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RESEARCH ARTICLE

Greening the manufacturing firms: do green supply chain management and organizational citizenship behavior influence firm performance?

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Abstract

The spontaneous organizational citizenship behavior towards environment (OCBE) of employees in the workplace is crucial to businesses' green development and low-carbon transition. However, it was not considered how such behavior could be encouraged for enhanced firm performance. From the natural resource-based view theory perspective, this study tests a model that investigates how green supply chain management practices, green culture, top management commitment, and OCBE, and influences firm performance. A structural equation model (SEM) was utilized to test the hypotheses using 600 survey questionnaires collected from manufacturing firms. The results show that green supply chain management indirectly affects firm performance through green culture and top management commitment. The results reveal that green culture and top management commitment positively and significantly mediate the relationship between green supply chain management and firm performance. Furthermore, the findings show that OCBE has a direct effect on firm performance. Moreover, the results highlight that OCBE has a positive moderating effect on the association between green supply chain management and firm performance. Finally, the study's findings and implications are disclosed to be useful policy instruments for organizations, administrations, and other stakeholders.

Keywords Organizational citizenship behavior towards environment · Green culture · Top management commitment · Green supply chain management · Natural resource-based view theory · Firm performance

Introduction

Recently, it has been noticed that the most significant reasons for environmental issues are damaging organizational activities that cannot be disregarded (Suki et al. 2020). Several organizations have begun implementing eco-friendly strategies to properly shape their activities (Wang et al. 2018). While firms preferred to prioritize the managerial and technical components of climate change, they fiercely opposed firms' acts that pose a hazard to the environment (Nejati et al. 2017). So, firms value workers who demonstrate organizational citizenship behavior towards environment (OCBE) or are actual environmentalists (Cheema et al. 2020). These personnel strive to maximize the good effect of activities at the workplace in a business setting (Adebayo and Kirikkaleli 2021). Moreover, they encourage business efforts that conserve natural resources and safeguard the environment (Kirikkaleli and Adebayo 2021). Before introducing green initiatives and sustainability, the world was seen as a commodity (Nureen et al. 2023b). Environmental problems have worsened over the last several decades due to humans' and businesses' ignorance and poor conduct (Nureen et al. 2023; Han et al. 2019). Green business techniques, including green supply chain management (GSCM), may improve firm performance (FPR) (Gahlot et al. 2023) (Fig. 1). Recently, the notion of green practices has evolved and attracted the interest of businesses seeking to manage

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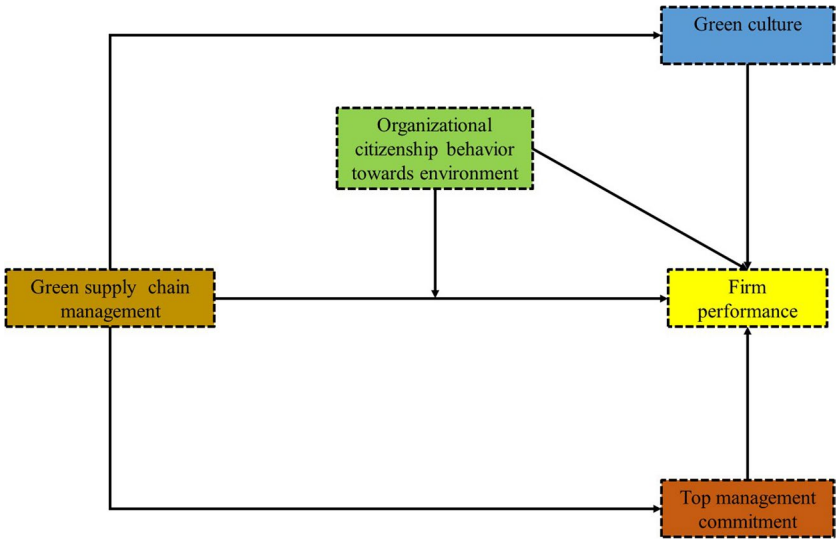
Fig. 1 Conceptual framework



environmental challenges (Rajabion et al. 2019). These green approaches have helped businesses to achieve competitiveness and sustainable FPR (Nureen et al. 2023). Green practices have enhanced supply chain operations, company operations, and firm efficiency (Cousins et al. 2019; Nureen et al. 2023c; Adebayo 2022).

Supply chain scholars and practitioners are developing an interest in GSCM practices. The increasing significance of this concern is a result of the deteriorating natural environment (Huang et al. 2022). Consequently, the significance of GSCM adoption inside enterprises should be considered a generator of value rather than a threat to it (Abdel-Baset et al. 2019). Governmental environmental laws, including carbon caps and environmentally friendly methodologies of mitigation, and green culture (GRCL) to safeguard the ecological condition of the planet are driving their implementation more widely over a variety of firm types thereby broadening the application of their implementation inside the corporate environment (Wang 2019). GSCM is the administration of information, components, and investment, in addition to collaboration among businesses in the supply chain, intending to dynamically incorporate goals linked to the three aspects of sustainable development—the economic, social, and environmental—that logically deduce from stakeholder and consumer demands (Nureen et al. 2023a). It is crucial to note that the effective application of GSCM requires a combination of approaches (Gedam et al. 2023; Novitasari et al. 2023). GSCM, a more economically beneficial and ecologically responsible technology, should be prioritized in organizations' attempts to evolve into a more ecologically sound (Sheng et al. 2022). GSCM improves the conventional concept of SCM from an ecologically responsible supply chain management perspective by enhancing the FPR over the entire life cycles of products and services. In the quest for robustness in supply chain procedures, the deployment of GSCM meets several obstacles, including insufficient funding for recycling (Esfahbodi et al. 2023).

