Investigating the effects of green operations management on sustainability performance of manufacturing and service firms: the mediating role of green customer integration in Vietnam

Abstract: While recent years have seen the conduct of works covering the connections between green operations, green supply chain integration, and corporate sustainability, a comparative study on manufacturing and service industries has not yet been carried out to examine these interrelations in developing countries. In Vietnam, insights from such endeavors are practically needed to inform management and policymaking given that senior managers and government legislators have paid insufficient attention to green supply chain management. In line with the resource-based view and dynamic capability, the present study demonstrates the mediating role green customer integration (GCI) plays in the relationship between the green operations and corporate sustainability of service and manufacturing firms. Partial least squares-structural equation models are used to illustrate the direct and positive effect of green operations on environmental performance in both service and manufacturing companies, and this effect is then partially mediated by GCI. With the other pillars of corporate sustainability (social and economic performance), the effect is fully mediated by GCI for manufacturing businesses. For service enterprises, GCI partially mediates the effect of green operations on social performance but does not occupy a significant role in the positive relationship between green operations and economic performance. Thus, firms that undertake green operations management should properly foster GCI to achieve the desired corporate sustainability results. In addition, the government should consider support or incentives that help firms offset related costs and promote sustainability.

Keywords: green operations management; green customer integration; corporate sustainability;

sustainability performance; service firms; manufacturing enterprises; developing countries.

1. Introduction

Recent years have witnessed many challenges that supply chain management faces in discovering resources for firms to enhance their competitive advantages (Cantele et al., 2023). Among these challenges are the increasing environmental issues in developing countries that have hindered the advantage of low-cost production (Hasani et al., 2021). When disregarding sustainability issues in their supply chains, companies consequently encounter several risks to operations and reputation (Hasani et al., 2021). Regarding this discussion, sustainable supply chain management (SCM) has captured significant attention from scholars and practitioners (Afum et al., 2020b; Romero-Silva and de Leeuw, 2021). Patel and Desai's (2019) literature review showed that this field of study is still in the early stages of exploratory and conceptual research even though there has been a recent shift to modeling and empirical papers, most of which collect data on large companies in advanced economies and their upstream supply chains (Bubicz et al., 2019). The literature review by Bubicz et al. (2019) recognized an increasing trend for research that investigates information technology applications, integrates supply chain stakeholders other than suppliers, and explores social issues, for instance, human rights and labor conditions in sustainable SCM. Indeed, the social aspect of sustainability has drawn the least attention in the sustainable SCM literature (Hussein et al., 2021) although the triple bottom line (TBL), a crucial and measurable conceptualization of sustainability (Gallagher et al., 2018; Yu et al., 2014), posits that corporate sustainability includes environmental, economic, and social performance (Caldelli and Parmigiani, 2004; Kholaif et al., 2024).

Proposed by Elkington (1997), the TBL incorporates the planet, people, and profit, which can be integrated into the three pillars of sustainability. Sustainability indeed underlines environmental stewardship (Porter and Kramer, 2006) and the commitment to such issues is associated with the TBL planet pillar (Gallagher et al., 2018). On the other hand, providing a healthy environment and equitable life for people lies in the scope of social sustainability (Karji et al., 2020), but to protect such a good environment clearly also entails environmental stewardship. With regard to economic performance, companies are expected to make profits to sustain their operations, employment, and (re)investment, but they must also need to respect the environment and society since their business depends on these two factors (Carroll, 2016; Porter and Kramer, 2011). Indeed, Carter and Rogers's (2008) conceptualization of organizational sustainability highlights the interrelationships between these environmental, social, and economic aspects to stress that integrating environmental, social, and economic goals (TBL) into practices has a vital role in the long-term economic viability of the firm and its supply chain.

A commonly studied approach to sustainable development is green SCM, which includes green manufacturing (GM) and focuses primarily on the environmental facet of sustainable SCM but can also have a positive effect on social performance (Afum et al., 2020b; Çankaya and Sezen, 2019; Carbone et al., 2019; Pang and Zhang, 2019). In the current literature, most research on green SCM has been undertaken in industrialized countries (Bhatia and Gangwani, 2021), whereas developing economies are in greater need of green SCM as they are top greenhouse gas emitters (Ahmed and Najmi, 2018) but operate in a context of weak environmental regulations (Sarkodie and Strezov, 2019). Through globalization and foreign direct investment, certain industries in advanced nations have been relocated to developing economies for regulatory and labor-related reasons (Asif et al., 2020; Sarkodie and Strezov, 2019). Nevertheless, since customers become increasingly aware of environmental stakes in such developing nations, multinational corporations should also undertake green SCM and GM in those locations (Asif et al., 2020; Niu et al., 2022).

Vietnam is a developing country experiencing fast industrial growth fueled by increased foreign direct investment inflows (Dang et al., 2020) and multinationals' supply relocation (Gereffi et al., 2021; Handfield et al., 2020; Meng et al., 2018). Given industrial growth usually accompanied by increasing environmental challenges (Ali et al., 2020), it is practically relevant to examine GM in Vietnam, an emerging global manufacturing hub (Nguyen, 2022), in order to help to contend with the expected industrial growth sustainably. Also, because of the dearth of research on green SCM and GM in Vietnam (Nguyen et al., 2023), the present study is needed to bridge this literature gap and inform green SCM and GM, of which consumers are increasingly conscious worldwide (Asif et al., 2020).

Among the global concerns is the alarming rise of greenhouse gases (Asif et al., 2020; Shen et al., 2021). Compared with Scope-1 emissions (from in-house operations) and Scope-2 counterparts (from activities directly connected with in-house operations), Scope-3 emissions (across the supply chain) are the most challenging to measure (Bodendorf et al., 2022). Yet, this category of emissions has recently obtained growing recognition (Ellram et al., 2022; Hertwich and Wood, 2018), which suggests that GM should be combined with green supply chain integration (SCI). Indeed, Afum et al. (2020b) ascertained that the positive influence of GM on the three dimensions of sustainability performance is partially mediated by green SCI.

According to estimations, tourism-related emissions constituted around 8% of global emissions between 2009 and 2013, inclusively (Lenzen et al., 2018). In Europe, transportation and logistics activities emit more greenhouse gases than manufacturing.[1] Nevertheless, the scholarship on green SCM has focused principally on the manufacturing, automotive, and electronics industries (Bhatia and Gangwani, 2021). Given the increasing interest in green SCM in the service sector, such as in logistics (Karaman et al., 2020; Stekelorum et al., 2021) and hospitality (Chen et al., 2021; Ghaderi et al., 2023), the present work considers both manufacturing and service industries and compares

[1] Eurostat (2020). https://ec.europa.eu/eurostat/documents/3217494/11478276/KS-DK-20-001-EN-N.pdf (accessed 17 July 2023)

their differences. Such comparisons are particularly relevant to Vietnam as its logistics segment is growing fast (Pham et al., 2023) and the tourism industry, a significant contributor to its economy, is associated with environmental degradation (Fatima et al., 2021). Nevertheless, few studies have looked at green practices in these domains in the country (Chen et al., 2022).

From a practical perspective, the government of Vietnam has acknowledged that improper use and exploitation of natural resources have resulted in environmental pollution in many regions in its territory (Ta et al., 2020). Vietnamese authorities have indeed followed several policies to meet these challenges and promote sustainable firms (Do and Nguyen, 2020; Pham et al., 2023). Green SCM is a widely explored approach to sustainable development (Afum et al., 2020b; Çankaya and Sezen, 2019; Carbone et al., 2019; Pang and Zhang, 2019), but it has attracted insufficient attention from senior management and in government legislation in Vietnam (Chen et al., 2022). The present research is therefore needed to inform management and policymaking.

Because the present work covers both manufacturing and service companies, green operations management (GOM) is used as an umbrella term for green production practices in these two types of enterprises. GM thus refers to GOM in manufacturing in this research. Supplier integration has been extensively studied in the SCI literature (Wong et al., 2021), so this research focuses on green customer integration (GCI), which can be further justified by the spike in customers' awareness of the environmental context in developing countries (Asif et al., 2020; Niu et al., 2022). In line with the TBL, sustainability performance consists of environmental, economic, and social performance (Caldelli and Parmigiani, 2004; Kholaif et al., 2024) in this work. In that light, this study attempts to answer the following research questions (RQs):

+ RQ1: Does GOM affect the three dimensions of sustainability performance of the firm?

+ RQ2: Does GCI mediate the effect of GOM on sustainability performance?

+ RQ3: Given the studied effects of GOM and GCI on sustainability performance, are there any differences between manufacturing and service firms that managers and policymakers should pay attention to?

