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The Impact of Sustainable Supply Chain Management Practices on Organizational Performance: A Quantitative Analysis of Manufacturing and Service Firms

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Abstract: This study investigates the relationship between Sustainable Supply Chain Management (SSCM) practices and organizational performance across manufacturing and service firms, aiming to quantify the impact of environmental, social, and economic initiatives on operational and financial outcomes. We employed a quantitative cross-sectional design with a sample of 200 organizations, yielding 978 valid responses from supply chain managers and sustainability officers through structured questionnaires and semi-structured interviews, supplemented by secondary data from corporate reports and industry databases. Data analysis involved multiple linear regression, Pearson correlation, and structural equation modeling, which demonstrated that green procurement ($\beta = 0.43, p < 0.001$), sustainable sourcing ($\beta = 0.39, p < 0.001$), supplier collaboration ($\beta = 0.34, p < 0.001$), and reverse logistics ($\beta = 0.29, p = 0.002$) were significant predictors, with the model explaining 74.1% of the variance in organizational performance ($R^2 = 0.741$). The correlation analysis revealed a strong positive association between SSCM adoption and overall performance ($r = 0.82, p < 0.001$). Furthermore, firms with comprehensive SSCM practices achieved 24.8% higher operational efficiency, 19.7% greater financial performance, and 28.5% improved environmental performance compared to those with low adoption. The novelty of this research lies in its comparative analysis across manufacturing and service sectors, providing empirical evidence that integrated sustainability initiatives yield multifaceted benefits. Consequently, these findings offer strategic implications for business leaders, demonstrating that systematic incorporation of sustainable practices into supply chain operations fosters long-term competitive advantage and organizational resilience. This work thereby contributes to the growing literature on sustainable operations management by validating a robust framework for performance enhancement through SSCM.

Keywords: Sustainable Supply Chain Management, Organizational Performance, Manufacturing Firms, Service Firms, Sustainability Practices.

Introduction

The growing awareness of environmental values and Social Responsibilities worldwide has resulted in drastic changes in the operation of today's organisations. True sustainable business is now taking off and many companies are measuring and incorporating their ecological and societal impacts as well as profits into their considerations (Jr et al., 2012). Sustainable Supply Chain Management (SSCM) now is beginning to be integrated into strategic discussions. In the whole lifecycle of activities in the supply chain, SSCM is inclusive of both environmental, social and economic effects from the raw materials (supply) generation to the product disposal (demand). Hence, the value of the practices realising actual measurable organizational outcomes, including impact (Adegoke et al. 2021).

As attractive and intuitive as SSCM was, however, the empirical findings which linked concrete practices with concrete measures of improvements remained rather indirect, particularly across different industrial contexts (Iansiti & Levien, 2002). There is a limited amount of study that details all parts of sustainability supply chain management (e.g., consideration of green procurement and reverse logistics), on the other hand, there are the lack of analytical frameworks to account for adoption of all aspects of SSCM portfolio and their differential effects on operational, financial and environmental performance (Vijayvargy & Sahoo, 2021). Such companies operate in a far more intricate environment of engaged complex suppliers, policy institutions and a variety of markets, which can lead to the introduction of significant degrees of diversity that can offset the effects of sustainability initiatives (Ashton, 2009). Therefore, it is required that a solid multi method investigation is used to elucidate these interactions in order to provide guidance to a strategy.

The primary aim of this research is to measure the effects of few pre-defined listed practices of SSCM (Green procurement, Sustainable sourcing, Supplier collaboration and reverse logistics) on various organisational performance aspects in a large and multi-sector organisation sample of manufacturing and service companies (Gorane & Kant, 2017). It is posited that such practices, practiced more fully will be positively and significantly connected with better operational efficiency, financial performance and attributes of the environment. Moreover, we hypothesize that organizations that have higher adoption of SSCM will be able to attain the advantages statistically significantly over the lower adoption organizations in terms of indices of key performance (Shebeshe & Sharma, 2025).

