Linking Green Supply Chains to Operational Performance in the Qatari Energy Industry

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***Abstract**: Interest in green practices within business organizations has grown significantly, along with the implementation of green strategies aimed at preserving the environment, reducing resource waste, and minimizing harmful residues. This study investigates the impact of green supply chain management practices (GSCMP) on operational performance (OP) in the gas and oil sector in Qatar. Using a descriptive analytical approach, a questionnaire was distributed to senior and middle management employees in gas and oil companies operating in Qatar, yielding 168 responses suitable for statistical analysis. Two software analysis programs were utilized to process data: the Statistical Package for Social Sciences (SPSS) and Structural Equation Modeling (SEM) through Smart Partial Least Squares (PLS).*

The study's key findings include that the surveyed sample perceives that oil and gas companies in Qatar do practice GSCMP, with an overall high mean value of 3.83. Additionally, the operational performance in these companies was found to be at a high level, with an overall mean value of 3.78. The structural model estimation revealed that GSCMP explains 58.1% of the variance in OP, and the recorded effect of GSCMP on OP was positive, with a beta value of 0.764. This indicates that for every unit increase in GSCMP application, OP is enhanced by 76.4%. The results confirm a direct relationship between green supply chain management and operational performance, suggesting that when more green practices are adopted, the greater the operational performance.

Based on these findings, the study recommends that the oil and gas companies in Qatar sustain their high levels of operational performance through continued collective efforts. These companies are also advised to better align their GSCMP, particularly in ecological design and green information systems, to more efficiently promote operational performance. Future studies could expand on the present model by integrating additional variables into the GSCMP and OP framework to deepen our understanding of these dynamics.

***Key words**: Green, Supply chain management practices, Operational performance, oil and gas sector, Qatar.*

Introduction

Environmental pollution has emerged as one of the most pressing global challenges, necessitating collective ethical action from countries and industrial institutions alike (Al Ramada et al., 2025; Nguyen et al., 2015). Addressing this issue requires the coordinated efforts of all stakeholders to mitigate its harmful effects and ensure long-term environmental sustainability (Jermsittiparsert et al., 2019). In this context, green supply chain management (GSCM) practices have gained increased attention due to their potential to reduce the negative environmental impacts of traditional supply chain activities while simultaneously improving operational and financial performance. By integrating environmentally friendly practices into supply chain operations, organizations can minimize waste, pollution, and energy consumption, while enhancing resource conservation and the organization's brand (Umar et al., 2021; Raza et al., 2022).

To achieve these outcomes, companies must adhere to environmental regulations and incorporate green principles into their operational strategies. Green supply chain management facilitates the achievement of environmental objectives through the adoption of green production systems and sustainable logistics processes. These practices not only enhance the environmental value of raw materials and products but also promote effective recycling and waste reduction, contributing to the broader goals of economic, environmental, and social development (Zhou et al., 2019).

Moreover, GSCM practices play a crucial role in enabling organizations to gain green competitive advantages. Developing a green supply chain necessitates collaboration and integration across organizational boundaries, such as in sharing knowledge, resources, and expertise with partners in the value chain. This collaboration supports continuous improvement in performance and

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product quality, ultimately leading to greater customer satisfaction (Al Ramada et al., 2025). Green supply chain operations also drive improvements in operational performance, which is vital for achieving excellence and maintaining a competitive edge (Yu et al., 2014).

Operational performance, a critical measure of organizational efficiency and effectiveness, is especially relevant within the context of supply chain management, where both efficiency and customer service are paramount. As environmental sustainability becomes a central concern in the business landscape, the integration of green supply chain practices into operational strategies is increasingly essential. Organizations that wish to remain competitive in today's dynamic and rapidly evolving market must adopt sustainable green approaches throughout their operations. This involves leveraging modern technologies, equipment, expertise, and knowledge to effectively implement green supply chain initiatives in today's digitally connected world (Khan et al., 2022; Mujtaba, 2023).

Against this backdrop, the primary aim of this study is to explore the relationship between green supply chain management practices and operational performance in the Qatari oil and gas industry. Existing research suggests that the successful implementation of GSCM can lead to significant benefits, including waste reduction, cost savings, and greater awareness of environmental sustainability. By incorporating green practices across all stages of production, organizations can enhance their performance in both environmental and economic domains.

Literature Review

The concept of supply chain management (SCM) first emerged in 1989, and by 1990, academic scholars began to provide clearer definitions and conceptual frameworks to distinguish SCM from traditional methods of managing the flow of materials and associated information between the various actors within the supply chain (Abdallah et al., 2014). SCM has since been recognized as one of the most significant challenges in business management, gaining prominence for its critical role in enhancing organizational competitiveness.

Although the concept was introduced in the late 1980s, the strategic importance of supply chain management became more evident in the early 1990s. This growing recognition stemmed from an understanding of the interdependence between different levels within supply channels, from the point of origin, typically suppliers or manufacturers, to the point of consumption, which includes consumers, customers, or end users (Asgari et al., 2017).

Several studies in the literature argue that the supply chain should be treated as the fundamental unit of competitive analysis. Rather than pursuing cost reductions or profit increases at the expense of supply chain partners, organizations are encouraged to adopt a more collaborative perspective, aiming to improve the overall competitiveness of the entire supply chain (Craighead et al., 2020).

Sustainability in Supply Chains

The concept of sustainability in supply chains is built upon the triple bottom line, which are economic, environmental, and social performance. Sustainable supply chain management (SSCM) focuses on creating long-term value by balancing economic goals with ecological responsibility and social equity (Carter & Rogers, 2008). This holistic approach encourages organizations to not only consider profitability but also the environmental and social impacts of their supply chain activities.

Studies have emphasized that sustainability-oriented supply chains often outperform traditional ones in terms of resilience, stakeholder trust, and innovation capability (Seuring & Müller, 2008). Furthermore, the integration of sustainability indicators into key performance metrics has become essential for organizations striving to meet global sustainability standards and reporting frameworks, such as the Global Reporting Initiative (GRI) or ISO 14001 (Pagell & Wu, 2009).

Green Practices in the Energy Industry

In resource-dependent economies such as Qatar, where the oil and gas sector plays a dominant role, the shift towards sustainable and green supply chain practices is both a necessity and a strategic opportunity. Given the sector's significant carbon footprint, adopting GSCM in the Qatari energy industry is crucial for aligning with Qatar National Vision 2030, which emphasizes environmental development and sustainable growth.