The contributions of the present research are threefold. First, it extends the literature on GCI, a fundamental part of green SCM, by studying a developing nation which is also an emerging global manufacturing hub, i.e., Vietnam. The findings can help inform management decision-making and government policymaking with respect to GOM and GCI to enhance sustainability. Next, the paper shows that the positive effect of GOM on corporate sustainability is mediated by GCI, highlighting the importance of having supply chain customers take part in sustainability-related efforts. Finally, by comparing service and manufacturing firms with reference to the relationships under analysis, this paper produces more specific insights for firms operating in these sectors.

This article is comprised of six sections. This introduction is followed by the literature review, which discusses prior works, related theoretical perspectives, and formed hypotheses. The research design and results are then described in the third and fourth sections, respectively. The penultimate section explains the results by referring to the covered theories and Vietnam's context and presents the theoretical and managerial implications of the study. The final section concludes this paper.

2. Theoretical background and hypothesis proposal

2.1. Related theories

The resource-based view (RBV) of the firm is a widely used theoretical perspective to account for the impact of green SCM on corporate performance (Çankaya and Sezen, 2019). This theory posits that a company with resources (accessible in-house or via supply chain collaboration) which have value, rarity, inimitability (are hard to imitate), non-substitutability (are difficult to substitute), and organizational exploitability can have sustainable competitive advantages (Arya and Zhiang, 2007;

Barney, 1991; Wernerfelt, 1984). In keeping with this theoretical framework, Carbone et al. (2019) demonstrated that the capabilities of engaging supply chain partners are valuable, rare, inimitable, and non-substitutable resources that play vital roles in the sustainability performance of companies adopting green SCM. Chen and Kitsis (2017) emphasized that the ability to cooperate with external stakeholders is more likely to improve the sustainability performance of the company than its in-house practices. Examples of recent works that have studied the influence of green SCM practices on corporate sustainability performance from the RBV perspective include the research of Kholaif et al. (2024) and Samad et al. (2021).

Dynamic capability theory (DCT), which refers to the capacity to adjust/reconfigure competencies adaptively to tackle environmental turbulence (Teece and Pisano, 1994), is another theoretical lens pertinent to this article. From that perspective, Pham and Pham (2021) demonstrated green SCI as a set of dynamic capabilities that enhance the environmental performance of construction projects. Meanwhile, Hsu et al. (2023) asserted that the dynamic capabilities of GOM can sustain the firm's environmental and economic performance. Trujillo-Gallego et al. (2022) showed that green SCM is a lower-order dynamic capability that mediates the influence of higher dynamic capabilities (i.e., digital technology adoption and green human resource management) on firms' environmental and economic performance. Carbone et al. (2019) corroborated that the dynamic capabilities developed in green SCM can be leveraged to help businesses attain superior social performance. Other studies that adopt the DCT to investigate the effect of green SCM on corporate sustainability performance include the works of Habib et al. (2021) and Sahoo et al. (2022).

Given the relevance of the resource-based view and dynamic capability perspective to this study on the interrelationships between GOM, GCI, and corporate sustainability, these theories are used as theoretical foundations to formulate the hypotheses in subsection 2.5.

2.2. Corporate sustainability performance

According to the TBL, corporate sustainability consists of economic (or financial and operational), environmental (or ecological), and social performance (Caldelli and Parmigiani, 2004; Kholaif et al., 2024). However, the economic and environmental dimensions have attracted more attention in the SCM literature than the social aspect (Beske, 2012; Govindan et al., 2021; Mogale et al., 2023). Because businesses are expected to sustain themselves by becoming profitable (Carroll, 2016), it is evident that economic performance (ECP) is commonly studied in the literature (Carbone et al., 2019). In line with other scholars' explanation (Afum et al., 2020b; Somsuk and Laosirihongthong, 2017), a company's economic performance can be conceptualized as the extent to which that firm enhances or optimizes its operational/financial outcomes. Prior studies have indeed examined this dimension of sustainability performance by combining performance metrics such as sales growth, profitability, return on investment, and reduction of costs relating to material procurement, energy consumption, and waste discharge and treatment (Afum et al., 2020a; Afum et al., 2020b; Çankaya and Sezen, 2019; Zhu et al., 2008).

Environmental sustainability has become one of the most radical challenges (Wang et al., 2023) that see a spike in public awareness (Hsu et al., 2023) and that companies are expected to respond to (Kitsis and Chen, 2023). Hence, corporate environmental performance has been widely studied. In fact, enhancing environmental performance (EP) is the principal objective of GOM (Nunes and Bennett, 2010). The concept of corporate environmental performance can be defined as the degree to which a business improves its environmental management and environmental impact (Li et al., 2020; Somsuk and Laosirihongthong, 2017). According to Çankaya and Sezen (2019), EP reflects companies' ability to reduce pollution, waste, and environmental accidents, and to avoid hazardous substances. In the literature, EP is indeed evaluated by measuring emissions and waste production

(Afum et al., 2020b; Wang, 2015), pollutant discharges and environmental accidents (Liu et al., 2019a), and hazardous inputs and environmental situations of the company (Hsu et al., 2023).

The social aspect of corporate sustainability performance has gained traction in SCM thanks to firms' awareness of their social responsibility (Afum et al., 2020a). Including social performance indices in corporate sustainability evaluation has been recognized in research and practice (Kühnen and Hahn, 2018). Corporate social performance can be understood as the extent to which a firm's social mission is accomplished (Afum et al., 2020a). The concept of corporate social performance refers overall to the company's enhancement of its social impact, i.e., its contribution to employees' well-being and the wider communities (Porter and Kramer, 2006; Somsuk and Laosirihongthong, 2017). In the literature, this dimension of corporate sustainability performance can be evaluated in regard to the staff's health/safety (Wang and Dai, 2018) and skill/education improvement, and the business's image or reputation, stakeholder relations (Afum et al., 2020a), and investment in social projects (Çankaya and Sezen, 2019).

Compared to the other two aspects of corporate sustainability, the social dimension has received the least attention in the SCM literature (Beske, 2012; Çankaya and Sezen, 2019; Govindan et al., 2021; Mogale et al., 2023). Also, the literature review by Chiesa and Przychodzen (2020) pointed out the lack of socially sustainable SCM research in service sectors and developing countries that draws on theories to explain its findings (see the online appendix for an overview of research gaps). To address this literature gap, the present study incorporates in its analysis the social performance of both service and manufacturing firms in a developing country (Vietnam) and uses the theories discussed in subsection 2.1 to formulate its hypotheses.

2.3. Green operations management

Green operations management (GOM) has been increasingly studied (Liu et al., 2019b). According to Nunes and Bennett (2010), the concept of GOM can be defined as practices which improve the environmental performance of enterprise operations. Kitsis and Chen (2021) argued that GOM can be composed of various practices but must focus on green product design and green process design. Green product design refers to designing products that consume less energy and fewer resources and use eco-friendly materials (Kitsis and Chen, 2021, 2023; Liu et al., 2019b), while green process design means evaluating and reengineering processes to address their economic and environmental issues (Kitsis and Chen, 2021, 2023). It should be noted that products can be goods or services.

The impact of GOM on the environmental performance of the firm has been investigated in the literature, which is understandable since green practices aim primarily to improve EP (Liu et al., 2019a). Kitsis and Chen's (2023) survey of more than 200 American manufacturers demonstrated that GOM exerts a positive and direct impact on their environmental performance. In Hsu et al.'s (2023) survey of 132 Malaysian manufacturing firms, green product design as a GOM dimension is positively and directly associated with the company's EP. Similar findings have been reported, for instance, in China (Liu et al., 2019a) and in the UK (Yu and Ramanathan, 2015). Of particular note, operations management also includes service operations, but the referenced research focused only on manufacturing industries, implying the need for more studies on GOM in the service sector (cf. Bhatia and Gangwani, 2021).

Most of the aforesaid empirical studies also examined the influence of GOM on the economic performance of the company. Kitsis and Chen (2023) and Liu et al. (2019a) showed that GOM also has a direct and positive impact on firm performance as GOM-enabled reduction in pollution and material waste can result in lower liability and compliance cost (Kitsis and Chen, 2020) and higher cost savings (Paulraj et al., 2017), respectively. Further, green product design and production, two aspects of GOM, can help win customer loyalty in the environmentally conscious population, thus increasing sales and earnings per share (Agyabeng-Mensah et al., 2020b). These findings suggest that GOM is valued by customers. Moreover, internal green practices, i.e., GOM, entail causally ambiguous resources that are developed via repeated learning over time and thus difficult to imitate (Shi et al., 2012). Therefore, GOM can sustain the competitive edge and performance of the focal firm from the RBV. In the DCT, GOM involves dynamic capabilities that can reconfigure current resources to meet customers' green expectations and gain sustainable competitive advantages (Hsu et al., 2023; Trujillo-Gallego et al., 2022). Nonetheless, it should be noted that the short-term effect on ECP can be negative or insignificant because of the massive capital outlay required (Hsu et al., 2023).