OCBE is a novel idea in which workers participate and volunteer their skills for the advancement and benefit of their businesses without compensation. There are both individual and organizational obstacles to OCBE (Mi et al. 2019). Individual obstacles comprise societal standards, personal conduct, deficiency in environmental understanding, consciousness, and self-efficacy. In contrast, organizational hurdles comprise firm ideals, a lack of independence, limited funding, and organizational commitment (Luu 2019b). Using OCBE in companies assists the management and practitioners in improving their FPR. The influence of OCBE on industrial enterprises and the link between managerial participation in OCBE and environmental management practices are also considerable (Luu 2019a). OCBE improves understanding of the relevance and importance of green goals, leading to enhanced FPR. Erstwhile studies have shown that GSCM and OCBE substantially influence FPR (Pham et al. 2019). The presence of OCBE is vital for effective FPR (Brisman and South 2013). Hence, green practices encourage workers to give greater consideration to environmentalism, which impacts OCBE and increases their awareness of environmental preservation in order to accomplish effective FPR (Khan et al. 2019a).

GRCL is one of the factors that have a considerable effect on FPR (Brisman et al. 2014). According to Hart (1995), a firm's resources are essential in developing the efficient mitigation strategies, and GRCL is one of the firm's resources that may promote competitiveness and FPR (Glotfelty 2012). In this context, GRCL refers to a common set of convictions, ethics, thoughts, and attitudes that impacts a firm's conduct. A management team may establish a firm's culture in order to propagate a number of principles that govern business objectives (Rizvi and Garg 2021). Thus, we consider GRCL, whose principles

the company has absorbed across the business and which are often articulated in a statement of purpose for all workers and management (van Uhm 2018). Hence, GRCL may encourage workers to adopt GSCM as a core organizational goal and to become more involved with environmental challenges (Elbaz and Iddik 2020). Considering GRCL's significance over the past few years, it is perhaps surprising that the success of GRCL techniques has received so little attention in the field of research (Asha et al. 2022). The link between GRCL, GSCM, and FPR is a growing concern for enterprises throughout the globe (Istriari and Murwaningsari 2023), providing us with little information to fill the gaps in the existing literature. This study adds to our understanding by studying how manufacturing firms convert their key resources into FPR, as well as determining how GRCL plays a mediating role in the relation between GSCM and FPR.

Until recently, numerous research studies have concentrated on investigating the relationship via the following lenses. Past research studies examined the relation between GSCM and FPR (Chu et al. 2017). Several studies have demonstrated a relation between GSCM and FPR; although this relationship is ambiguous, scholars keep looking into it (Schmidt et al. 2017). In particular, some scholars have projected the usage of mediators or moderators in this association (Sharma et al. 2021). Among several other topics, OCBE and GRCL research has concentrated on the other service sectors, environmental factors, and employee satisfaction (Elche et al. 2020). While the effect of GRCL and OCBE on GSCM is crucial for improving FPR in the manufacturing sector and environmental attributes, so, additional research is necessary. Few experimental academic research investigations, especially in the industrial sector, link GRCL to organizational as well as environmental outcomes (Wang 2019). Moreover, research in emerging nations pertaining to GRCL and TPMC, a crucial component of GSCM for greater FPR, is sparse. Numerous studies explore how GRCL can improve the FPR of manufacturing firms (Yeşiltaş et al. 2022). This research seeks to investigate the association of GSCM and FPR with meditation of GRCL, TPMC, and moderation of OCBE in the developing country setting.

The following are the major research contributions: initially, this research investigates the variables that may impact FPR. Although this is a pioneering study performed from a developing country context. The connection between FPR, TPMC, GRCL, GSCM, and OCBE has not been well-researched. This research used the natural resource-based view (RBV) theory to investigate the abovementioned relationships. The researchers provided GRCL and OCBE little attention while analyzing FPR. This study addresses such literature gaps. This research examines in detail the link between GSCM and FPR with mediation of GRCL, TPMC, and moderation of OCBE, grounded in natural RBV theory. The current elements and the suggested novel characteristics were missed by prior research.

The remaining parts of this research are structured as follows: in the "Theoretical background and development of hypotheses" section, a review of the literature and hypotheses development are discussed. The research design and methodology are detailed in the "Methodology" section. The "Analysis and results" section discusses the findings and analysis. In the "Discussion" section describes the study's findings, policy implications, research limitations, and suggestions for further investigation.

Theoretical background and development of hypotheses

Natural resource-based view theory

The resource-based view (RBV) theory has been frequently employed to illustrate how GSCM practices affect FPR (Choi and Hwang 2015). The RBV declares that industries must expand their resources and capabilities and employ them in order to attain sustained competitiveness (Barney 2000). GRCL, OCBE, information systems, finances, infrastructure, and learning are illustrations of intangible and tangible resources. RBV theory designates a deliberate asset as a rare, significant, irreplaceable, and poorly imitable resource. Companies that shape distinguishing competencies by merging strategic assets in innovative conduct may gain competitiveness and generate above-average return rates (Le 2020). The RBV theory has often been employed to illustrate how GSCM practices influence FPR (Schmidt et al. 2017). The RBV says that businesses must expand their resources and capabilities and employ them in order to achieve sustained competitiveness.

Hart (1995) has recently sought to widen the application of RBV by integrating the natural environment's restrictions and possibilities. Hart's paradigm, known as the natural RBV, claims that industries may obtain competitiveness by deploying green initiatives, such as pollution reduction, sustainable development, and product stewardship. Pollution prevention aims to avoid trash and pollution from their source instead of their final destination. Product stewardship ensures that all stakeholders involved in a good's life cycle work to reduce any negative effects on the environment. Economic and social issues are a part of sustainable development in addition to environmental hazard mitigation. Substantial GSCM studies have investigated the competitive advantage consequences of various policies, particularly pollution control (Hart and Dowell 2011). Several academics have refined the natural RBV to demonstrate the significance of green initiatives as a strategic asset that inevitably leads to improved FPR (Jaaffar et al. 2019).