Recent studies highlight that firms in the energy sector have begun implementing green procurement, cleaner production technologies, and energy-efficient logistics systems to reduce emissions and improve overall operational performance. However, challenges remain, including the need for organizational readiness, stakeholder engagement, and investment in green innovation (Khan et al., 2022).

By embracing GSCM, energy companies in Qatar cannot only comply with international environmental standards but also gain a competitive edge in the global market by improving efficiency, reducing waste, and enhancing their reputation for corporate responsibility (Zhou et al., 2019).

Operational Performance

Operational performance has been a central focus of supply chain and organizational studies, as it plays a critical role in determining a firm’s ability to efficiently and effectively achieve its strategic objectives through shared leadership (Mujtaba, 2025).

Operational performance is the extent to which an organization achieves its predetermined goals and the degree to which its production processes adhere to planned targets within a specified time frame (Agyei-Owusu et al., 2022). This definition highlights the role of performance monitoring in identifying weaknesses, diagnosing the causes of deviations from plans, and proposing corrective actions for future improvements.

Khan et al. (2022) describe operational performance as encompassing both the desired outcomes and the necessary leadership practices and mechanisms to attain them. Using diverse leadership styles, managers must link organizational goals to the specific tasks and duties executed by employees, reflecting how well activities align with strategic intent (Zareen et al., 2015). Abdallah and Al-Ghwayeen (2020) emphasize the dynamic interaction between a company and its internal and external environments. They define operational performance as the outcome of coordinated efforts across various management levels, shaped by both internal resources and external factors. Inman and Green (2018) provide a process-oriented perspective, viewing operational performance as the implementation of systematic procedures aimed at maximizing resource utilization and enhancing organizational effectiveness. Buer et al. (2018) highlight innovation in resource use as a key factor, stating that operational performance refers to the ultimate goal of a company, to employ available resources innovatively to improve both efficiency and effectiveness.

Gambi et al. (2015) focus on the administrative dimension, noting that operational performance represents the results achieved by managerial functions within a specific time frame. These outcomes reflect the success or failure of such functions in meeting organizational goals and in reinforcing the company's competitive standing. Xu et al. (2022) take a planning perspective, defining operational performance as a comprehensive blueprint that outlines the human and financial resources, budgets, production volumes, and timelines required to execute specified activities.

Overall, operational performance reflects a company’s capability to effectively utilize its diverse human resources, tools, and technological systems to enhance operational efficiency, sustainability, and responsiveness (Delapenha et al., 2020; U-tantada et al., 2025; Assefa and Mujtaba, 2025). It encompasses cost reduction, product quality improvement, and agile adaptation to environmental changes. Moreover, it functions as a source of competitive advantage, enabling organizations to maintain sustainability and superiority in increasingly dynamic and competitive markets (Subramaniam et al., 2024).

Recent studies have increasingly focused on the relationship between green supply chain management practices and various aspects of organizational performance, including operational performance, sustainability, and innovation. Despite the growing body of research, there remains a noticeable gap in the literature concerning the Qatar industrial sector, underscoring the significance of the current study.

Singh (2025) examined the effect of green supply chain strategies and sustainable practices in Indian industries, highlighting the mediating role of green innovation. Singh's study found a significant positive relationship between GSCM strategies and circular supply chain development, with green innovation enhancing the link between strategy and sustainability. Similarly, El Mokadem and Khalaf (2025) investigated Egyptian manufacturing firms and confirmed that internal and external GSCM practices positively impact sustainable performance across environmental, economic, and operational dimensions. They recommend adopting GSCM as a holistic approach beyond its environmental implications. Nazir et al. (2024) explored the moderating role of institutional pressure in Pakistani manufacturing firms and found a significant relationship between GSCM practices and environmental performance, moderated by regulatory and market factors.

In the Chinese context, Xu et al. (2022) examined how corporate social responsibility and relational capital influence GSCM practices and operational performance in Chinese manufacturing firms. They showed that both customer and supplier relational capital enhance flexibility and delivery performance within green supply chains. Ethical leadership is important for the socially responsible behavior of employees in all countries so they can get along and function as a high performing workforce (Mujtaba, 2019).

Agyei-Owusu et al. (2022) studied firms in Ghana, highlighting the mediating role of operational performance in the relationship between supply chain integration and firm performance. Internal integration was found to significantly influence both supplier and customer integration, thereby affecting operational efficiency. Khan et al. (2022) confirmed the mediating role of technological innovation between GSCM practices and operational performance in Pakistani firms. Their study recommended expanding research into other dimensions such as green logistics and internal environmental management.

Other studies such as those by Sugandini et al. (2020) in Indonesia and Wongleedee (2020) in Thailand highlighted the role of GSCM in enhancing green marketing and sustainable performance, respectively, particularly within small and medium-sized enterprises. Abdallah and Al-Ghwayeen (2020) concluded that GSCM practices positively impact environmental, operational, and business performance in Jordanian manufacturing firms. They identified mediating roles for both environmental and operational performance in linking GSCM to broader business outcomes.

In sum, these studies consistently support the view that GSCM contributes positively to operational performance, particularly through enhanced efficiency, innovation, and stakeholder engagement. However, the lack of empirical research within Qatar's industrial sector highlights the need for localized studies to understand context-specific dynamics.

Methodology

This study aims to investigate the impact of green supply chain management practices on operational performance in the oil and gas industry, with a specific focus on companies listed on the Qatar Stock Exchange. The research addresses the following specific objectives:

1. To examine the overall effect of GSCM practices on operational performance in the oil and gas industry.
2. To assess the impact of internal environmental management on operational performance.
3. To evaluate the influence of green procurement on operational performance.
4. To investigate the role of cooperation with customers in enhancing operational performance.
5. To explore the effect of ecological design on operational performance.
6. To determine the impact of investment in waste recycling on operational performance.
7. To analyze the contribution of green information systems to operational performance.

A descriptive-analytical research design was employed to address the research objectives. The study adopted a quantitative methodology, utilizing structured questionnaires as the primary instrument for collecting data. This approach allows for the measurement of relationships between GSCM practices and operational performance, as well as the testing of research hypotheses.

The target population consisted of employees working in the supply, production, and maintenance departments of oil and gas companies listed on the Qatar Stock Exchange, which includes a total of six companies. These participants were selected based on their direct involvement in operational and supply chain processes, thus providing relevant insights into GSCM practices.