As the social dimension of sustainability has received less attention than the other two aspects in the literature (Beske, 2012; Govindan et al., 2021; Mogale et al., 2023), less research has studied the direct influence of GOM on the social performance of businesses. In manufacturing businesses, GOM/GM is overall positively and directly associated with their social performance as such green practices present positive images that meet customers' expectations and improve their satisfaction (Çankaya and Sezen, 2019; Govindan et al., 2014). Further, clean production that avoids hazardous materials protects employees' health and safety (Afum et al., 2020a; Govindan et al., 2014; Wang and Dai, 2018). Carbone et al. (2019) indeed demonstrated that the dynamic capabilities developed for green SCM, including GOM, can be leveraged to help firms attain superior social performance.

As the referenced works only covered manufacturing industries, incorporating service firms in the analysis provides an interesting path to fill this literature gap. The RBV indeed postulates that an enterprise's effective and efficient utilization of its resources and capabilities results in superior performance irrespective of its industry (Barney, 2001; Fernández et al., 2022). Empirical research based on the RBV has also illustrated the lesser importance of industry effects as compared to firm effects (Bamiatzi et al., 2016; Fernández et al., 2022). Therefore, the present study considers firms in service sectors, which are understudied in GOM (cf. Bhatia and Gangwani, 2021), and compares them to their manufacturing counterparts to produce new insights and extend the literature.

2.4. Green customer integration

Green SCM necessitates supply chain integration/collaboration to obtain desired results (Badi and Murtagh, 2019; Nguyen and Le, 2022). According to Afum et al. (2020b), SCI mediates the effect of GOM on the sustainability performance of the company. In Pham and Pham's (2021) research, SCI is regarded as a dynamic capability that mediates the impact of environmental knowledge on environmental performance. Since SCI can be defined as strategic collaboration with supply chain partners to manage processes across intra/inter-organizational boundaries (Pham and Pham, 2021), green SCI is defined by Wong et al. (2015) as SCI for the purpose of managing the environmental impact of firms.

Given the importance of customer integration in a firm's successful environmental management (Lin, 2013; Tseng et al., 2019), green customer integration (GCI) is considered an integral part of green SCI and its concept can be regarded as collaboration with customers in operations processes to reach environmental goals (Wu, 2013). GCI in fact entails consistent environmental information sharing (Afum et al., 2020b), green process coordination, and green strategic alignment between a firm and its customers (Han and Huo, 2020). According to Yang et al. (2020), GCI also consists of joint planning, decision-making, and problem-solving to pursue environmental goals collectively, e.g., resolving environmental concerns and decreasing environmental impacts of products/services and operations.

In the SCI literature, supplier integration has been most extensively studied (Wong et al., 2021). On the Web of Science, a widely used database for literature reviews (Nguyen et al., 2022; Nguyen and Le, 2022), the number of journal articles discussing green supplier integration is nearly double the figure for GCI (see the online appendix).[2] Thus, this research focuses on GCI, which is further justified by the increase in customers' awareness of environmental issues in developing countries (Asif et al., 2020; Niu et al., 2022).

2.5. Hypothesis development

Research has reported that the participation of customers is needed to achieve the EP target (Afum et al., 2020b; Yu et al., 2014). Thus, firms adopting GOM should also pursue GCI. As Hart (1995) proposed from the RBV perspective, pollution prevention evolves over time from an internal to an external process. Several researchers (e.g., Ahmed et al., 2020; Akhtar et al., 2023; Han and Huo, 2020; Pham and Pham, 2021) have argued that environmental practice and knowledge are initially accumulated in-house. Afum et al. (2020b) reported empirical support for the hypothesis that GOM affects GCI positively. Those findings suggest that GOM precedes GCI.

Next, the literature has shown that GCI is positively associated with companies' environmental performance (e.g., Ahmed et al., 2020; Guo et al., 2022). Akhtar et al. (2023) indeed argued that GCI enables enterprises to understand customers' environmental requirements better and respond appropriately to improve their environmental performance. Further, GCI helps set joint goals and plans for pollution and waste reduction, e.g., utilization of green packaging and separation of waste and recycling (Ardakani et al., 2023). Another real-life example is Boise Inc.'s collaboration with its customer, OfficeMax, for coordinated reordering, which allows the transition from truck to rail shipment to reduce emissions (Blanco and Cottrill, 2014). As the RBV postulates, SCI creates a socially complex network of complementary resources and capabilities that are hard to substitute or imitate (Shi et al., 2012). As a crucial part of green SCI, GCI can thus provide such capabilities

[2] Data taken from the Web of Science (https://www.webofscience.com) on 9 February 2024

and resources to boost the focal firm's environmental performance. Given that GOM precedes GCI that is positively associated with the firm's EP, the following hypothesis is made:

H1. GCI mediates the positive effect of GOM on the firm's environmental performance.

As rail transport is more cost-effective than trucking, the example of Boise Inc.'s collaboration with its customer (Blanco and Cottrill, 2014) also features economic benefits. In keeping with this result, Ardakani et al. (2023) added that GCI helps reduce business waste and environmental cost through the separation of waste from recycling for reverse logistics. Han and Huo (2020) further argued that GCI promotes joint planning and problem-solving to work out economical solutions. Ahmed et al. (2020) demonstrated that GCI has a positive influence on sales turnover, profit, and return on assets. In effect, GCI facilitates the firm's grasp of customer demand to boost sales and profits (Yang et al., 2020). Supportive evidence was reported in the research of Akhtar et al. (2023) and Guo et al. (2022). From the DCT perspective, Habib et al. (2021) and Trujillo-Gallego et al. (2022) showed that green SCM is a set of dynamic capabilities that can improve the enterprise's economic performance. As part of green SCM, GCI can arguably offer such dynamic capabilities to enhance the economic pillar of corporate sustainability. Given that GOM influences GCI, which correlates positively with the firm's economic performance, the following hypothesis is formed:

H2. GCI mediates the positive effect of GOM on the firm's economic performance.

Regarding the underexplored aspect of corporate sustainability in the SCM literature, i.e., social performance of the business (Beske, 2012; Bhatia and Gangwani, 2021; Çankaya and Sezen, 2019; Mogale et al., 2023), the literature has demonstrated that GCI can have a positive influence on this dimension of corporate sustainability (e.g., Han and Huo, 2020; Yang et al., 2020). Han and Huo (2020) in effect argued that GCI can assist firms in building a good reputation or positive image in their customers' eyes. An improved understanding of market demand enabled by GCI can then be translated into boosted customer satisfaction (Afum et al., 2020b), a measurement item of social performance (Çankaya and Sezen, 2019). In line with the DCT, Carbone et al. (2019) reported that the dynamic capabilities developed in green SCM can be leveraged to help firms achieve superior social performance. Likewise, the dynamic capabilities developed in GCI, which is part of green SCM, can arguably be leveraged for the same purposes. As GOM affects GCI, which is positively associated with the social performance of the focal firm, the following hypothesis is put forward:

H3. GCI mediates the positive effect of GOM on the firm's social performance.

