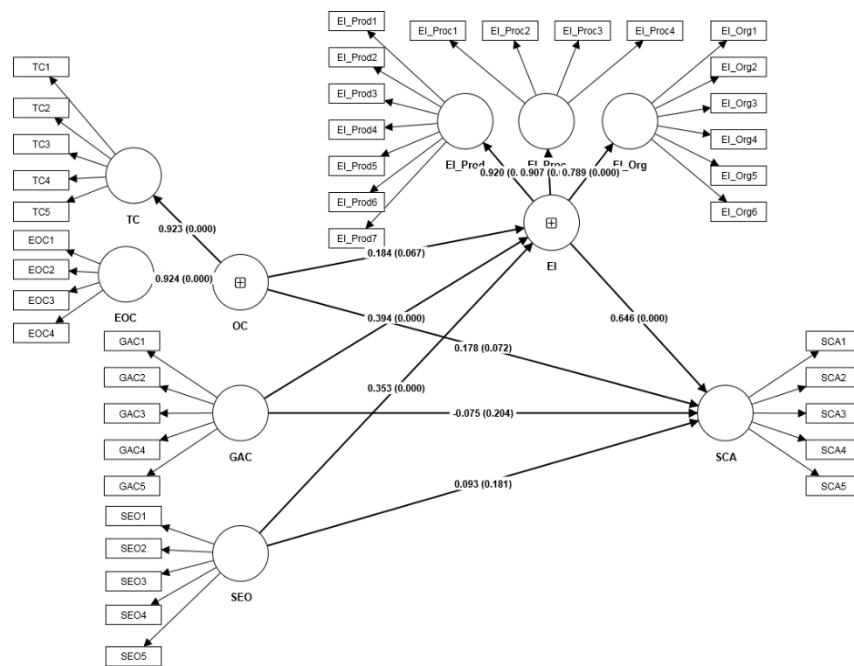
	b	z	p-value
Skewness	9.937837	291.50987	0
Kurtosis	48.973933	11.07888	0

<https://webpower.psychstat.org/models/kurtosis/results.php?url=b2cc970c600a1dca3241bc7a4057a845>

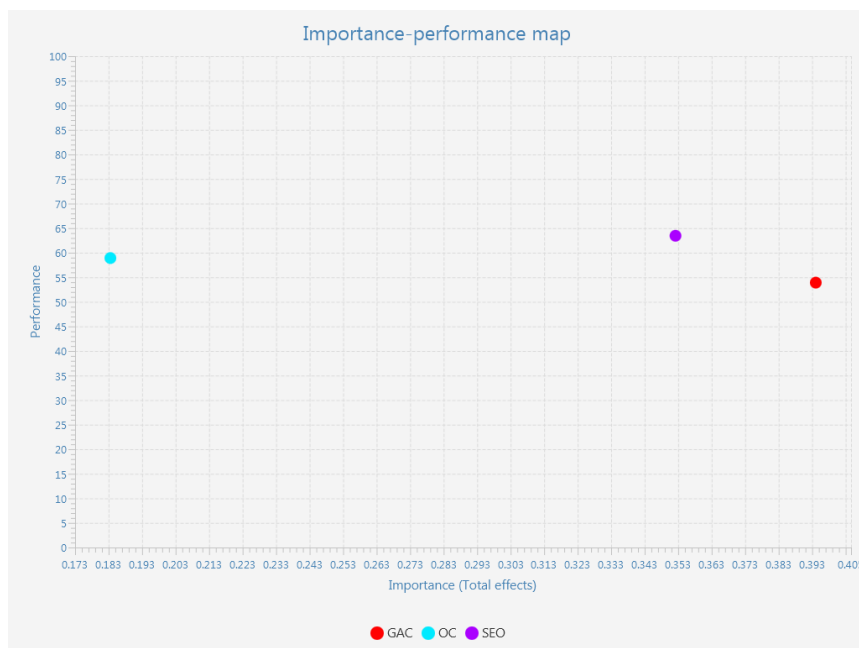
Appendix B: Assessment of Measurement Model



Appendix C: assessment of structural model



Appendix D: Importance-performance map for the eco-innovation construct.



Appendix E: Importance-performance map for the SCA construct