The questionnaire was developed based on an extensive review of previous studies on GSCM and operational performance. Items were adapted and refined to fit the context of the oil and gas sector. The instrument consisted of closed-ended questions, designed using a five-point Likert scale ranging from 1 (very low) to 5 (very high), allowing respondents to indicate their level of agreement with each statement.

To ensure content validity, the initial draft of the questionnaire was reviewed by subject matter experts and faculty members in the field of business and supply chain management. Based on their feedback, items were revised or eliminated to improve clarity and conceptual relevance. Additionally, exploratory factor analysis (EFA) was conducted to examine the underlying structure of the scale and to confirm the dimensionality of the constructs. The final version of the questionnaire was organized into three main sections:

Section I – Demographic Information.: This section gathered personal data from respondents, including gender, age, educational qualifications, work experience, and job title.

Section II – Green Supply Chain Management Practices. This section included 31 items representing six key dimensions of GSCM:

- Internal Environmental Management
- Green Procurement
- Cooperation with Customers
- Ecological Design
- Investment in Waste Recycling
- Green Information Systems

The items were presented in a randomized order to minimize response bias and prevent the respondents from grouping items by dimension.

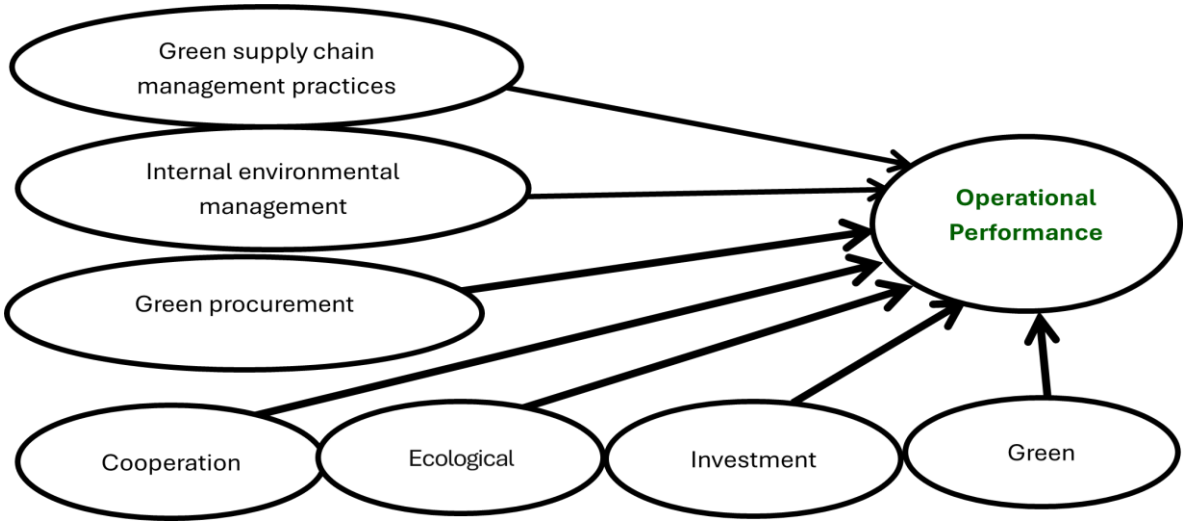

Figure 1: The Theoretical Framework

Section III – Operational Performance. This section consisted of 6 items designed to measure different aspects of operational performance, such as flexibility, quality, efficiency, and delivery.

This study is built upon a theoretical framework that conceptualizes the relationship between green supply chain management practices and operational performance in the oil and gas industry. The independent variable is GSCM practices, comprising six key dimensions: internal environmental management, green procurement, cooperation with customers, ecological design, investment in waste recycling, and green information systems. The dependent variable is operational performance.

As shown in Figure 1, the framework was developed based on the research problem, existing literature, and prior empirical studies, and it aims to demonstrate the logical relationships between variables in order to offer a structured approach to the study objectives. The following research questions guide this study:

- To what extent do green supply chain management practices affect operational performance in the oil and gas industry sector in Qatar?
- What is the effect of internal environmental management on operational performance?
- What is the effect of green procurement on operational performance?
- What is the effect of cooperation with customers on operational performance?
- What is the effect of ecological design on operational performance?
- What is the effect of investment in waste recycling on operational performance?
- What is the effect of green information systems on operational performance?

Based on the research questions and theoretical framework, the following hypotheses have been formulated:

> H1: *Green supply chain management practices positively influence operational performance in the oil and gas industry sector*.

The sub-hypotheses are as follows:

- H1.1: Internal environmental management positively influences operational performance.
- H1.2: Green procurement positively influences operational performance.
- H1.3: Cooperation with customers positively influences operational performance.
- H1.4: Ecological design positively influences operational performance.
- H1.5: Investment in waste recycling positively influences operational performance.
- H1.6: Green information systems positively influence operational performance.

The unit of study and analysis consists of employees, specifically department heads, assistants, and operational staff, working in the supply, production, and maintenance departments of oil and gas companies listed on the Qatar Stock Exchange. These companies include:

- Qatar Gas Operating Company Limited
- Qatar Energy
- ConocoPhillips Company
- ExxonMobil Corporation
- TotalEnergies
- Qatar Petroleum

The researchers aimed to obtain approximately 30 responses from each company, using a purposive sampling method. The use of an electronic questionnaire distributed via Google Forms enabled conveient accessibility and flexible participation, given the geographic dispersion of company sites. This approach also increased the response rate and allowed for timely data collection.

To ensure objectivity and minimize researcher bias, the questionnaire consisted solely of closed-ended questions. The development of the questionnaire items was informed by an extensive literature review, and existing validated scales were adapted from previous studies, particularly those by Al-Khatib (2025) and Huang et al. (2021).

To minimize potential response bias, particularly social desirability bias, all items from sections two and three were randomly mixed in a single block. This strategy was employed to prevent respondents from identifying the thematic grouping of the questions, thereby enhancing the objectivity and reliability of the responses.