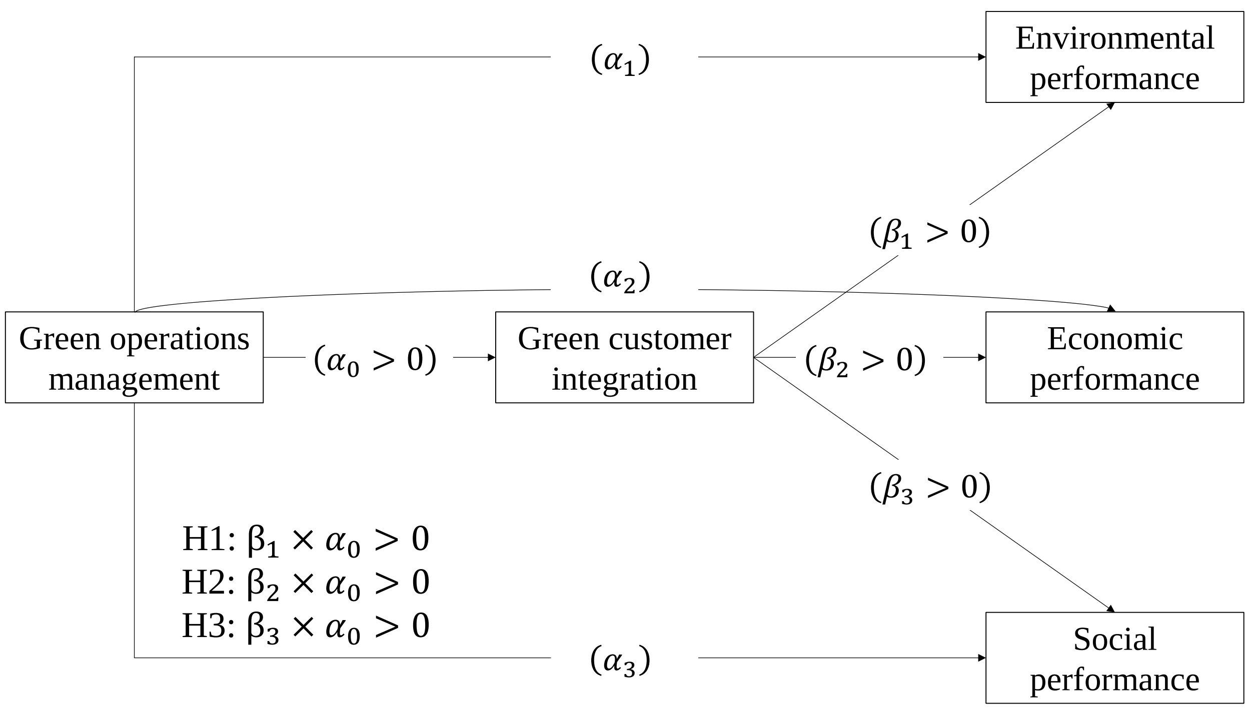

Figure 1. Conceptual model hypothesized

In keeping with Sobel's (1982) approach to mediation modeling, the equivalent model formulae of the hypothesized model in Figure 1 are provided below, with $\varepsilon_0, \varepsilon_1, \varepsilon_2, \varepsilon_3$ being the error terms assumed to be uncorrelated:

$$GCI = \alpha_0(GOM) + \varepsilon_0 \quad (1)$$

$$\mathrm{EP} = \beta_1(\mathrm{GCI}) + \alpha_1(\mathrm{GOM}) + \varepsilon_1 \quad (2)$$

$$\text{ECP} = \beta_2(\text{GCI}) + \alpha_2(\text{GOM}) + \varepsilon_2 \quad (3)$$

$$\text{SP} = \beta_3(\text{GCI}) + \alpha_3(\text{GOM}) + \varepsilon_3 \quad (4)$$

$$\text{H1: } \beta_1 \times \alpha_0 > 0 \quad (5)$$

$$\text{H2: } \beta_2 \times \alpha_0 > 0 \quad (6)$$

$$\text{H3: } \beta_3 \times \alpha_0 > 0 \quad (7)$$

The next section describes the research design to test the hypotheses proposed in this section.

3. Research method

This research utilized online self-administered surveys to collect data and ran partial least squares-structural equation modeling (PLS-SEM) to test the hypothesized model.

3.1. Variable measurement

To operationalize the variables under analysis, this study adapts the reflective constructs and their measurement items validated from previous research.

According to Çankaya and Sezen (2019), environmental performance measures a firm's ability to reduce pollution, waste, and environmental accidents, and to avoid hazardous substances. In the literature, environmental performance is evaluated by measuring emissions and waste production (Afum et al., 2020b; Wang, 2015), pollutant discharges and environmental accidents (Liu et al., 2019a), and hazardous inputs and environmental situations of the enterprise (Hsu et al., 2023). The operationalization of EP in Çankaya and Sezen's (2019) frequently cited article (e.g., Afum et al., 2020a; Agyabeng-Mensah et al., 2020a; Nguyen et al., 2023) is selected in the present research as it includes most measurement items in other works.

Regarding economic performance, prior studies have measured this variable by growth in sales, profitability, return on investment, and reduction of costs related to material procurement, energy consumption, and waste discharge and treatment (Afum et al., 2020a; Afum et al., 2020b; Çankaya and Sezen, 2019; Zhu et al., 2008). The present research uses the operationalization of economic performance in the study of Çankaya and Sezen (2019), which covers most measurement items in other papers and has been often cited (e.g., Afum et al., 2020a; Agyabeng-Mensah et al., 2020a).

For social performance, the construct can be understood as the degree to which a firm's social missions are accomplished (Afum et al., 2020a). This dimension of sustainability performance can be assessed with reference to employees' health/safety (Wang and Dai, 2018) and skill/education improvement, and the firm's image/reputation, stakeholder relationships (Afum et al., 2020a), and investments in social projects (Çankaya and Sezen, 2019). As the SP operationalization in Çankaya and Sezen's (2019) widely cited work (e.g., Afum et al., 2020a; Agyabeng-Mensah et al., 2020a; Kholaif et al., 2024) comprises most measurement items covered in other articles, including those at the staff and community levels (Kühnen and Hahn, 2018), the present paper utilizes their social performance construct in its analysis.

Operations management, which traditionally referred to manufacturing production, now covers several corporate functions, e.g., logistics and procurement (Bayraktar et al., 2007; Nguyen et al., 2022). Several authors have thus also incorporated other processes, e.g., green purchasing (Hsu et al., 2023; Liu et al., 2019b), in their conceptualization of GOM. Nevertheless, in the present work, GOM only includes green operations internal to the company while operations that entail external stakeholders such as customers are covered in GCI. This article therefore operationalizes GOM by adapting the measurement of Çankaya and Sezen (2019) and Shang et al. (2010), which refers to green product design and internal processes (in line with Kitsis and Chen, 2021, 2023).

Given that GCI is understood as a collaboration with customers for environmental management programs (Lin, 2013; Tseng et al., 2019; Wu, 2013), the variable has been operationalized as green process coordination and strategic alignment between a company and its customers (Han and Huo,

2020) for cleaner production and green packaging (Wu, 2013). In Yang et al.'s (2020) paper, GCI also includes joint planning, problem-solving, and decision-making for environmental goals, e.g., resolving environmental issues and decreasing environmental impacts of operations, products, and services. The present paper adapts the GCI measurement from Lin (2013) and Wu (2013), which has been adopted by several studies (e.g., Afum et al., 2020b; Ardakani et al., 2023; Tseng et al., 2019).

The fact that these measurements have been cited by many peer-reviewed articles indicates their reliability and validity. The survey of the present research was built on these validated items and its data collection is described in the next subsection.

3.2. Data collection

Firstly, using survey instruments built on measurement items validated in the literature, in-depth interviews with twenty supply chain experts were carried out to detect confusing points and receive suggestions for improvement of the questionnaire draft. The interviewees were chosen according to two criteria: expertise and experience. In particular, the interviewees must have more than three years' experience in SCM-related fields, e.g., logistics and purchasing. This stage involved one-on-one in-person interviews using open-ended questions to allow the experts to discuss and express their perspectives on the questionnaire freely. Each expert was given about thirty minutes and the location was chosen at their convenience. Their responses were compiled and reviewed to check if the items needed modification. Overall, the experts' comments focused on the wording and the complexity of the items in the questionnaire. Given these interview results, the questionnaire was modified to clarify these items (see the online appendix). The Likert five-point scale, from "1–completely disagree" to "5–completely agree", was employed for each measurement question.

Because of the pandemic, online surveys were deployed for data collection, which was launched in January 2021. Through personal connections, each target respondent who worked for a service or manufacturing company in Vietnam was contacted via email, with the questionnaire, along with the confidentiality and assurance letters, attached. The academic aims of the study were described in the email and all abstract terms were explained in the questionnaire to avoid misunderstanding. Assuring respondents that their identities would remain hidden helps address social desirability biases as they do not need to worry about choosing socially desired answers rather than those that truly reflect their company's situation (Podsakoff et al., 2003). This convenience sampling allowed collecting data from managers with the target expertise, but to reduce bias, the snowball technique was also used (Bell et al., 2022) with the respondents asked to forward the survey to other experts with the target experience in their networks. Alternatively, the respondents could give the contact details of their recommended experts in the responses and the data collection team would repeat the process later. Each respondent had a month to submit the response. Reminders were sent two weeks after the initial emails. The process was repeated until the usable sample size exceeded the required minimum in line with the 10-times rule (Hair et al., 2021). According to this heuristic, the sample size must be at least 10 times the number of arrowheads in the PLS-SEM (Hair et al., 2021). In the present paper, there are 32 arrowheads (25 from indicators to latent variables and 7 between latent variables).

After 13 months, 384 responses were received from respondents working for food processing, textile, shoe manufacturing, hospitality, and logistics service businesses. Incomplete responses and those with respondents having less than one year's experience were eliminated. Finally, 359 usable responses were obtained from 193 manufacturers (in the food processing, shoe manufacturing, and textile industries) and 166 providers of hospitality and logistics services. The descriptive statistics of the data are provided in Table 1.