Green supply chain management and firm performance

The supply chain comprises many sectors interested in directly or indirectly fulfilling a customer's need (Stekelorum et al. 2021). Nowadays, coordinating various supply chain organizations has been deemed an SCM. It should be highlighted. However, that supply chain does not refer to a chain of companies with business-to-business, one-to-one relationships but rather to a system of businesses and relationships (Laguir et al. 2021). SCM is integrating and administrating a complex network of operations performed to provide a final commodity to end-users or consumers (Uddin et al. 2022). There are three typical supply chain processes: procurement, production, and distribution. Each phase may include various facilities in different global areas. Some manufacturers and merchants have used SCM to improve the efficacy of the value chain (Olajide et al. 2019). Manufacturers are now leveraging supplier benefits and technological advances to aid in developing innovative products. Sellers consistently incorporate their tangible distribution functions with the transport team to enhance retail stores shipping or go further than docking without needing inspection and testing (Rusmawati and Soewarno 2021). The supply chain is fundamental to the success of any organization. With natural disasters such as the COVID-19 pandemic, SCM in the food and healthcare supply chains has also been a significant concern (Alharbi 2022).

Traditionally, the primary purpose of SCM was to reduce costs and enhance service while placing less focus on environmental problems. The external forces, including government legislation and the competitor industry establishment load, compelled businesses to design their supply chain networks with environmental considerations in mind. Before, studies were confined to waste management, lean management, and service lane improvement with little time, energy, and material inputs. A closed-loop supply chain management has recently developed, representing the profit gained through value-added elements, reusing, and recycling commercial goods. While GSCM originated in the USA in the 1960s, it is now acknowledged worldwide (Graham et al. 2023). Few businesses in emerging nations, such as India and China, have effectively embraced the notion of environmental sustainability (Sharif et al. 2020a). GSCM was established to revitalize ecological sustainability from an organizational standpoint. Thus, supply chain management has evolved into SSCM and GSCM, directed by institutional pressures and operating primarily within the generally recognized framework for worldwide ecological stewardship (Stekelorum et al. 2021).

In addition, the human population's fear has grown over the last 2 decades due to a rise in global calamities and ecological scientists' predictions that the sea level would rise due to melting ice caps (Rauf et al. 2023). Ecological inequalities from the misuse of natural resources (Sharif et al. 2019), poor disposal of plastic and rubber, excessive waste generation, and general environmental damage cause global warming (Yuping et al. 2021). Environmental change was driven by firm expansion and dynamics (Kirikkaleli et al. 2021). Global corporate activities have a significant effect on nature (Awosusi et al. 2022). The traditional business strategy did not account for environmental thresholds or over-exploited natural resources (He et al. 2022). In recent years, rising environmental consciousness has pressured local governments and member states to adopt and rigorously implement environmental protection regulations to avoid further environmental harm (Sharif et al. 2020b). This is one of the primary reasons behind the GSCM's advancement (Waiyawuththanapoom et al. 2022). Companies are increasingly integrating GSCM with other management functions, such as purchasing, production, repair, and logistics. The GSCM idea has gained popularity by disseminating knowledge at international conferences. Consistent empirical data demonstrates the critical relationship between the GSCM and FPR (Islam et al. 2021). GSCM is a catalyst for transforming enterprises towards a more equitable and sustainable economy (Zailani et al. 2019). The advent of GSCM as a significant innovation has assisted firms in establishing "win-win" processes that achieve profitability and dominance objectives through reduced environmental risks and ramifications while simultaneously enhancing their FPR. GSCM techniques may also be implemented throughout the entire value chain, from suppliers to end users, if firms provide purchasers with the knowledge they need to reduce their environmental impact. Each activity can indirectly reduce the firm's direct and environmental impacts (Martínez-Falcó et al. 2023). Manufacturers have been using GSCM approaches in response to consumer expectations for ecologically sustainable goods and services created using sustainable and eco-friendly techniques while also considering environmental regulatory laws (Huma et al. 2022). To improve customer service, firms have grown more environmentally sensitive in their supply chains to lower waste, protect product quality, save natural resources, and enhance FPR (De La Grandiere 2019). Thus, we proposed that:

H1: GSCM significantly influences FPR.

Green supply chain management, firm performance, and green culture

GRCL is a new concept, as well as its explanation, is inconclusive since this subject of study remains in its infancy in the academic literature (Kamolkittiwong 2015). Several studies assert that the concept of GRCL may be derived from corporate culture studies (García-Machado and

Martínez-Ávila 2019). Thus, GRCL may be described as the beliefs, concepts, and values that direct the firm's operations to be ecologically responsible. Also, a firm is considered to have a GRCL if its members behave and think beyond income reasons to enhance its activities' goodwill while limiting the functions' negative effect on the natural settings (El Baz and Iddik 2022). Other words for the GRCL include green awareness, sustainable culture, and environmental culture (Rizvi and Garg 2021).

In an attempt to become more greener, businesses should pursue GSCM practices that are simultaneously environmentally and economically advantageous. According to the natural RBV, the combination of senior leadership and environmental management, including GSCM, may assist enterprises in resolving issues in implementing green projects. This is due to the fact that green human resource management (GHRM), described as the synchronization among standard human resource activities and environmental goals and regulations (including GRCL and effectiveness ratings), may increase worker engagement in sustainable FPR (Yang et al. 2016). We emphasized GRCL as one of the GHRM tactics that may assist GSCM. GRCL has a significant relationship with the development of environmental management in businesses. Culture's significance is expressed in industrial activities (Dorantes et al. 2019). Yet, the effect of corporate GRCL on FPR has not been fully studied. In addition, the outcomes vary across the green and non-green firms. The mentality of the majority of customers is a crucial external element that impacts corporate culture, as it creates a reluctance to shift to more ecological, green approaches inside firms, ultimately leading to enhanced FPR (Syamimi Zulkefli et al. 2019). In consideration of the above factors, we have developed the following hypotheses:

H2: There is a significant positive association between GSCM and GRCL.
H3: GRCL significantly and positively influences the FPR.