The scope and limitations of this study are defined across four key dimensions to clarify the study's boundaries and ensure contextual understanding:

- *Spatial Limitations*: This research is confined to employees working in the supply, production, and maintenance departments of companies operating in the oil and gas sector in Qatar.
- *Temporal Limitations*: The study was conducted within the calendar year of 2024, capturing data relevant to this specific time frame.
- *Human Limitations*: The study sample is limited to department heads, assistants, and employees specifically within the supply, production, and maintenance functions of the selected oil and gas companies. This target group was chosen due to their direct involvement and familiarity with supply chain processes and operational performance.
- *Scientific (Objective) Limitations*: The research focuses solely on examining the effect of Green Supply Chain Management practices on operational performance in the oil and gas industry within the Qatari context. Broader factors or other industry sectors are beyond the scope of this investigation.

Data were collected during July and August 2024 using a structured online questionnaire. A total of 169 responses were initially received. After screening the responses for completeness and consistency, one response was excluded due to uniform answers across all items, leaving 168 valid responses for analysis. The responses were coded and entered into SPSS, with Likert-scale answers numerically transformed for quantitative analysis. Outlier detection was performed using Cook's Distance as recommended by Weinberg and Abramowitz (2008). In this method, any value exceeding 0.1 is considered an outlier. As shown in Figure 2, the highest Cook's Distance in this study was 0.04969, confirming that no significant outliers existed.

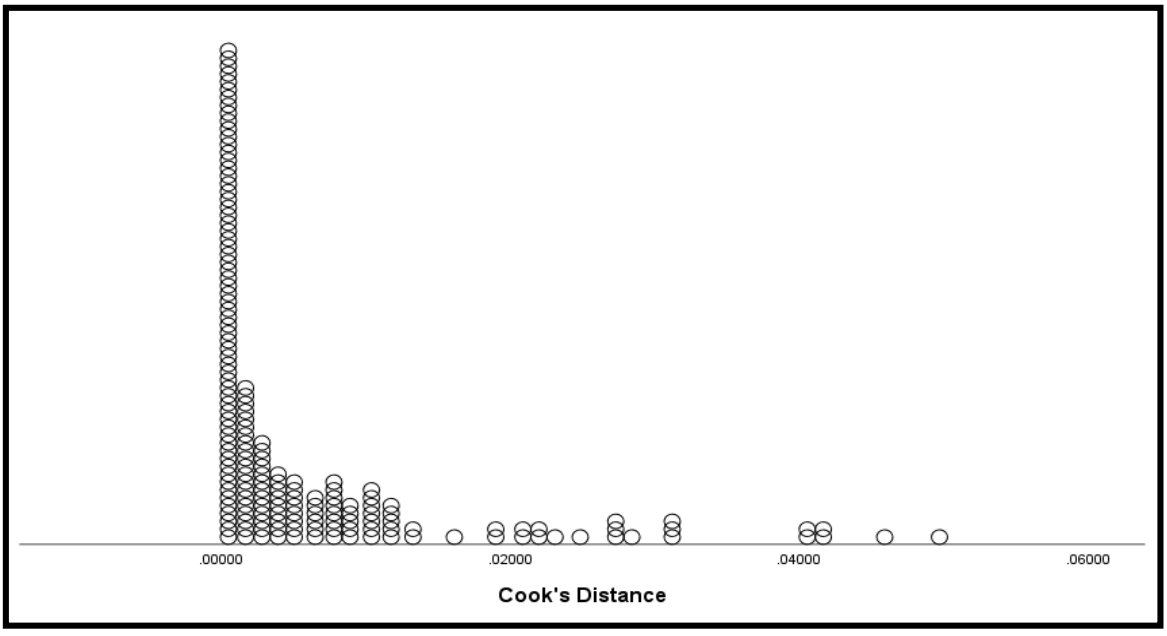

Figure 2. Cook's Distance Values

Analysıs

In order to analyze the data collected in this study, two statistical software packages were employed. The first was IBM SPSS Statistics (version 27), which was used to code the data, conduct preliminary analyses, and generate descriptive statistics. The following statistical techniques and diagnostics were utilized within SPSS:

- Cook's Distance to identify potential outliers in the dataset;
- Skewness and Kurtosis coefficients to assess data normality;
- Variance Inflation Factor (VIF), Tolerance, and Pearson correlation coefficients to detect multicollinearity;
- Descriptive statistics (frequencies and percentages) to summarize the demographic profile of the sample;
- Descriptive statistics (means and standard deviations) to assess the average level of agreement among participants regarding the study variables.

To examine the relationships proposed in the theoretical framework, the study employed the Structural Equation Modeling (SEM) approach, specifically using SmartPLS software. SEM, as a second-generation multivariate analysis technique, enables the testing of complex models involving multiple constructs and relationships, making it well-suited for this research (Hair et al., 2021).

Data analysis in SmartPLS was conducted in two phases: the measurement model and the structural model. The measurement model was evaluated using Confirmatory Factor Analysis to ensure the reliability and validity of the constructs. The following tests were conducted for this purpose:

- Factor Loadings (FL) to assess item-level internal consistency;
- Composite Reliability (CR) and Cronbach's Alpha to examine construct-level internal consistency;
- Average Variance Extracted (AVE) to evaluate convergent validity;
- Fornell-Larcker criterion and Heterotrait-Monotrait ratio (HTMT) to establish discriminant validity.

Subsequently, the structural model was evaluated to estimate the path coefficients representing the strength and significance of relationships among the study variables. Bootstrapping with 5,000 resamples was used to test the statistical significance of the path coefficients at the 5% level of significance, with a critical t-value threshold of 1.96 (Hair et al., 2021).

Descriptive Findings

To provide insights for the extent of GSCMP and levels of OP in oil and gas companies in Qatar, this section gathered descriptive analysis results using mean and standard deviation.

Table 1 provides the descriptive analysis results for the extent to which GSCMP in oil and gas companies in Qatar were delivered. The results in Table 1 shows that sample's perception of GSCM practices in the oil and gas companies in Qatar based on overall mean value of 3.83. All GSCMP constructs were in the high levels of approval entailing that all practices of GSCM are practiced to high levels in the oil and gas companies in Qatar. Scored mean values for GSCM practices were as follows: internal environmental management [3.76], green procurement [4.04], cooperation with customer [3.81], ecological design [3.78], investment waste recycling [3.78] and green information system [3.78]. Regarding the extent of homogeneity and agreement among surveyed sample, standard deviation values were within the scope of [0.45] and [0.53], hereby, all Std. values were less than cutoff of [1], that is explained by statistics as assessments is clustered around its mean values entailing agreement and homogeneity in assessments. Delivered findings demonstrate high awareness and responsibility toward the environment among oil and gas companies in Qatar based on their high score of GSCMP. These companies are encouraged to continue their efforts regarding taking responsibility for the wellbeing of earth and to contribute toward the sustainability of the environment while attaining business growth at the same time.