Table 1. Descriptive statistics

		Manufacturers	Service firms	Total
Experience	1–5 years	95 (49%)	93 (56%)	188 (52%)
	More than 5 years	98 (51%)	73 (44%)	171 (48%)
Position	Managing director	16 (8%)	12 (7%)	28 (8%)
	Manager	30 (16%)	17 (10%)	47 (13%)
	Supervisor	65 (34%)	63 (38%)	128 (36%)
	Executive	75 (39%)	70 (42%)	145 (40%)
	Others	7 (4%)	4 (2%)	11 (3%)
Department	Design	0 (0%)	3 (2%)	3 (1%)
	Procurement	1 (1%)	4 (2%)	5 (1%)
	Demand planning	19 (10%)	27 (16%)	46 (13%)
	Operations–Quality	69 (36%)	50 (30%)	119 (33%)
	Finance	8 (4%)	54 (33%)	62 (17%)
	Human resource	4 (2%)	17 (10%)	21 (6%)
	Marketing	20 (10%)	9 (5%)	29 (8%)
	Project management	47 (24%)	2 (1%)	49 (14%)
	Others	25 (13%)	0 (0%)	25 (7%)
Firm size	Small (< 100 staff)	10 (5%)	18 (11%)	28 (8%)
	Medium (100–500 staff)	118 (61%)	118 (71%)	236 (66%)
	Large (>500 staff)	65 (34%)	30 (18%)	95 (26%)
Industry	Hospitality		30 (18%)	
	Logistics service		136 (82%)	
	Food processing	89 (46%)		
	Textile	47 (24%)		
	Shoe manufacturing	57 (30%)		

In order to check common method bias, the nonresponse bias was tested between the early (first quartile) and late (fourth quartile) respondents and the result demonstrated no significant difference between the two groups at the 1% level. This implies that the nonresponse bias was not a problem in the present research. Detailed nonresponse bias test results are provided in the online appendix.

Since the dataset was based on self-reported single-respondent surveys, Harman's single-factor test was used to check the presence of common method variance. The exploratory factor analysis results showed that no single factor accounted for more than 50% of the variance, indicating that none dominated the majority of the variance in the dataset, and suggesting no evidence of common method bias.

To further assess common method bias, a marker variable (MV) which is theoretically unrelated to the constructs of interest was added to the PLS-SEM to detect the presence of common method variance (Lindell and Whitney, 2001; Podsakoff et al., 2003; Sancha et al., 2016). Then, any high correlation between the MV and at least one construct under analysis would indicate the presence of common method variance (Chowdhury and Quaddus, 2021; Lindell and Whitney, 2001; Sancha et al., 2016). In keeping with Hu et al. (2020) and Li et al. (2020), the respondent's work experience was used as a marker variable in this paper because it is theoretically unrelated to the firm's GOM, GCI, or sustainability performance. The results in the online appendix illustrate no high correlation between the MV and other constructs. Also, there was no big difference between the R^2 values of each endogenous construct before and after the inclusion of the MV into the model (see the online appendix). These results further indicate that there was no evidence of serious common method bias in this article (Nguyen et al., 2023).

3.3. Data analysis

Partial least squares-structural equation modeling was selected for data analysis in the present work for three reasons. First, PLS-SEM can perform mediation analyses without increasing the sample size required or the model complexity (Afum et al., 2022; Trujillo-Gallego et al., 2022), which makes it suitable for studying the mediating effects in the hypothesized model. Second, with PLS-SEM, the normality assumption can be relaxed, which is notably helpful for the analysis of Likert-scale datasets (Afum et al., 2022; Afum et al., 2020a; Hair et al., 2019) as used in the present work. Finally, PLS-SEM can handle small sample sizes (Hair et al., 2019; Wong et al., 2021), facilitating comparisons of subsamples (i.e., manufacturing vs service). Rönkkö and Evermann (2013) stated that a drawback of PLS-SEM is its low sensitivity to discriminant validity assessment based on the common Fornell-Larcker criterion (Afum et al., 2020a). Nonetheless, this can be overcome by deploying heterotrait-monotrait (HTMT) as a complementary evaluation criterion for discriminant validity (Henseler et al., 2015).

Table 2. Measurement model

Factor	Item	Loading	SE	CA	CR
Green operations management (adapted from Çankaya and Sezen, 2019)	The firm’s operations process can reduce noise to a minimum.	.8308	.0212	.9071	.9350
	The firm’s operations process substitutes polluting and hazardous materials or parts.	.9078	.0111		
	The firm’s operations process filters and controls emissions and discharges.	.8815	.0144		
	The firm’s operations planning and control focus on reducing waste and optimizing materials exploitation.	.9161	.0117		
	The firm’s operations process design focuses on reducing energy and natural resource consumption.	*Omitted (factor loading<0.7)*			
Green customer integration (adapted from Lin, 2013; Wu, 2013)	The firm collaborates with major customers for joint planning to achieve environmental goals.	*Omitted (factor loading<0.7)*		.8297	.8981
	The firm cooperates with major customers to reduce the environmental impact of its products.	.8578	.0198		
	The firm cooperates with major customers for environment-friendly operations, green packaging, or other environmental activities.	.8621	.0188		
	The firm collaborates with major customers to implement environmental management programs.	.8711	.0164		
Environmental performance (adapted from Çankaya and Sezen, 2019)	The firm has improved its environmental situation.	.7556	.0305	.8572	.8972
	The firm has reduced its waste (water and/or solid).	.8080	.0227		
	The firm has reduced its air emissions.	.8094	.0226		
	The firm has decreased its consumption of hazardous/harmful/toxic materials.	.8008	.0205		
	The firm has decreased the frequency of its environmental accidents.	.8118	.0238		
Economic performance (adapted from Çankaya and Sezen, 2019)	The firm has decreased its cost of materials purchased.	.7635	.0293	.8882	.9147
	The firm has decreased its cost of energy consumption.	.7657	.0296		
	The firm has decreased its cost of waste	.8234	.0195		

	discharge.				
	The firm has improved its earnings per share.	.8320	.0252		
	The firm has improved its return on investment.	.7979	.0304		
	The firm has improved its sales growth.	.8206	.0198		
Social performance (adapted from Çankaya and Sezen, 2019)	The firm has improved its customer satisfaction.	.8800	.0166	.8799	.9171
	The firm has improved its image in the eyes of its customers.	*Omitted (factor loading<0.7)*			
	The firm has improved its investment in social projects (education, culture, and sports).	.8333	.0242		
	The firm has seen improvements in its employee training and education.	.8295	.0183		
	The firm has improved the occupational health and safety of its employees.	.8842	.0149		

SE = standard error; CA = Cronbach's alpha; CR = composite reliability. 359 observations. 5000-replication bootstrap.

Table 3. Convergent and discriminant validity analyses

	EP	ECP	SP	GCI	GOM
Environmental performance (EP)	.6358				
Economic performance (ECP)	.2339	.6416			
Social performance (SP)	.2338	.2962	.7347		
Green customer integration (GCI)	.2530	.1258	.1452	.7460	
Green operations management (GOM)	.2872	.1437	.1154	.1709	.7826

Note: Highlighted on the diagonal is the average variance extracted. The off-diagonal entries are the squared inter-factor correlations. 359 observations. 5000-replication bootstrap.

Table 4. Discriminant validity analysis based on HTMT ratios

	EP	ECP	SP	GCI	GOM
Environmental performance (EP)	.				
Economic performance (ECP)	.5438	.			
Social performance (SP)	.5559	.6100	.		
Green customer integration (GCI)	.5909	.4104	.4397	.	
Green operations management (GOM)	.5981	.4200	.3783	.4756	.

Note: The off-diagonal entries are the heterotrait-monotrait (HTMT) ratios. 359 observations. 5000-replication bootstrap.

As utilizing bootstrap to compute the mediating effect is the recommended approach to address the limitation of the Sobel test (Malhotra et al., 2014), this study performed PLS-SEM with 5000-replication bootstrap deploying the "plssem" package in STATA 15.1 (Venturini and Mehmetoglu, 2019) and the "seminr" package version 2.3.2 in R (Ray et al., 2022).[3] The measurement part of the PLS-SEM results is reported in Table 2, and its convergent and discriminant validity analysis in Table 3. Overall, the measurement model met the validity and reliability criteria. In particular, both the composite reliability and Cronbach's alpha were above the threshold of 0.7, indicating the reliability of each construct (Benítez et al., 2020; Hair et al., 2019) reported in Table 2. Moreover, the loadings of the retained measurement items were statistically significant and greater than 0.7 (see Table 2), attesting to indicator reliability (Afum et al., 2022). Along with indicator reliability, the average variance extracted (AVE) above 0.5 (Table 3) offered evidence of convergent validity (Hair et al., 2019; Trujillo-Gallego et al., 2022). Discriminant validity was supported by the AVE greater than all the squared interfactor correlations in Table 3 and the HTMT ratios below 0.85 in all the off-diagonal entries in Table 4 (Benítez et al., 2020; Trujillo-Gallego et al., 2022).