Green supply chain management, top management commitment, and firm performance

It is explored that FPR will be improved when the TPMC of a firm is included as an essential element in management relationships (Ilyas et al. 2020). The researcher discovered that TPMC is one of the most essential factors in boosting the FPR of an organization. FPR is a complex combination of both intangible and tangible factors, such as the enhancement of the FPR, and monetary and economic results. PourKiani, M., and Tanabandeh (2016) examined the relationship between TPMC, job happiness, service quality, and FPR. They discovered that TPMC directly improves FPR, as well as a positive correlation between FPR and TPMC. According to Solovida and Latan (2017), TPMC is the primary determinant of a firm's objectives and strategies, and the dedication of the manager is essential to the attainment of any organizational progress. TPMC plays an essential role in promoting firms effectiveness, which is only feasible with successful FPR (Hoejmose et al. 2012). The past research argued that if senior management is less devoted or less efficient in adopting GSCM practices, then the company would be unable to deliver excellent green goods and services and its overall FPR will suffer. TPMC ensure that people improve their decision-making skills. Whenever TPMC integrating GSCM into production processes, as detailed by the authors, it is straightforward to improve the FPR (Pinna et al. 2018). Yet, the present research suggested the following hypothesis:

H4: GSCM has a significant influence on TPMC.
H5: TPMC has a significant influence on FPR.

The mediating role of green culture and top management commitment

By implementing GSCM, firms would be expected to communicate their environmental preservation philosophy and commitment to their workers. GRCL is now a principal factor (Istriari and Murwaningsari 2023) in boosting FPR after GSCM is acknowledged by firms. Moreover, the effectiveness of GRCL depends on workers' shared assessment of the situation in which they find themselves (Shahzad et al. 2020a). Consequently, it can be concluded that a solid GRCL may emerge when employees within a company have similar principles, attitudes, and actions about the natural environment. This results in a common conceptual representation or understanding of the surrounding world. Employees then move beyond income goals and successfully cooperate to promote FPR, leading to a sound organizational situation (Imran et al. 2021). This might be accomplished via greening recruiting, compensation, performance appraisal, and development. At a business with GRCL, for example, management would push workers to gain green expertise and involve them in a discourse about environmental challenges. Collectively, they tackle the protection of environmental concerns and embrace a feeling of environmental stewardship, thereby fostering GRCL (Jayant and Azhar 2014). GRCL tends to promote GSCM practices that result in improved FPR and more psychological and social contentment among workers. And therefore, GRCL is an important link connecting GSCM and FPR (Gurlek and Tuna 2015).

Similarly, GSCM practices are more likely to create GRCL, which boosts FPR. In particular, enhanced FPR recognized as a result of good teamwork that motivates staff

members to collaborate with their coworkers to meet or surpass the significant environmental indicators established by the firms, i.e., GRCL (Al-Swidi et al. 2021). GRCL strives to strengthen the FPR, and the achievement of outstanding GRCL is recognized by a firm's management as a distinctive edge that encourages organizational efforts to decrease waste and pollution. According to studies, embracing a GRCL enhances a company's competitiveness. It is believed that GRCL necessitates the development and dissemination environmental protection expertise among personnel (Muduli et al. 2013). Existing research indicated that how TPMC perceives environmental sustainability may have a significant impact on what GSCM initiatives are undertaken (Chu et al. 2017). In addition, researchers refer to the mediation function of TPMC (Alshourah et al. 2023) as a potential explanation for contradictory results (Kitsis and Chen 2021). Although the influence of TPMC as an element (Liu 2019) or a moderator (Ali et al. 2021) has been studied in the literature, to the greatest of our understanding, the function of TPMC as a mediator between GSCM and FPR has not yet been the topic of thorough empirical study.

The erstwhile research identified the mentality of senior management as the origin of sustainable activities (Wang et al. 2019). Theoretically, there is a solid foundation for tying TPMC to green practices. The upper echelons hypothesis claims that top management experiences, beliefs, and values are transmitted downward. Their characteristics significantly impact their decisions. The human resource management viewpoint argues that certain individual preferences and ideals of senior management impact FPR (Wijethilake and Lama 2019). Studies have also indicated that the ideals and devotion of senior management impact a company's environment, organizational personnel choices and actions allow authorization of people and monetary resources and contribute to enhanced operations and FPR (Hsu et al. 2019). Moreover, the dedication to an environmental standards enforced by the directors of the company (Khan et al. 2019b) and top leadership delivers a strong message to workers and encourages them to adopt GSCM practices for enhanced FPR (Liu et al. 2020). Likewise, academics have studied the many dimensions of green activities and acknowledged the crucial mediation function of TPMC. For example, past study referred to managerial morals and beliefs serve as mediators of stakeholder impacts (Ma et al. 2019). There are demands on supply chain efficiency. Many more investigations investigated how TPMC may serve as a mediator between pressures and supplier-related activities or supplier cooperation (Dubey et al. 2019). Furthermore, scholars studied the impact of TPMC in the context of institutional forces, in addition to reverse logistics (García-Sánchez et al. 2019). Notwithstanding the few studies mentioned above, the mediating function of TPMC in the link between GSCM and FPR has not been established. To close the gap, we hypothesize:

H6: GRCL significantly mediates the link between GSCM and FPR.
H7: TPMC significantly mediates the link between GSCM and FPR.

Organizational citizenship behavior towards environment as a moderator

Multiple prior research has shown that OCBE has a substantial beneficial effect on FPR. Thus, OCBE is crucial to FPR (Elche et al. 2020). Due to the rise of environmentalism, academics linked organizational citizenship with environmental preservation, which is known as OCBE. Such spontaneous worker conduct is not directly governed by the firm's rewards and evaluation system for performance, yet it may immediately enhance the FPR. OCBE determined that this is connected to workers' commitments to the firm's GSCM activities, such as involvement with environmental occurrences, advertising the firm's green goodwill, and voluntary participation in events related to the firm's GSCM practices (Bogler and Somech 2019). As a consequence of the creation of preventative techniques, GSCM practices in the workplace are crucial to reducing pollution at its source. The desire of a firm's employees to execute environmental attitudes measures, including OCBE, has been identified as a key critical component for GSCM and enhanced FPR (Sypniewska 2020). Optimizing manufacturing operations and FPR necessitates the development of lean and GSCM practices by employees. This research posits that environmental protection groups cannot operate without the backing of their employees. Consequently, OCBE may be seen as a means to an environmental end (Khan et al. 2020). Hence, OCBE has a beneficial impact on FPR.