Table 1: Extent of GSCMP in Qatar (N= 168)

No.	Order	Construct	Mean	Std.	Rank
1	6	Internal environmental management [IEM]	3.76	0.48	High
2	1	Green procurement [GP]	4.04	0.45	High
3	2	Cooperation with customers [CC]	3.81	0.53	High
4	4	Ecological design [ED]	3.78	0.51	High
5	3	Investment waste recycling [IWR]	3.78	0.53	High
6	5	Green information system [GIS]	3.78	0.49	High
Overall			3.83		High

Table 2: Extent of Internal Environmental Management in Qatar

No	Order	Statement	Mean	Std.	Rank
1	2	Senior executives make a commitment to green supply chain management	3.77	0.71	High
2	5	Your company's mid-level supervisor supports green supply chain management	3.72	0.70	High
3	3	Your company promotes cross-departmental cooperation to improve environmental protection	3.73	0.68	High
4	1	Your company promotes total quality management	3.87	0.52	High
5	4	Your company promotes an environmental management system	3.72	0.64	High
Overall mean			3.76		

Table 2 shows the perceived levels of practice in the internal environmental management in the oil and gas companies in Qatar, which are considered high as per overall mean value of 3.76. All statements that measured IEM practices were at high levels of approval with mean values ranging between 3.87 and 3.72. The first rank was for the statement "Your company promotes total quality management", second rank was for the statement "Senior executives make a commitment to green supply chain management", and third rank was for the statement "Your company promotes cross-departmental cooperation to improve environmental protection." Furthermore, Std. values were within the scope of 0.52 and 0.71, hereby, all values were less than the cutoff value of 1, that is explained in statistics as assessments are clustered around its mean values entailing agreement and homogeneity in assessments.

Table 3 shows that the levels of practice in green procurement in the oil and gas companies in Qatar are at high levels, based on overall mean value of 4.04. All statements that measured GP practices were in high levels of approval with mean values ranging between 4.26 and 3.77. The top three ranks of approval were for the following statements: first rank was for the statement "Your company cooperates with suppliers for environmental protection purposes", second rank was for the statement "Your company puts an ecolabel on the supplied products", and third rank was for the statement "Your company provides design specifications to suppliers, including environmental protection requirements for purchased materials". Furthermore, Std. values were within the scope of 0.54 and 0.67, hereby, all values were less than the cutoff and are clustered around their mean values, entailing agreement and homogeneity in assessments.

Table 3: Extent of Green Procurement [GP] in Qatar

No.	Order	Statement	Mean	Std.	Rank
1	2	Your company puts an ecolabel on the supplied products	4.08	0.67	High
2	1	Your company cooperates with suppliers for environmental protection purposes	4.26	0.59	High
4	4	Your company requires suppliers to promote ISO 14001 certification	3.77	0.54	High
6	3	Your company provides design specifications to suppliers, including environmental protection requirements for purchased materials	4.07	0.66	High
Overall mean			4.04		High

Table 4: Extent of Cooperation with Customer [CC] in Qatar

No	Order	Statement	Mean	Std.	Rank
1	4	Your company cooperates with customers to promote environmentally friendly design	3.76	0.69	High
2	1	Your company cooperates with customers to promote cleaner production	3.88	0.70	High
3	2	Your company cooperates with customers to promote green packaging	3.82	0.70	High
4	3	Your company cooperates with customers to use less energy during product transportation	3.80	0.63	High
Overall mean			3.81		High

Table 4 shows the levels of practice in cooperation with customer in the oil and gas companies in Qatar, which are at high levels based on the overall mean value of 3.81. All statements that measured CC practices were in high levels of approval with mean values ranging between 3.88 and 3.76. The top three ranks of approval were for the following statements: first rank was for the statement “Your company cooperates with customers to promote cleaner production”, second rank was for the statement “Your company cooperates with customers to promote green packaging” and third rank was for the statement “Your company cooperates with customers to use less energy during product transportation”. Furthermore, Std. values were within the scope of 0.63 and 0.70, hereby, all values are clustered around their mean values entailing agreement and homogeneity in evaluations.

Table 5 shows the levels of practice of ecological design in the oil and gas companies in Qatar, which are at high levels based on overall mean value of 3.78. All statements that measured ED practices were in high levels of approval with mean values ranging between 3.80 and 3.74. The top three ranks of approval were for the statement “Your company’s product design can reduce material/energy consumption”, second rank was for “The design of your company’s products can reduce the use of toxic materials” and third rank was for the “The design of your company’s products reuse materials or parts”. Furthermore, Std. values were within the scope of 0.55 and 0.70, hereby, all values are clustered around their mean values entailing agreement and homogeneity in evaluations.

Table 5: Extent of Ecological Design [ED] in Qatar

No.	Order	Statement	Mean	Std.	Rank
1	1	Your company's product design can reduce material/energy consumption	3.80	0.55	High
2	3	The design of your company's products in reuse of materials or parts	3.74	0.70	High
3	2	The design of your company's products can reduce the use of toxic materials	3.80	0.68	High
Overall mean			3.78		High

Table 6 shows the levels of practice in investment waste recycling in the oil and gas companies in Qatar, which are at high levels based on the overall mean value of 3.78. All statements that measured IWR practices were in high levels of approval with mean values ranging between 3.80 and 3.77. The top three ranks of approval were for the following statements of "Your company is implementing investment recovery of excess materials", second rank was for "Your company sells excess capital equipment", and third was for the statement of "Your company sells scraps and used materials". Furthermore, Std. values were within the scope of 0.64 and 0.69, hereby, all values were less than the cutoff, and clustered around its mean values, entailing agreement and homogeneity in evaluations.

Table 6: Extent of Investment Waste Recycling [IWR] in Qatar

No.	Order	Statement	Mean	Std.	Rank
1	1	Your company is implementing investment recovery of excess materials	3.80	0.69	High
2	3	Your company sells scraps and used materials	3.77	0.64	High
3	2	Your company sells excess capital equipment	3.77	0.66	High
Overall mean			3.78		High

Table 7 shows that the levels of practice green information system in the oil and gas companies in Qatar are at high levels, based on the overall mean value of 3.78. All statements that measured GIS practices were at high levels of approval with mean values ranging between 3.87 and 3.71. The top three ranks of approval were for the following statements of "Your company uses a green information system to support the production and distribution of renewable energy," second rank was "Your company uses a green information system to track environmental protection information (such as toxic substances, energy usage, water consumption, air pollution, etc.", and third rank was for "Your company uses green information system to confirm the role of information system in the energy policy".