It should be noted that the *t*-test results show no significant difference between the measurement models for manufacturing and service firms in the data (see the online appendix), so only the global model pooled across these two groups of firms is provided here. Since the reliability and validity of the reflective measurement model are supported, the next section discusses the structural model which performs hypothesis testing with 5000-replication bootstrap.

4. Research results

Regarding the manufacturing firms in the data, the direct paths in the structural model are depicted in Figure 2 while the indirect paths, which are the hypothesized effects, are given in Table 5. These

[3] This paper used the default settings of the STATA "plssem" package developed by Venturini and Mehmetoglu (2019) and the composite "seminr" package in R developed by Ray et al. (2022), which both produced qualitatively the same results for the present study.

results were built on 5000-replication bootstrap, which is the recommended approach to mediation analysis (Malhotra et al., 2014).

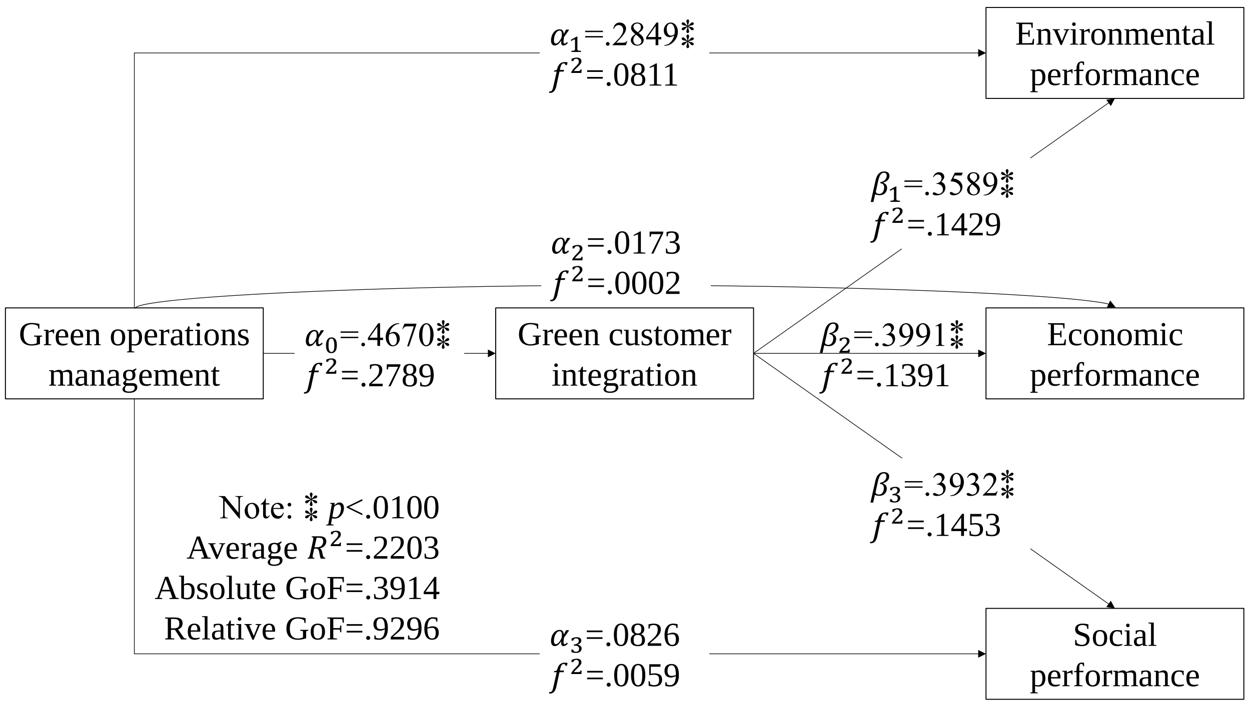

Figure 2. Structural model for manufacturing firms

Table 5. Hypothesis test results for manufacturing firms

Hypothesis	Path	Coefficient	p-value	Result
H1	GOM → GCI → EP	.1676 (= $\beta_1 \times \alpha_0$)	.0003	Supported
H2	GOM → GCI → ECP	.1864 (= $\beta_2 \times \alpha_0$)	.0003	Supported
H3	GOM → GCI → SP	.1836 (= $\beta_3 \times \alpha_0$)	.0002	Supported

EP = environmental performance; ECP = economic performance; SP = social performance; GCI = green customer integration; GOM = green operations management. 5000-replication bootstrap to calculate the p-value. 193 observations.

As can be inferred from Figure 2, the average R^2 value of the structural model is above the 0.13 threshold for medium effect sizes (Cohen, 1988; Wetzels et al., 2009). In fact, the R^2 values of all endogenous constructs (i.e., GCI, EP, ECP, and SP) are greater than 0.13 (see the online appendix). Regarding the goodness-of-fit (GoF) indices, the absolute GoF is greater than the threshold of 0.36 recommended by Wetzels et al. (2009) while the relative GoF exceeds the threshold of 0.90 for a good model (Mehmetoglu and Venturini, 2021). These indicators provide support for the predictive ability of the PLS-SEM reported (Mehmetoglu and Venturini, 2021).

As illustrated in Figure 2, GOM has a direct and positive effect on environmental performance (α_1=.2849, p<.01, f^2=.0811) and its effect size (f^2) is above the 0.02 threshold for small effects (Cohen, 1988; Hair et al., 2021; Mehmetoglu and Venturini, 2021). GOM also has a positive effect on GCI (α_0=.4670, p<.01, f^2=.2789) and its effect size (f^2) is greater than the threshold of 0.15 for medium effect sizes (Cohen, 1988; Hair et al., 2021; Mehmetoglu and Venturini, 2021). GCI then positively affects environmental performance (β_1=.3589, p<.01, f^2=.1391), and the indirect path is positive and significant according to 5000-replication bootstrap ($\beta_1 \times \alpha_0$=.1676, p<.01, in Table 5). This means that GCI partially mediates the relationship between GOM and environmental performance, supporting H1 for manufacturing businesses.

With respect to the other hypotheses, the direct effect of GOM on economic (α_2=.0173, p=.85, f^2=.0002) and social (α_3=.0826, p=.28, f^2=.0059) performance is insignificant (see Figure 2), but the indirect paths through GCI (see Table 5) are positive and significant ($\beta_2 \times \alpha_0$=.1864, p<.01 for economic performance and $\beta_3 \times \alpha_0$=.1836, p<.01 for social performance). This indicates that GCI fully mediates the effect of GOM on economic and social performance, giving support to both H2 and H3 for manufacturing firms.

Overall, these findings suggest that manufacturing enterprises can improve their environmental performance directly by adopting GOM and that this effect is partially mediated by GCI. However, for their economic and social performance, the effect of GOM is fully mediated by GCI, providing support for the importance of supply chain integration in corporate sustainability, in line with the RBV (Afum et al., 2020b; Yu et al., 2017) and DCT (Pham and Pham, 2021).

The hypothesis test results for service companies are presented in Figure 3 for direct paths and in

for indirect paths (hypothesized effects). In Figure 3, both the absolute and relative GoF indices are greater than the thresholds of 0.36 and 0.90 for good models, respectively (Mehmetoglu and Venturini, 2021; Wetzels et al., 2009), and the average R^2 exceeds the 0.26 threshold for large effects (Cohen, 1988; Wetzels et al., 2009), offering support for the predictive power of the PLS-SEM for service companies. It should be noted that there are no significant differences between manufacturing and service enterprises with regard to their levels of GOM and GCI (see the online appendix), but the effects of GOM and GCI on their sustainability performance are not always the same.