Merging into a novel, integrative and comparative approach is novel and principal contribution of this book. Data examined comes from 200 companies and from various sectors and using a complex methodological approach that combines multiple linear regression, Pearson correlation and structural equation modelling (SEM) provides a more complex and generalizable understanding of the SSCM-performance nexus. Moving from single-sector analyses towards comparative perspectives of the dynamics in manufacturing and service contexts. This empirical rigor allows us to validate a broad model explaining a pertinent percentage (74.1%) of organizational performances. Through the lens of the findings, a business and policy roadmap is provided, which guarantees that an investment priority can be given to investments that secures sustainable competitiveness and organization resilience in the long term (Baah, 2019).

Below is a summary of the paper. The first section of the paper (Section 2) 'souls' the literature relevant to SSCM practices and organizational performance, laying the groundwork for the hypotheses that were tested. The research methodology is presented in section 3 by explaining the sample used, tools collected and statistical techniques used. The key findings which we used to inform our quantitative analysis are listed in Section 4. These findings are discussed in terms of the existing literature in section

5 and the theoretical and practical implications of the findings are discussed. Finally, in 6 the important findings are summarized, its limitations are identified and directions for future research are provided.

Literature Review

A common approach to providing understanding is the resource-based view of the firm (RBVF), which aims at understanding whether sustainable supply chain behavior can be linked to firm outcomes or results. This places competencies that are rare, valuable and hard to imitate as a source of sustainable competitive advantage (Wernerfelt, 1984). In this context, SSCM strategies, such as green procurement, green reverse logistics, are regarded as other firms' capacities, enlightening the companies and putting forward lower expenses, positive brand-image, and higher-quality upcoming green laws and policies (Jr et al.,2012). Numerous empirical research have been carried out regarding some aspects of SSCM. Research on green procurement has been showing that there is growing relationship between green procurement and operational performance; for example, one research had concluded that the relationship between green procurement and operational performance is positive, meaning that, green procurement is able to reduce waste and energy usage throughout the growing process (Asante-Darko & Osei, 2024). Similarly sustainable-sourcing policies are strongly linked to supply chain resilience and risk reduction, likely because policies that aim for sustainability are often created in the context of longer-term supplier relationships and supplier development programs (Carter & Rogers, 2008). Results of the research into reverse logistics indicate reverse logistics can be applied in value recovery by welcoming returned products that can contribute to financial performance and resources usage (Govindan et al., 2015). At the same time there is a great deal of fragmentation as can be seen in the literature. A large number of studies only provide the information for a single sector, mostly the manufacturing sector, which would also restrict the scope of broad application of the findings (Sahoo & Vijayvargy, 2021). For example, some significant relationships between GSCM and cost reduction with study have been identified with manufacturing Indian organizations; however, such relationships are not evident for service-oriented organizations, and the closeness of the supply chain. Additionally, multiple SSCM practices were comparatively studied in a single analytical framework multiple times which was multiple times very rarely (Gorane & Kant, 2017). The previous studies mainly consider each practice individually but are lacking in the consideration of the co-effects of the practice and ignoring the added value of an integrated sustainability approach.

These gaps have been slowly being bridged by more recent studies. To investigate the relationship between SSCM and performance and its possible mediating role, a SEM technique is adopted (Baah, 2019). These works propose that SSCM practices have no direct impact on performance, but do so through the creation of a company's market position, and differentiation. In other works, customer relationship management (CRM) was also utilized to conclude that the impact of sustainable practice on the organizational performance is stronger when applied along with high levels of customer engagement (Das & Hassan, 2022). There has been no comparable lack, however, that comparative analyses across the various contexts of manufacturing and services, in one large scale empirical study.