OCBE encompasses a variety of sustainable actions, including the control of industrial trash, recycling, and anti-carbon initiatives, as well as the encouragement of employees to embrace eco-friendly behaviors (Ahmad et al. 2020). OCBE necessitates worker's conducts and actions that frequently violate official procedures and perks. OCBE not only significantly increases the resource efficiency of organizations but also enhances overall FPR. OCBE has a good influence on the FPR of businesses and will assist them in addressing environmental concerns such as climate change and global warming (Garg 2020). According to our understanding, this was the first research to include OCBE as a moderator. No research has used OCBE as a moderator as of yet. Hence, actual findings of OCBE between GSCM and

FPR were documented in this study. Thus, the following hypotheses are proposed:

H8: OCBE significantly and positively influences FPR.
H9: The association between GSCM and FPR is significantly moderated by OCBE.

Methodology

Questionnaire development

To evaluate the suggested hypotheses, a questionnaire was used to gather data for this quantitative investigation. The items for TPMC with five elements were taken by Latan et al. (2018). The items for GRCL with four components were taken by Naz et al. (2021). The research assessed OCBE using the four-item measure developed by Anwar et al. (2020). The five items were used to evaluate GSCM taken by Yildiz Çankaya and Sezen (2019). We assessed the FPR by utilizing a five-item measure generated by Tran et al. (2022). In the current research, all characteristics were evaluated using a five-point Likert scale, with 1 referring to "strongly disagree" and 5 to "strongly agree." The participants were advised to select one scale for each item on the GRCL, GSCM, TPMC, OCBE, and FPR scales.

Before the study, a pilot test with a nominal sample size was done to validate that the survey questionnaire was legitimate and would provide valuable results (Al-Swidi et al. 2021). As part of the data collection, 1000 individuals were requested to complete and return questionnaires within 1 month. Respondents were given an inclusive clarification of each survey section. Thereafter, respondents submitted their questionnaires within the allotted time span. Six hundred valid responses were received, representing 60% of the initial size of the sample. Our framework requires a minimum sample size of 536 according to Westland's formula (Westland 2010). Nonetheless, sample size of this study (600 respondents) is much larger, showing that it is enough for an empirical study.

Sampling and data collection

This survey targeted middle and senior-level managers of manufacturing firms from electronics departments as respondents. This research was done from a Chinese perspective. The intended responders must know GSCM, FPR, TPMC, GRCL, and OCBE. The information was collected using an online questionnaire. One thousand surveys were sent online, of which 600 were filled out and viable. The remaining surveys were discarded because they provided insufficient information. Table 1 shows the respondents' age, experience, education, and gender.

Table 1 Respondents' demography

Features	Options	Frequencies	(%)
Age	20–30	300	50.00
	30–50	240	40.00
	Above 50	60	10.00
Gender	Male	380	63.33
	Female	220	36.66
Level of education	Primary	100	16.66
	High school	150	25.00
	College degree	200	33.33
	Graduate	150	25.00
Experience	Less than 5 years	150	25.00
	5–10 years	290	48.33
	More than 10 years	160	26.66

Incomplete questionnaires are discarded

Table 2 Discriminant validity

Factor	GSCM	GRCL	TPMC	OCBE	FPR
GSCM	**0.838**				
GRCL	0.335	**0.711**			
TPMC	0.226	0.176	**0.797**		
OCBE	0.253	0.312	0.714	**0.746**	
FPR	0.207	0.314	0.392	0.498	**0.824**

Bold values represent the square root of AVEs

Data analysis

The AMOS (version 26) and SPSS (version 26) software packages are utilized for statistical analysis. Employing structural equation modeling (SEM), the anticipated hypotheses are assessed. SEM is regarded as a realistic approach that generates dependable and authentic outcomes when studying the connection between several factors and has three important benefits over prior methodologies. (i) The appropriate assessment of measurement imprecision. (ii) Using observable data to estimate latent constructs. (iii) The model's validity used to assess and operate a sequence on the basis of data compliance (Cuevas-Vargas et al. 2022). Additionally, the numerous multivariate methods ignore measurement errors by design. Despite this, the SEM explores dependent and independent structures through errors of estimation. Due to its sturdiness and resiliency, this methodology gives precise and accurate findings (Shahzad et al. 2020b) Table 2.

The SEM allows the development of distinct indicator patterns for each element and yields reliable findings. In addition, the erroneous portions of the analyzed variables

are appraised. So, the relationship between variables yields reliable results. In addition, by including group evaluations and mean, it is able to analyze complicated relationships and many hypotheses, something that other prototypes and models cannot achieve (García Alcaraz et al. 2022). Focusing on the advantages of this method, we applied it in this study owing to its efficacy in establishing the relationship between all investigated factors (Hock-Doepgen et al. 2021).

Analysis and results

Confirmatory factor analysis

Confirmatory factor analysis (CFA) is utilized to examine the framework's reliability and validity, including all item scales (Fig. 2). The CFA model is suitable for the data. Furthermore, we analyzed the fitness test to check the fitness of data. The chi-square (X^2) = 2.483; incremental fit index (IFI) = 0.929; comparative fit index (CFI) = 0.929; parsimony normal fit index (PNFI) = 0.785; tucker-lewis index (TLI) = 0.919; and root mean squared error of approximation (RMSEA) = 0.066; the results highlighted that model is fit (Cuevas-Vargas et al. 2022) (see Table 3). Furthermore, we examined the discriminant validity of data (see Table 2). The Cronbach alpha (α) values are also acceptable because they exceed the cutoff limit 0.70. In general, the findings confirmed the strong reliability and convergent validity of the measurement constructs. These are assessed in addition to average variance extracted (AVEs) and composite reliability (CR). In prior literature, the CRs and AVEs values got the 0.50 standard value.