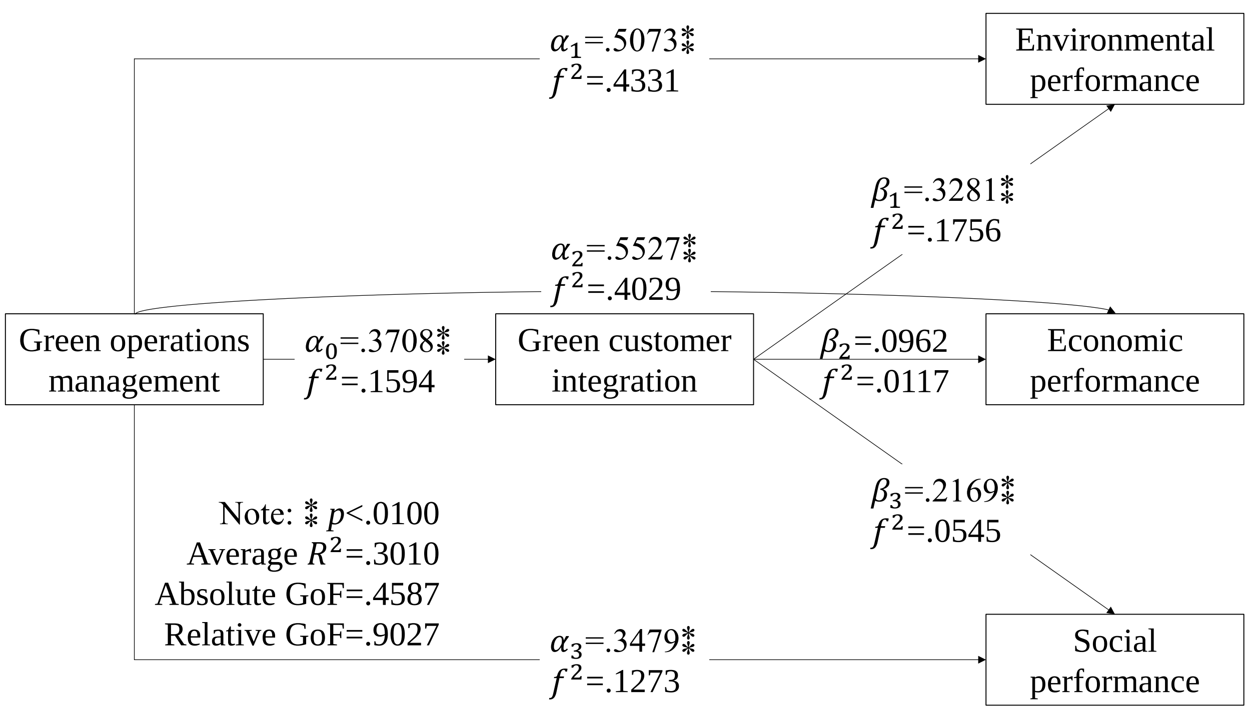

Figure 3. Structural model for service companies

Like manufacturing enterprises, service firms can boost their EP directly with GOM (α_1=.5073, p<.01, f^2=.4331 in Figure 3) and GCI partially mediates that effect ($\beta_1 \times \alpha_0$=.1217, p<.01 in

), so H1 is supported. However, unlike their manufacturing counterparts, service companies can improve their ECP directly with GOM (α_2=.5527, p<.01, f^2=.4029 in Figure 3) and the effect size (f^2) is greater than the 0.35 threshold for large effects (Cohen, 1988; Hair et al., 2021; Mehmetoglu and Venturini, 2021). Given that the indirect effect of GOM on economic performance via GCI is not significant ($\beta_2 \times \alpha_0$=.0357, p=.21 in

), H2 is not supported for service firms. In regard to H3, the direct effect of GOM on social performance is significant (α_3=.3479, p<.01, f^2=.1273 in Figure 3), and the indirect path through GCI is marginally significant ($\beta_3 \times \alpha_0$=.0804, p=.04 in

). This indicates that GCI partially mediates the effect of GOM on social performance and that H3 is supported for service enterprises.

Table 6. Hypothesis test results for service companies

Hypothesis	Path	Coefficient	p-value	Result
H1	GOM → GCI → EP	.1217 (= $\beta_1 \times \alpha_0$)	.0028	Supported
H2	GOM → GCI → ECP	.0357 (= $\beta_2 \times \alpha_0$)	.2108	Not supported
H3	GOM → GCI → SP	.0804 (= $\beta_3 \times \alpha_0$)	.0403	Supported

EP = environmental performance; ECP = economic performance; SP = social performance; GCI = green customer integration; GOM = green operations management. 5000-replication bootstrap to calculate the p-value. 166 observations.

The results in Figure 3 and

show that service firms, unlike manufacturing businesses, can enhance the three aspects of corporate sustainability directly with GOM, and these differences are statistically significant (in Table 7). Nevertheless, it should be noted that the effect of GOM on environmental and social performance remains mediated by GCI, as hypothesized for service and manufacturing companies. Indeed, there is no significant difference between these two sectors with respect to Hypotheses H1 and H3 (see Table 7).

Table 7. Comparisons between manufacturing and service companies

Hypothesis	Path	Manufacturing (α)	Service (β)	$\lvert\alpha - \beta\rvert$	p-value
	GOM → GCI	.4670⁑	.3708⁑	.0962	.3303
	GOM → EP	.2849⁑	.5073⁑	**.2224**	**.0245**
	GOM → ECP	.0173	.5527⁑	**.5354**	**.0000**
	GOM → SP	.0826	.3479⁑	**.2653**	**.0196**
	GCI → EP	.3589⁑	.3281⁑	.0308	.7690
	GCI → ECP	.3991⁑	.0962	**.3029**	**.0027**
	GCI → SP	.3932⁑	.2169⁑	.1763	.1110
H1	GOM → GCI → EP	.1676⁑	.1217⁑	.0459	.4597
H2	GOM → GCI → ECP	.1864⁑	.0357	**.1507**	**.0109**
H3	GOM → GCI → SP	.1836⁑	.0804*	.1032	.1017

⁑p<.01, *p<.05. EP = environmental performance; ECP = economic performance; SP = social performance; GCI = green customer integration; GOM = green operations management. Printed in boldface are the path effects whose differences between manufacturing and service companies are statistically significant at the 5% level. 5000-replication bootstrap to calculate the p-value.

On the other hand, the comparison of hypothesis testing results in Table 7 reveals a statistically significant difference between manufacturing and service firms in Hypothesis H2. Although there is no statistically significant difference between manufacturing and service companies with respect to the effect of GOM on GCI, the effect of GCI on ECP is not significant for service enterprises but positive and significant for manufacturing businesses. This partly accounts for the statistically significant difference in the indirect effect of GOM of manufacturing and service firms on ECP. Detailed explanations about these significant differences with reference to Vietnam, the developing economy under analysis in the present paper, are provided in the next section.

5. Discussions and implications

5.1. Result discussions

In line with the literature on green supply chain management (GSCM), this paper shows evidence of the significant effect of GOM on GCI in both the manufacturing and service sectors. This result is in accord with previous studies (Afum et al., 2020b) that presented the positive effect of green in-house operations on GCI. Several researchers (e.g., Ahmed et al., 2020; Akhtar et al., 2023; Han and Huo, 2020; Pham and Pham, 2021) have argued that environmental knowledge and practice are initially accumulated in-house. In keeping with Hart's (1995) proposition based on the RBV that pollution prevention evolves over time from internal to external processes, the present research points to the significance of internal GOM in increasing GCI in the GSCM field.

Since the primary objective of GOM is to boost environmental performance (Liu et al., 2019a; Nunes and Bennett, 2010), GOM can be directly associated with the EP of both manufacturing and service firms. The result of the present research accords with earlier studies, e.g., Kitsis and Chen (2023), Liu et al. (2019a), and Yu and Ramanathan (2015). Nonetheless, the results for H1 confirm that GCI performs a significant mediating role in the effect of GOM on environmental performance in both sectors. These results, in line with Ahmed et al. (2020), underline the vitality of GCI in EP, particularly in developing countries such as Vietnam. By collaborating with customers, especially large ones, the focal firm can leverage external support for cleaner operations, green packaging, and environmental management programs.

Even though there is no significant difference between these two sectors in terms of their GOM (see the online appendix), the direct effects of their GOM on ECP and SP are not the same. Indeed, the present research finds no evidence pointing to the significant effect of GOM on ECP and SP in manufacturing industries. However, the results are in line with Han and Huo (2020), who argued that green in-house operations need long-term efforts to achieve profitability, thus not likely having an immediate effect on ECP in the short term, particularly in manufacturing industries. The cost associated with GOM implementation (Ahmed et al., 2020) is much higher in manufacturing than in service sectors. This partly explains why the results herein show that GOM has a significant and positive effect on ECP in service industries, which is not supported in manufacturing. In respect of the social aspect of corporate sustainability, GOM is also positively associated with SP in service industries, but that effect is found insignificant in the manufacturing sector. In Vietnam, hospitality and logistics service providers have promoted GOM by utilizing green materials and energy as a marketing strategy to enhance their customers' perception. Since services often require interactions between providers and customers (Kuijken et al., 2017), service firms' GOM is more likely to be directly associated with growth in customer satisfaction and staff wellbeing than is the case for their manufacturing counterparts'.