The present study directly tackles this limitation. If someone looks back at the previous efforts in this field, he or she will know that understanding the individual mechanisms and mediators has made remarkable progress but, we propose, more modern and comprehensive and less fragmented approaches that model four of the most important SSCM practices – green procurement, sustainable sourcing, supplier collaboration and reverse logistics – as predictors of a multiplicity of performance dimensions. Moreover, because manufacturing and Service firms were both incorporated in sampling, we bring a comparative point of view to the forefront which the literature lacked. This allows for further analysis of the SSCM performance-vs.-structure relationship under various operation conditions that are

essentially different from the previous analysis that has strengthened the theoretical understanding of how to make a sustainability campaign work in various industrial environments. The RBV of the firm is frequently used to present relevant theories to explain how sustainable supply chain strategies can drive business outcomes, as well as create a more actionable and generalizable model for practitioners than previous studies with a focus on one sector or one practice have been able to offer. This view assumes that organisations develop a set of capabilities that are valuable, rare and hard to imitate that can provide them with ongoing competitive advantage (Wernerfelt, 1984). Meanwhile in this context, green procurement and reverse logistics are viewed as being abilities of the firm that can enable firms to not only realize cost savings, but also enhance brand image and ensure adherence to increasingly stringent environmental laws (Jr et al., 2012).

A lot of empirical study has been carried out on the specific aspects of SSCM. All the research papers on Green purchasing have reported a correlation between the link to operational aspects (waste and energy saved during the manufacturing process) and the performance (Asante-Darko & Osei, 2024), and the stronger the link the better the performance. Likewise, the sustainability of sourcing approaches is related to the resilience and risk management of supply chain, and they tend to have longer-term contractual terms and supplier development programmes (Carter & Rogers, 2008). The study of reverse logistics revealed that via the recovery of value, returned products' reverse logistics contribute to an improvement of financial performance and resource utilization (Govindan et al., 2015).

The published literature, however, is far from coherent, too. Most of the studies are relatively narrow (usually related to manufacturing), and not attentionally broadly generalizable (Sahoo & Vijayvargy, 2021). However, since the chain closely intertwined, such as service sector companies, cost reduction was observed as more significant in the practices of GSCM for manufacturers and the results cannot be assured for service sector companies. In addition, the study and analysis of several SSCM practices, within one analysis framework, is a less common approach (Gorane & Kant, 2017). Much of the research literature focused on practices would focus on practices separately - perhaps the impact of interactions between practices would be emphasised as would promotion of implementation of an integrated sustainability approach.

With the above-mentioned faults that were found during the more recent investigations. Numerous studies on SSCM-performance has examined the mediating effect of competitive advantage in between the SSCM and performance relationships (Baah, 2019). The works show, for example, that there is no straightforward link between SSCM practices and performance – the change happens through the effect that SSCM practices has on the market position, or on the differentiation of a firm. A number of studies had already investigated the role of customers' relationship management (CRM) on the link between its sustainable practices and organization's performance, and in this study, they also reported that the positive relationship between sustainable practices and performance of the organization is further enhanced by customers' relationship management (CRM) (Das & Hassan, 2022). However, certain limitations existed in the studies: no comparative study across manufacturing/service was conducted at any given time within a large-scale empirical study—only at the conclusion of a large-scale empirical study.

This is a case in which the present research is directly in focus which is even exceptional. Previous studies have shed light on the mechanisms and mediators, but our study simultaneously models the four key SSCM practices, green procurement, sustainable sourcing, supplier collaboration and reverse logistics, as predictors of multiple dimensions of performance, in a more integrated framework. Furthermore the samples used are not only manufacturing companies but also service providers, thus providing a comparative feeling, seldom reported in literature. The results when combined with the

assessments of SSCM and performance under a variety of contexts can help us deepen our understanding of how sustainability initiatives in different industrial contexts operate, and understanding of the strength of the relationship between SSCM and performance. The empirical confirmation of such a wide and cross-sectoral context of SSCM in this study is therefore very important and may even be more general and practically oriented than the ones found in the previous studies, which were more specific and single practice based.

Methodology

Research Design and Sampling Strategy

A quantitative, cross-sectional design research was used to examine the causal relationship between sustainable management (SSCM) practices and organizational outcomes of the performance in this study. The cross-sectional approach was selected since it can collect data from many organisations, providing the opportunity to find patterns and associations at one specific time (Creswell & Creswell, 2017). The target audience included manufacturing and service companies in various industries such as automotive, electronics, food & beverage, retail, logistics and professional services. This representation was obtained in relation to the various sizes and industry categories to the organization through a stratified random sampling method. Stratification variables used were: industry sector - manufacturing or service, organization size - small, medium and large (by number of employees and by dollar volume - annual revenue). A sampling frame of 500 organizations identified in industry databases and chambers of commerce registries was developed and 200 were randomly selected (proportional to strata) to form the sample. Finally up to five members of the selected organizations were invited – supply chain managers, procurement officers, logistics managers, production managers and sustainability officers – in order to get a total of 1,000. The multi-respondent approach aimed to minimise single-source bias and to gain access to a diversity of functional perspectives on implementing the introduction of SSCM practices and how these are impacting the practice. (Podsakoff et al., 2003).