Furthermore, Std. values were within the scope of 0.57 and 0.70, hereby, all values are clustered around their mean values, entailing agreement and homogeneity in evaluations.

Table 7: Extent of Green Information System [GIS] in Qatar

No.	Order	Statement	Mean	Std.	Rank
1	8	Your company uses a green information system to reduce transportation costs	3.73	0.66	High
2	7	Your company uses a green information system to support teamwork and video conferences for employees around the world to reduce air travel	3.73	0.70	High
3	2	Your company uses a green information system to track environmental protection information (such as toxic substances, energy usage, water consumption, air pollution, etc.	3.87	0.70	High
4	5	Your company uses a green information system to monitor the output of smoke and waste	3.75	0.68	High
5	6	Your company uses a green information system to provide information to encourage customers to choose green production	3.74	0.70	High
6	4	Your company uses a green information system to improve the CEO's decision-making on important sustainability issues	3.77	0.70	High
8	1	Your company uses a green information system to support the production and distribution of renewable energy	3.87	0.57	High
9	9	Your company uses a green information system to limit the emission of carbides and other substances	3.71	0.66	High
10	3	Your company uses green information system to confirm the role of information system in the energy policy	3.83	0.66	High
Overall mean			3.78		High

In Table 8, descriptive analysis results for the extent of OP in oil and gas companies in Qatar are presented.

Table 8: Extent of Operational Performance in Qatar

No.	Order	Statement	Mean	Std.	Rank
1	1	The firm's product delivery cycle times have improved compared to competitors	3.91	0.72	High
2	2	The firm responds to customer requirements faster than competitors	3.78	0.70	High
4	5	The firm's capability to reduce operational costs has improved recently	3.73	0.64	High
5	3	The firm has high flexibility in introducing the product mix	3.76	0.70	High
6	4	The firm's capability to reduce transportation costs has improved recently	3.75	0.70	High
Overall mean			3.78		High

The levels of operation performance in the oil and gas companies in Qatar are at high levels, based on the overall mean value of 3.78. All statements that measured aspects of operational performance were at high levels of approval with mean values ranging between 3.91 and 3.73. The top three ranks of approval were for the following statements of "The firm's product delivery cycle times have improved compared to competitors," second rank was for "The firm responds to customer requirements faster than competitors", and third rank was for "The firm has high flexibility in introducing the product mix". Furthermore, Std. values were within the scope of 0.64 and 0.72, hereby, all values were less than the cutoff of 1, and clustered around its mean values, entailing agreement and homogeneity in assessments.

Hypotheses Testing

To examine the hypotheses, the structural model was tested using the Smart PLS to examine relationships and influences between the variables in the model. To judge the quality of the structural model, it is vital to examine the amount of explained variance that the predictor (independent) variables explained in the dependent variable based on the R2 coefficient. Hair et al. (2021) proposed that R2 coefficient exceeding 25% till 50% shows moderate amount of variance, meanwhile, exceeding 50% of the variance shows high level of explained variance in the model. Further, the decision of hypotheses is presented based on the Beta coefficient that determines the amount of influence, along with its significance at P-value ≤ 0.05 and T-value > 1.96.

Figure 3 displays the structural model testing for the overall influence of GSCMP on OP in oil and gas companies in Qatar.

H.1: Green supply chain management practices will positively influence operational performance in the oil and gas industry sector.

The estimation of the structural model demonstrated that GSCMP overall explained 58.1% of the variance in OP, indicating a moderate amount of variance that GSCMP explains in OP, which is evident in its significance in explaining OP. Furthermore, the scored influence of GSCMP on OP was positive, scoring a Beta value of 0.764, hence, entailing that for each 1 unit of applying GSCMP, OP is enhanced by 76.4%. The influence was significant at the significance level of $P \leq 0.05$, as the P-value was 0.00 along with a T-value of 25.87 exceeding the critical T-value of 1.96. The results provide support for hypothesis 1. For sub-hypotheses, Figure 4 displays the structural model testing for the influence of GSCMP on OP in oil and gas companies in Qatar.