Likewise, no significant difference exists between these two groups of firms in their GCI (see the online appendix), but the mediating effects of their GCI on ECP and SP differ. In manufacturing firms, GCI fully mediates the influences of GOM on ECP and SP. These results reflect the situation of manufacturing enterprises in developing economies, which are aware of the role of supply chain customer integration in raising economic and social performance (Afum et al., 2020b). This paper reveals that manufacturing companies in Vietnam depend on collaboration with their customers to advance their economic and social agenda. Indeed, Chen and Kitsis (2017) emphasized that the capability for collaborating with external stakeholders is more likely to enhance the sustainability performance of the company than its in-house practices. For example, joint planning and problem-solving with customers can reach economical solutions (Ahmed et al., 2020; Han and Huo, 2020) that support GOM to cut waste (Ardakani et al., 2023; Blanco and Cottrill, 2014; Guo et al., 2022), make products in line with market demand (Akhtar et al., 2023; Yang et al., 2020), and improve customer satisfaction (Afum et al., 2020b; Çankaya and Sezen, 2019). These results are in accord with prior studies in both advanced nations (Çankaya and Sezen, 2019; Wu, 2013) and developing economies (Afum et al., 2020b), which corroborated the important role of customer integration in enhancing firms' economic and social performance.

In the service sector, GCI partially mediates the effect of GOM on SP, in line with Han and Huo (2020). Since customers are often involved in the value co-creation process of services (Kuijken et al., 2017), service firms' better understanding of market demand and stakeholder requirements enabled by GCI can translate into enhanced customer satisfaction and stakeholder welfare (Afum et al., 2020b; Han and Huo, 2020). However, the effect of service companies' GCI on ECP is not significant, giving no support to the hypothesis that GCI mediates the relationship between GOM and ECP. Golicic and Smith (2013) argued that GCI may need more time to generate profitability (Han and Huo, 2020) because value co-creation in services can add value but also cost, especially in complex processes which involve customers' experiences gained from repeat contacts with the service provider (Eichentopf et al., 2011).

5.2. Theoretical implications

Regarding theoretical implications, this present study provides empirical support for the resource-based view and dynamic capability theory. In fact, the dynamic capabilities of GOM and GCI can be leveraged to raise not only the environmental but also the economic and social performance of the company (cf. Carbone et al., 2019; Hsu et al., 2023) because such activities not only serve their primary purpose of improving environmental performance but also help obtain information from stakeholders to respond to their requirements, augment operating efficiency, and build a positive reputation or image (Ardakani et al., 2023; Azevedo et al., 2011; Han and Huo, 2020; Wong et al., 2015). This work also shows that the role of GCI in mediating the influence of GOM on social and environmental performance remains qualitatively unchanged between manufacturing and service firms.

Chen and Kitsis (2017) stressed that the ability to collaborate with external stakeholders is more likely to improve the company's sustainability performance than its in-house practices. The present work indeed reports that the effect of GOM on corporate sustainability is mediated by GCI, which can be explained from the RBV. In particular, GCI offers access to complementary resources and capabilities that facilitate joint planning and problem-solving to monitor and cut waste discharge and reach economical solutions (Ardakani et al., 2023; Azevedo et al., 2011; Han and Huo, 2020; Yang et al., 2020). Prior research has proven that the capabilities to engage supply chain actors are valuable, rare, inimitable, and non-substitutable resources that play a vital role in the sustainability performance of the businesses adopting green SCM (Carbone et al., 2019). Indeed, SCI creates a socially complex network of valuable and complementary resources and capabilities that are hard to substitute or imitate (Shi et al., 2012). The current study is generally in line with these theoretical underpinnings.

5.3. Managerial implications

According to the research findings herein, Vietnamese companies aiming to undertake GOM can boost their economic, environmental, and social performance through GCI, a crucial part of green SCI. Further, the government should introduce policies that promote both GOM and GCI to help firms achieve their target sustainability. Nonetheless, given the differences between manufacturing and service industries, supply chain managers should implement different integration strategies to augment GOM efficiency.

Regarding manufacturing businesses, GOM can be directly associated with their environmental performance, but their economic and social performance improvement is fully mediated by GCI. Thus, manufacturers should collaborate with customers to gain access to complementary resources and capabilities which facilitate joint planning to monitor and reduce environmental cost and waste discharge by separating waste from recycling for reverse logistics (Ardakani et al., 2023). Further, collaboration with customers promotes joint planning and problem-solving to produce economical solutions from accurate demand understanding and timely replenishment (Ahmed et al., 2020; Han and Huo, 2020; Yang et al., 2020). Then, market demand understanding enabled by GCI can be translated into high customer satisfaction (Afum et al., 2020b). In fact, GCI helps gain information from stakeholders and respond to their requirements, thereby boosting the focal company's social performance (Han and Huo, 2020). Collaboration with supply chain partners can also assist firms in building a good reputation or positive image (Han and Huo, 2020; Wong et al., 2015). Moreover, the government should consider giving incentives or support to encourage manufacturing firms to invest in GOM and help them offset related expenses.

Like manufacturing companies, service providers' GOM is also directly associated with their EP, and this effect is also partially mediated by GCI. Unlike manufacturing firms, however, service companies' GOM is directly associated with their social performance. Still, GCI partially mediates this relationship. This suggests that the aforesaid recommendations for manufacturing businesses to boost their environmental and social performance through GCI also apply to service enterprises. Nevertheless, while GOM has a direct effect on service firms' economic performance, the indirect effect through their GCI is not statistically significant. This is possibly because GCI might require more time to achieve profitability (Golicic and Smith, 2013; Han and Huo, 2020). Indeed, value co-creation in services can add value but also cost, especially in complex processes which involve customers' experiences gained from repeat contacts with the service provider (Eichentopf et al., 2011). Therefore, service providers should engage customers early in the process to facilitate their learning and experience acquisition in GCI, thus cutting coordination costs. The government can incentivize such initiatives by lending support that helps service companies with efficient customer integration.

6. Conclusion

The present study addresses a gap in the literature by examining the mediating role that GCI plays in the relationship between GOM and corporate sustainability of service and manufacturing firms in a developing economy (Vietnam). This work is among the first attempts to compare the service and manufacturing sectors explicitly in terms of GOM, GCI, and sustainability performance.

The PLS-SEM results demonstrate that both service and manufacturing enterprises have GOM directly associated with their environmental performance and that this relationship is mediated by GCI. Nevertheless, the effect of manufacturers' GOM on their economic and social performance is fully mediated by GCI while service businesses' GOM is directly associated with their economic and social performance. The effect of service companies' GOM on SP is also mediated by their GCI, but this indirect effect does not apply to their ECP. Therefore, firms undertaking GOM should properly foster GCI to achieve the desired sustainability results. The government should consider appropriate incentives and support to promote GOM, GCI, and sustainable business. The present study offers empirical support for the resource-based view and dynamic capability perspective by demonstrating that GCI provides access to complementary resources and capabilities that can be dynamically leveraged to improve not only the environmental but also other aspects of the focal company's sustainability performance.

Like prior research, this study has limitations despite its contribution to the field of green supply chain management. First, its sample covers solely Vietnam, which limits the generalization of its findings to other geographical areas. As Vietnam is a developing nation, the results reported herein may apply to other developing economies rather than developed countries. Also, the sample of the manufacturing sector includes only food processing, shoe production, and textile firms, while the collected dataset for the service sector is only from hospitality and logistics service providers. This may limit the generalizability of the study. Therefore, further research should replicate the present study's data collection and analysis to retest and compare the hypotheses in different countries and sectors.

Finally, the present article extends the discussion about the RBV literature by highlighting the differences between service and manufacturing firms in terms of their sustainability performance despite their similar GOM and GCI. The primary purpose of this work was to fill a literature gap, and to that end, it employed the gap-spotting approach prevalent in the literature (Sandberg and Alvesson, 2010). Indeed, the present study used the neglect-spotting mode of gap-spotting, where underexplored themes are identified as motivations to extend the literature or address its lacunae (Sandberg and Alvesson, 2010). The relevance of gap-spotting to the reinforcement and refinement the established theoretical foundation is undeniable; however, problematization that challenges the assumption undergirding the literature is more likely to result in high-impact research and theories (Alvesson and Sandberg, 2011; Sandberg and Alvesson, 2010). This is another limitation of this article. Future research may consider leveraging the findings of this paper or other prior works to identify implicit yet open-for-problematization assumptions that might serve as starting points for potentially impactful studies or theories.

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