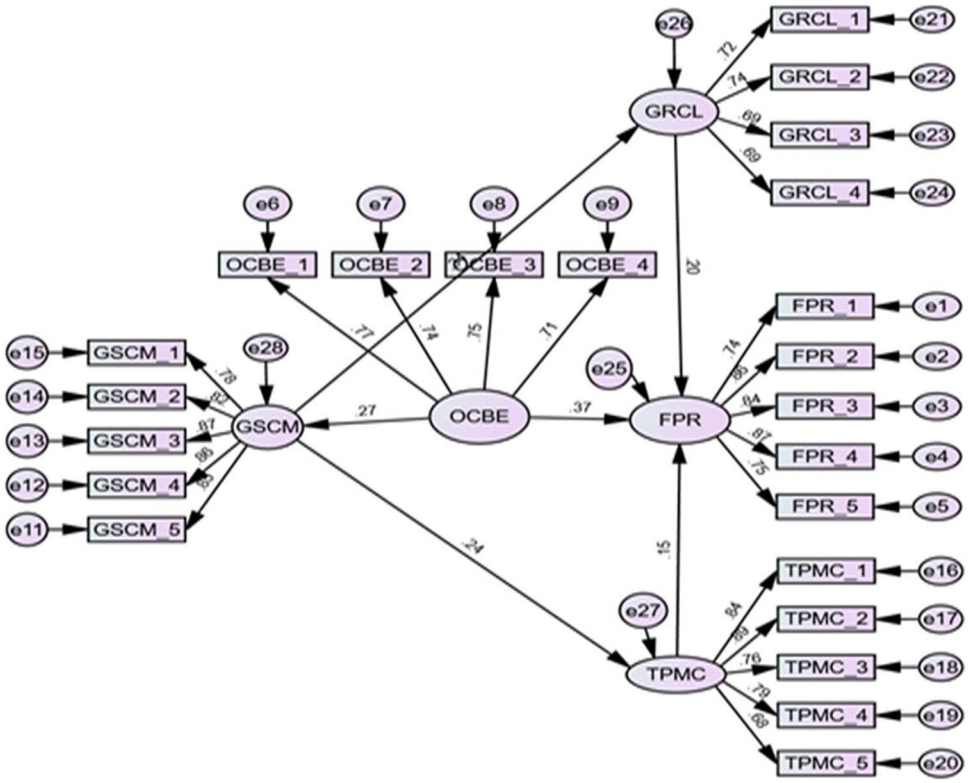


Fig. 2 Structural model

Table 3 Goodness-of-fit indices values of the structural model

Fit index	Description	Recommended criterion	Values-based on a structural model
CFI	Comparative fit index	> 0.9 good fit	0.929
PNFI	Parsimony normal fit index	> 0.5good fit	0.785
IFI	Incremental fit index	> 0.9 good fit	0.929
TLI	Tucker-Lewis index	> 0.9 good fit	0.919
RMSEA	Root mean squared error of approximation	< 0.08 good fit	0.066
X^2/df	Chi-square	< 3 good fit	2.483

Table 4 Factor loadings and results of reliability analysis

Factors	Items	Standard loadings	AVE	CR	Cronbach-α
Green supply chain management			0.702	0.922	0.919
	GSCM_1	0.780			
	GSCM_2	0.821			
	GSCM_3	0.876			
	GSCM_4	0.859			
	GSCM_5	0.850			
Green culture			0.506	0.804	0.803
	GRCL_1	0.717			
	GRCL_2	0.741			
	GRCL_3	0.691			
	GRCL_4	0.694			
Top management commitment			0.636	0.879	0.894
	TPMC_1	0.830			
	TPMC_2	0.880			
	TPMC_3	0.769			
	TPMC_4	0.799			
	TPMC_5	0.698			
Organizational citizenship behavior towards environment			0.556	0.833	0.831
	OCBE_1	0.757			
	OCBE_2	0.730			
	OCBE_3	0.747			
	OCBE_4	0.748			
Firm performance			0.679	0.931	0.910
	FPR_1	0.749			
	FPR_2	0.869			
	FPR_3	0.851			
	FPR_4	0.877			
	FPR_5	0.763			

In order to show discriminant validity, each latent' AVE value should encompass the square correlation among each component's set (Singh et al. 2019) (see Table 4).

Common method variance

Owing to the cross-sectional study's framework, common method bias (CMB) may exist. This study examined common method bias using the Harman's single-factor test (i.e., extraction method = primary axis factoring). In accordance with the core principles (Waqas et al. 2021), CMB alters the outcomes when a single component accounts for more than 50% of the gathered variance. The maximum influence of a single component was determined to be 34.50%, which is below the 50% cutoff value. These findings indicate that no CMB is present in the data. Moreover, we employed a defined method to investigate the CMB. This method highlights that a variation in the VIF bigger than 3.30 specifies the presence of CMB in the model. Despite this, the outcomes highlight that the VIF factor level is under the specified cutoff of 3.30. According to the above-mentioned data, it is confirmed that there is no CMB in this research framework (Munawar et al. 2022).

Hypotheses results and structural model

Utilizing SEM techniques, we analyzed the model's linkages. The path coefficient of the variables confirmed that GSCM and FPR do not have any significant link. So, H1 is rejected. GSCM has a positive impact on GRCL ($\beta = 0.340$, $p < 0.01$), and GRCL positively influences FPR ($\beta = 0.214$, $p < 0.01$). Therefore, H2 as well as H3 are accepted. Similarly, GSCM has a positive impact on TPMC ($\beta = 0.197$, $p < 0.01$), and TPMC has a significant effect on FPR ($\beta = 0.505$, $p < 0.01$). Therefore, H4 and H5 are accepted. Likewise, the mediating impact of GRCL on the link between GSCM and FPR was considered. GRCL ($\beta = 0.163$, $p =$