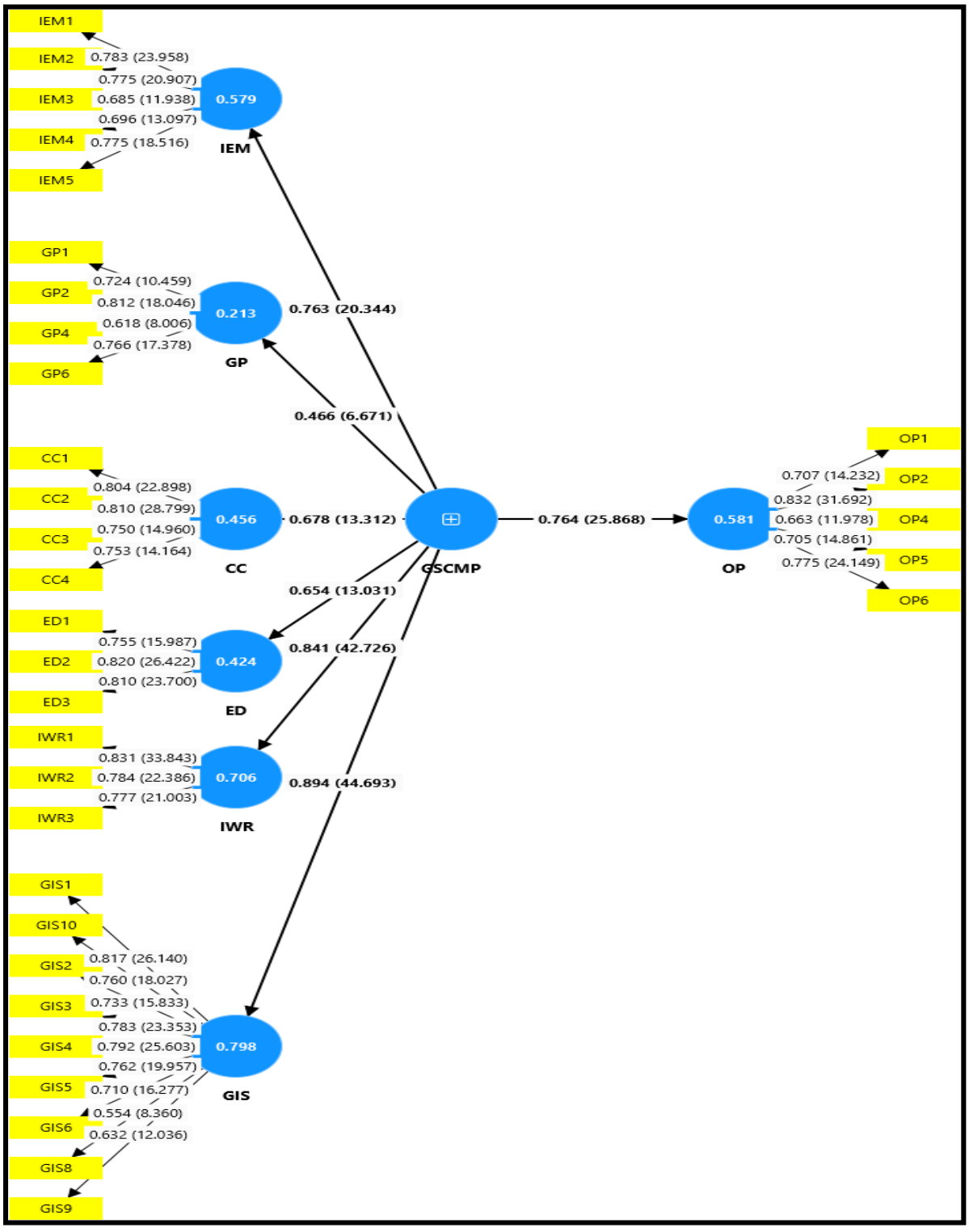

Figure 3: Structural Model Testing for Overall Influence of GSCMP on OP

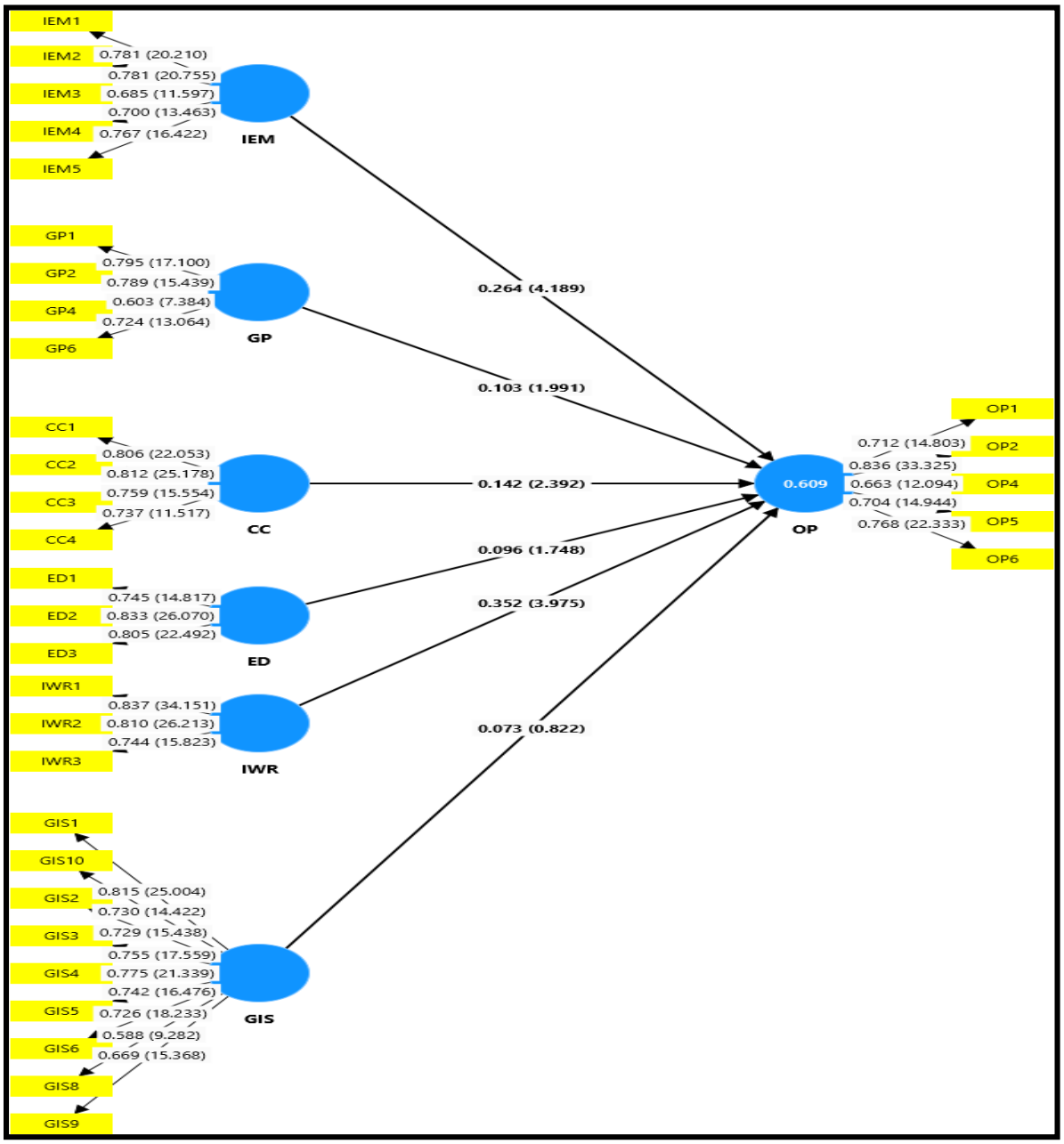

Figure 4: Structural Model Testing for Direct Influence of GSCMP on OP

The estimation of the structural model demonstrated that GSCMP constructs explained 60.9% of the varaince in OP, showing a moderate amount of variance that GSCMP constructs explain in OP. Results of sub-hypotheses were as follows:

H1.1: Internal environmental management will positively influence operational performance.