Data Collection Instruments and Procedures

Primary data was collected by using two complimentary tools which are structured questionnaire and semi-structured interview protocol. A structured questionnaire was created from a thorough literature search of validated questionnaires used in previous SSCM studies (Jr et al., 2012). It comprised four parts that measured organizational characteristics (size, industry sector and years in operation); (b) level of implementation of SSCM practices on a five-point Likert scale from 0 (not implemented) to 4 (fully implemented); (c) perceptions of organizational performance in several dimensions on five-point Likert scales, and (d) contextual factors (regulatory pressure, market competition). In this field, that is sustainable procurement, there were 6 items for green procurement and 5 for sustainable procurement and 4 transportation logistics accounting taking into consideration sustainable aspects. Additionally, five items were related to waste management practices, four items related to reducing carbon emissions through initiatives, six items related to the collaboration with suppliers, five items for implementation of reverse logistics and four items for resource efficiency. The organizational operational performance, financial performance, customer satisfaction and organizational competitiveness were measured, respectively, using 4, 5, 6 and 5 performance items of the organization. Face-Reliability-Cleanliness Test was given to 30 respondents (5 Organizations) out of the outset sample to examine on the aspects of Face, Reliability and clarity. Clear information from feedback was gathered and procedural changes/additions to items were made.

The 20 organizations were purposefully sampled and included in the interviews, which were semi-structured, with a total of 40 interviewees (2 in each organization), depending on the level of SSCM adoption. The reasons for using practices, perceived barriers to use, perceived facilitating factors to the use and anecdotes on impacts on performance were asked in the interview guide. All of these were audio taped with permission and transcribed and themed (Patton, 2014) following the 45-60 minutes of each interview. Most of the interview data was used for triangulation purposes, as well as to elaborate the quantitative findings in the context of the study.

Data Collection Procedures and Ethical Considerations

Having started data collection in Jan-Jun 2023, it continued for six months. Appropriate respondents were identified and written request made to them and the human resources departments/senior management of each target was made by telephone to ensure the consent of the organizations. When consents were obtained, we sent out the structured questioners in electronic format via a secure online survey (Qualtrics) did so and also sent them as paper copies if requested. In order to increase the response rate, we sent three reminders over a period of two weeks, and provided them with a summary of the results of our research in order to provide them an incentive. Semi-structured interviews were arranged at the subject's convenience and either given over video or attendance interview. The anonymity and confidentiality requests were explained to all of the participants as well as obtaining informed consent prior to collecting information from each person who responded. The protocol of research was reviewed and approved by the IRB of affiliated university (approval number: IRB 2022-SCM-047).

Secondary Data Sources

The secondary data has been obtained from a few of the data that were publicly available as an adjunction and a corroboration of the principal data. These included industry-related publicly available databases (e.g. Global Reporting Initiative, Carbon Disclosure Project), government publications of industry performance and environmental compliance (87 organizations disclosed environmental information), and annual sustainability reports (for 112 organizations that put such reports together). Objective measures of environmental performance (in terms of carbon emission, intensity of waste generation, intensity of energy consumption) as well as financial indicators (return on assets, operating margins) were extracted from these sources. The secondary data were used to cross-validate the measures of organizational performance that were obtained from the surveys, to enhance the internal validity of the study (Vartanian, 2010).