Table 5 Hypotheses testing and specific indirect effects

Hypotheses	Hypothesized paths	Beta	S.E.	C.R.	*P*-value	Decision
H1	GSCM→FPR	0.379	0.087	4.362	.589	Rejected
H2	GSCM→GRCL	0.340	0.063	5.357	***	Accepted
H3	GRCL→FPR	0.214	0.052	4.109	***	Accepted
H4	GSCM→TPMC	0.197	0.059	3.362	***	Accepted
H5	TPMC→FPR	0.505	0.085	5.954	***	Accepted
H6	GSCM→GRCL→FPR	0.163	0.060	2.712	.007	Accepted
H7	GSCM→TPMC→FPR	0.264	0.093	3.797	***	Accepted
H8	OCBE→FPR	0.142	0.062	2.593	***	Accepted
H9	OCBE * GSCM→FPR	0.121	0.0.71	4.149	**	Accepted

***$p < 0.01$, **$p < 0.05$. Source: author's calculation

0.007) completely mediates the association between GSCM and FPR based on estimations. Thus, H6 is accepted. Likewise, the mediating impact of TPMC on the relation between GSCM and FPR was considered. TPMC ($\beta = 0.264$, $p < 0.01$) fully mediates the association between GSCM and FPR based on estimations. Thus, H7 is accepted. Additionally, OCBE significantly and positively influences FPR ($\beta = 0.142$, $p < 0.01$). Thus, we accepted H8. Moreover, the moderating impact of OCBE on the link between GSCM and FPR was determined. OCBE ($\beta = 0.121$, $p < 0.05$) moderates the association between GSCM and FPR. Therefore, H9 is accepted (see Table 5).

Discussion

Overall, this research provides an expanding body of knowledge on FPR by underlining the relevance of crucial complementing factors, i.e., GSCM, GRCL, TPMC, and OCBE. As previously noted, past research examining the impact of GSCM techniques highlighted the need to identify potential moderators. This work also contributes to the expanding corpus of FPR research in developing nations. GSCM and FPR research has often concentrated on developed nations such as Germany (Wissuwa and Durach 2023) and the UK (Esfahbodi et al. 2023). Current GSCM researchers have transitioned to nations like India (Gedam et al. 2023), China (Sheng et al. 2022), Taiwan (Kuwornu et al. 2023), etc., as an increasing number of companies relocate a substantial portion of their manufacturing companies to Asia. These studies demonstrated that these nations had generated distinctive green initiatives to enhance FPR, indicating that the study of green practices for enhanced FPR should focus more on country-specific aspects in this area. According to prior research, GSCM practices positively influence the FPR. This study has shown that GSCM practices indirectly affect the FPR, supporting the idea that the implementation of GRCL, TPMC, and OCBE is crucial for firms. This suggests that firms in the manufacturing sector must adopt these green initiatives and that their FPR will be improved as a result (El Baz and Iddik 2022). The findings indicate that firms in general, and specifically manufacturing firms, have been able to implement an integrated approach that covers multiple elements of GSCM, as well as GRCL, TPMC, and OCBE that lead to enhanced FPR.

Consequently, the more effectively an organization maintains GRCL and TPMC, the greater its likelihood of promoting GSCM and facilitating OCBE, likely contributing to enhanced FPR. These findings support previous research. This enables players in the supply chain to decrease resource waste, prevent negative effects on society and the environment, and establish GRCL, OCBE, and environmental integrity that prioritize performance enhancement (Azam et al. 2022). In addition, GRCL and TPMC mediate the interactions between GSCM and FPR. Hence, improved implementation of GRCL and TPMC enhances the application of GSCM, resulting in FPR accomplishment. In addition, this study demonstrates that OCBE moderates the relationship between GSCM and FPR. Therefore, enhanced GRCL, TPMC, and OCBE implementation results in improved GSCM, which eventually results in FPR.

Theoretical implications

The current research makes the following significant theoretical contributions. Firstly, this expands the literature by suggesting a conceptual model that incorporates the mediating impact of GRCL and TPMC on the link of GSCM and FPR grounded on the natural RBV theory (Fig. 3). This issue has not been examined in the literature. Secondly, it offers more empirical insights into the significance of OCBE, GSCM, and FPR. This research investigates the moderating influence of OCBE between GSCM and FPR. This extends the concept of natural RBV theory to empirical study in a specific developing market context. Thirdly, it is the expansion of GSCM, GRCL, TPMC, OCBE, and FPR to a larger scale within the framework of the manufacturing sector. This contribution is