For the influence of internal environmental management (IEM) → OP, the scored influence was positive scoring a Beta value of 0.264, hence, entailing that for each 1 unit of applying IEM, OP is enhanced by 26.4%. The influence was significant at the significance level of $P \leq 0.05$, with a P-value of 0.00 and a T-value of 4.189. The results provide support for the first sub hypothesis1.1.

H1.2: Green procurement will positively influence operational performance.

The influence of green procurement [GP] → OP was positive, scoring a Beta value of 0.103, hence, entailing that for each 1 unit of applying GP, OP is enhanced by 10.3%. The influence was significant as per the P-value of 0.047 along with the T-value of 1.991. The results provide support for sub H1.2.

H1.3: Cooperation with customers will positively influence operational performance.

The influence of cooperation with customer [CC] → OP was positive, scoring a Beta value of 0.142, entailing that for each 1 unit of applying CC, OP is enhanced by 14.2%. The influence was significant as P-value was 0.017 along with a T-value of 2.392. The results provide support for the third sub H1.3.

H1.4: Ecological design will positively influence operational performance.

The influence of ecological design [ED] → OP was non-significant with a P-value of 0.080 along with a T-value of 1.748 below the critical value of 1.96. The results render no support for the fourth sub H1.4.

H1.5: Investment waste recycling will positively influence operational performance.

The influence of investment waste recycling [IWR] → OP was positive with a Beta value of 0.352, entailing that for each 1 unit of applying IWR, OP is enhanced by 35.2%. The influence was significant as P-value was 0.00 along with a T-value of 3.975, providing support for the fifth sub H1.5.

H1.6: Green information system will positively influence operational performance.

The influence of green information system [GIS] → OP was non-significant with a P-value of 0.411 along with a T-value of 0.822, below the critical value of 1.96. The results failed to support the sixth sub H1.6.

Table 9 shows a summary of structural models testing for the hypotheses results of GSCMP influence on OP in the oil and gas companies in Qatar.

Table 9: Structural Models Testing Results of GSCMP Influence on OP

H	Path	Beta	P-value	T-value	R^2	Decision
H1	GSCMP overal → OP	0.764	0.000**	25.868	58.1%	*Supported*
H1.1	Internal environmental management [IEM] → OP	0.264	0.000**	4.189	60.9%	*Supported*
H1.2	Green procurement [GP] → OP	0.103	0.047**	1.991		*Supported*
H1.3	Cooperation with customer [CC] → OP	0.142	0.017**	2.392		*Supported*
H1.4	Ecological design [ED] → OP	0.096	0.080	1.748		*Not supported*
H1.5	Investment waste recycling [IWR] → OP	0.352	0.000**	3.975		*Supported*
H1.6	Green information system [GIS] → OP	0.073	0.411	0.822		*Not supported*

** Significant at (0.05) level

Conclusion

This study examined the effects of green supply chain management practices on operational performance within the oil and gas industry in Qatar. Data were collected from employees working in the supply, production, and maintenance departments of six companies listed on the Qatar Stock

Exchange. The research findings revealed a statistically significant positive effect of the overall green supply chain management practices on operational performance. This indicates that enhanced implementation of green supply chain practices leads to improved operational performance in the oil and gas companies under investigation. Among the individual dimensions of green supply chain management practices, each was found to exert a positive and significant influence on operational performance.

Internal environmental management was positively associated with higher operational performance, suggesting that internal environmental initiatives are essential drivers of efficiency and effectiveness. Green procurement demonstrated a strong positive relationship with operational performance, underscoring the importance of sustainable sourcing strategies.

Cooperation with customers was also positively related to operational performance, highlighting the value of collaborative relationships in achieving operational excellence. Ecological design practices showed a significant positive impact, indicating that incorporating environmental considerations in product and process design contributes to operational improvements. Investment in waste recycling was found to enhance operational performance, suggesting that recycling initiatives support both environmental and operational goals.

Green information systems had a positive effect, demonstrating that leveraging digital technologies for environmental data management supports better operational outcomes. The descriptive statistics supported these findings by showing a generally high level of green supply chain management practices implementation across the companies included in the study. The overall mean score for green supply chain management practices indicate strong agreement with the presence of these practices.

Specifically, green procurement had the highest mean, followed by cooperation with customers, ınternal environmental management, ecological design, ınvestment in waste recycling, and green information systems. With regard to operational performance, the results demonstrated a high overall level. The sub-dimensions of operational performance also showed consistently high agreement levels, suggesting that these organizations maintain strong performance metrics.

These findings suggest that oil and gas companies in Qatar are not only actively engaged in green supply chain initiatives but they are also benefitting from them in terms of improved operational outcomes. The results reinforce the theoretical model underpinning the study, which posited a positive association between green supply chain management practices and operational performance. Furthermore, the high implementation levels of green practices suggest a growing strategic orientation toward environmental sustainability in Qatar's energy sector.

Implıcatıons / Recommendatıons

Based on the findings of the present study, there are some relevant implications and recommendations proposed for practitioners and researchers working in the oil and gas energy sectors, especially those dealing with operational performance in Qatar.

Oil and gas companies in Qatar are strongly encouraged to sustain and enhance their implementation of green supply chain management practices, given their critical role in promoting favorable operational outcomes and supporting environmental sustainability. The continued adoption and integration of green supply chain management practices, including practices such as internal environmental management, ecological design, and green information systems, will not only contribute to environmental preservation but also facilitate long-term business growth and competitiveness. By prioritizing green supply chain management practices, organizations may position themselves as regional leaders in balancing economic performance with environmental stewardship, which is very important in the global energy market. To maintain the high levels of operational performance currently observed, oil and gas firms should recognize the collective organizational efforts required and reinforce the alignment of operational processes with green initiatives. Special attention should be given to improving the effectiveness of ecological design and green ınformation systems, which were identified as areas requiring further enhancement to maximize their contribution to operational performance.

Future studies and researchers are encouraged to expand the existing research framework by incorporating additional variables such as innovation capability, regulatory pressure, or organizational culture to gain a deeper understanding of the dynamics between green supply chain management practices and operational performance. Researchers should also explore the barriers and challenges that hinder the full implementation of green supply chain management practices in the oil and gas industry in Qatar, thereby providing actionable insights for overcoming such obstacles.

Comparative research across different national and regional contexts is recommended to determine whether the findings from this study are generalizable. Such cross-contextual studies could enhance our global understanding of the impact of green supply chain management practices on operational performance and inform context-specific policy and managerial practices.

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