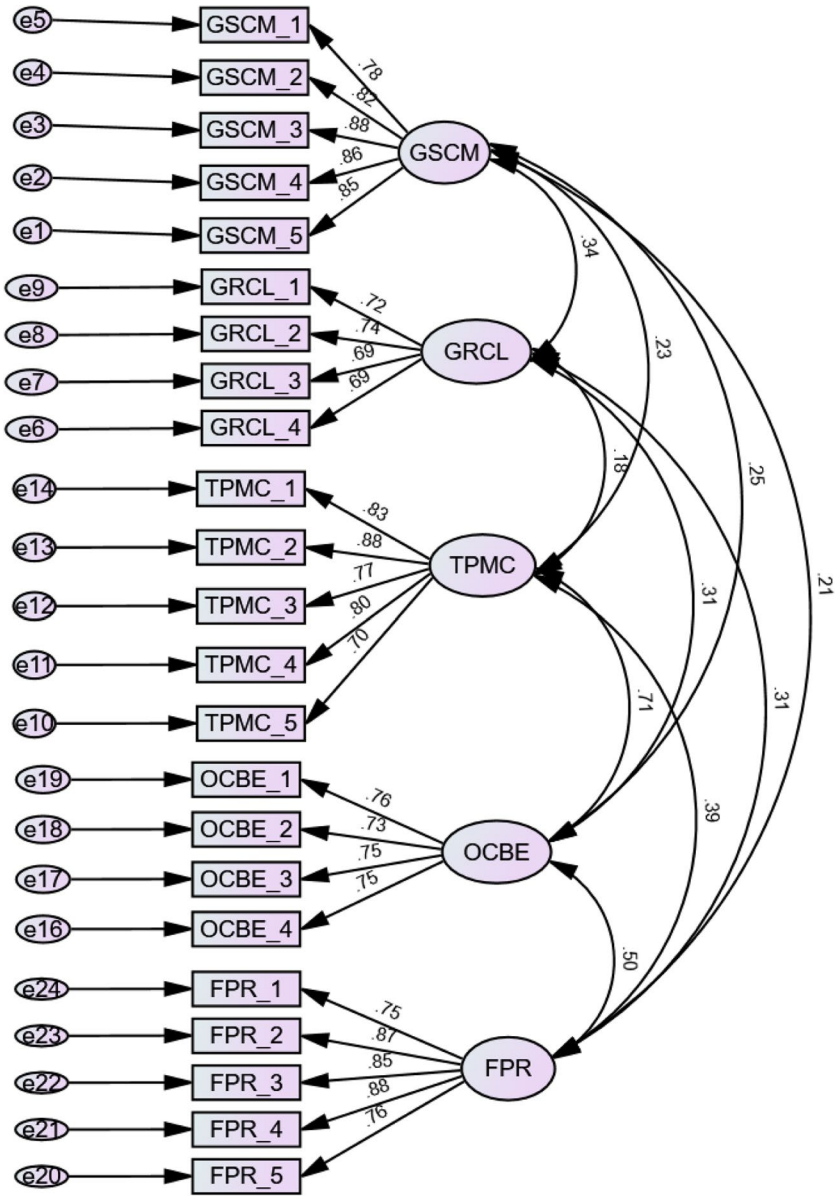


Fig. 3 Confirmatory factor analysis representing the measurement model. Source: author's calculations

essential for a greater knowledge of the crucial components in the research framework for GSCM and FPR. Hence, it provides insight into how GRCL, TPMC, and OCBE support the implementation of GSCM, resulting in enhanced FPR. The results are consistent with the natural RBV theory (Hart 1995), which declares that these factors are considered strategic resources that play a crucial role at each significant step of the journey toward enhanced FPR. They are seen as preconditions for developing competitiveness.

Practical implications

Our results have important management implications. GRCL and TPMC have a demonstrated beneficial effect on FPR. GRCL and TPMC, which supports eco-friendly ideals, instruct managers to be careful of the materials they utilize, the trash they generate, and the power they utilize to enhance the FPR. Acknowledging that current green environmental standards and rapidly evolving technology settings may provide formidable obstacles, our findings recommend managers to embrace GRCL traits. For a business to consider GRCL a focus, it must select managers that embrace ecological issues that embody the firm's desired GRCL shared values. In keeping with increasingly stringent environmental rules and knowledge, managers should engage in sustainable and environmental behavior to generate additional market prospects for their businesses, therefore, spreading the importance of GRCL throughout a company. For instance, managers must promote environmentally friendly principles in order to disseminate information to organizational

members. In an ecologically conscious work setting, managers can consider fostering a GRCL. GRCL allows the invention of the manufacturing company s GSCM practices via the supporting actions of the personnel. Workers at firms with GRCL and TPMC are more inclined to engage in pollution prevention, boosting the FPR. In addition to contributing to the increasing body of knowledge, this study provides supply chain managers with insights into the crucial relationship between GSCM, TPMC, and FPR. This study's findings illustrate the advantages of reinforcing TPMC to environmental initiatives, GSCM, and ultimately company profitability and enhanced overall FPR. Existing research has shown that TPMC to sustainability is a key driver of sustainable operations and effective FPR (Amir and Chaudhry 2019). Our findings corroborate these findings.

Our findings indicated that mediating impact of GRCL and TPMC and moderating impact of OCBE are significant since these influence the relationship between GSCM and FPR which has been mainly neglected in prior studies. GRCL has typically concentrated on superior expertise and market leadership to enhance FPR and competitiveness. Our findings indicate that managers may be capable of influencing GRCL by boosting the principles of lowering ecological damage that contribute to the development of robust GSCM. To effectively innovate and adapt to environmental development, managers must fulfill specific standards about their shared values. An environmentally friendly invention might be integrated into GRCL and TPMC, which managers are often expected to adopt for enhancing the FPR. This result demonstrates that GRCL may enhance its competitive advantage. In a practical sense, managers must cultivate a culture that supports environmental principles since GRCL and TPMC may distinguish the company from its rivals. To maintain the competitive advantage, managers may foster the shared value of eco-friendly manufacturing methods to prevent negative environmental consequences via GRCL. However, OCBE's role as moderator has favorable and substantial effects on the relationship between GSCM practices and FPR. So, managers must focus on these elements when assessing FPR.

Limitations and future recommendations

The current research, despite its crucial contributions, showed numerous notable shortcomings. GRCL and TPMC were initially a mediator between GSCM and FPR in this investigation. Thus, future research should include other mediators, such as environmental uncertainty and absorptive capacity. Secondly, management approaches vary among nations and industries. Thus, GSCM practices vary between nations, enterprises, sectors, and developed nations. As a consequence, the generalizability of the findings is limited since this research study only investigated the manufacturing sector in a single nation (China). Finally, the role of OCBE as a moderator between GSCM and FPR was investigated. Future researchers should thus explore the moderating impact of pro-environmental behavior and adaptive capability, which would make a considerable contribution to the FPR literature. Fourthly, information was collected only from the manufacturing sector. So, future researchers should examine other sectors, such as the technology and services industries, that are more imaginative in tackling the problems of FPR.

Authors' contributions N. Nureen: conceptualization, writing—original draft, methodology. L. Da: supervision, funding acquisition. M. Irfan: formal analysis, data handling, and methodology, writing—review and editing. R. Sroufe: writing—review and editing.

Data availability All data generated or analyzed during this study are included in this article.

Declarations

Ethics approval and consent to participate This research study was conducted according to the Declaration of Helsinki guidelines. The Institutional Review Board of North China Electric Power University has approved the study (protocol code 1543–9 on 27 April 2022).

Consent for publication Informed consent was obtained from all respondents belonging to this research study.

Competing interests The authors declare no competing interests.

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