Variable Definitions and Measurement

Independent (IV) variables of this study were eight SSCM practices namely: green procurement, sustainable sourcing, eco friendly transportation, waste management practices, carbon emission reduction initiatives, supplier collaboration, reverse logistics implementation, and resource efficiency. All of the practices were translated to the composite index score which is the average of all the items of that particular practice being rated on Likert scale. Organizational performance was considered as the dependent variable where we considered it to be a multi-dimensional construct and included operational performance, financial performance, customer satisfaction and organizational competitiveness. Some sub-indices (derived indices) were also computed to analyze in particular cases. A Sustainable Supply Chain Management Index (SSCMI) was then constructed following the aggregation in the same way of all the scores from the 8 practice items of the SSCM index. On the other hand the Operational Performance Index (OPI), Financial Performance Index (FPI), Environmental

Performance Index (EPI), Customer Satisfaction Index (CSI), Resource Efficiency Index (REI) and Organizational Competitiveness Index (OCI) were determined by averaging the item sets. These were included as summary statistics for further data analyses such as correlation analysis or structural equations modelling.

Data Preprocessing and Preliminary Analyses

To perform inferential analyses, we have been very careful in processing the data, following a well-designed data pre-processing pipeline. There were 22 cases of high missing rates of important variables (30% or more), which were not included in the final analysis, leaving 978 responses for analysis. For all but the few variables where less than five percent (fewer than ten observations) were missing, the median value was used instead of the Was congratulated to them for using this approach. For those few variables where less than five per cent of the values were missing (less than ten observations), the median value was used because, as Graham (2009) noted, most items were of a categorical nature and the median is a suitable estimate of central tendency for skewed distributions. The categorical variables (organisation size small - coded 1, medium - coded 2; and large - coded 3, and industry sector as manufacturing - coded 1, service - coded 2) were then coded and the frequencies of each were analysed for coding errors. The Outlier method used for outlier detection was the Inter Quartile Range (IQR) method whereby those numbers smaller than $Q1 - 1.5 \times IQR$ or larger than $Q3 + 1.5 \times IQR$ were flagged for review. In total there were 14 possible outlier scores identified for the performance measures; but data source was examined and no data were discovered to be input errors; rather, the scores were just results of variation across the performance of these organizations. For the comparability of scales, the continuous variables were rescaled (Min-Max normalization):

$$X_{\text{norm}} = \frac{X - X_{\min}}{X_{\max} - X_{\min}}$$

The smallest and largest values of these variables are called the variables' $X_{\min}$ and $X_{\max}$, respectively. The normalization helped to make regression coefficients interpretable and provided useful comparisons of different measurement scales (Desai et al., 2025).

The internal consistency of the composite scales was measured by using Cronbach's Alpha coefficient in reliability assessment. For the internal consistency, scale α for SSCM has a value of 0.89, indicating it has a high degree of consistency. The organizational performance scale has a value of $\alpha=0.87$, and scale α of the operational performance and financial performance is 0.85, scale α of the environmental performance is 0.83 and scale α of environmental performance is 0.88. These values indicate the validity of the instruments used in this study.

Statistical Analysis Techniques

The analytical approach was divided into a few stages. Descriptive statistics, such as means, SDs as well as frequencies and percentages were calculated to describe the sample and distribution of key variables, first. Second, bivariate analysis using Pearson correlation was performed to explore the preliminary evidence of hypothesized relationships between all SSCM practices, and organizational performance dimensions.

Third, multiple linear regression analysis was used to assess the predictive capacity of the eight SSCM practices on the overall organizational performance. A regression model was defined as:

$$OP = \beta_0 + \beta_1(GP) + \beta_2(SS) + \beta_3(ET) + \beta_4(WM) + \beta_5(CR) + \beta_6(SC) + \beta_7(RL) + \beta_8(RE) + \epsilon$$

The organizational performance (OP), the green procurement (GP), the sustainable procurement (SP), the eco-friendly transportation (ET), the waste management (WM), the carbon reduction (CR), the supplier collaboration (SC), the reverse logistics (RL), the resource efficiency (RE), intercept and error term are respectively. Multicollinearity was checked by Variance Inflation Factors (VIFs) of less than 5 were deemed acceptable.

Fourth, one-way ANOVA was used to test if the relationship between SSCM and performance was affected by organizational characteristics in that there were differences in the mean performance scores across organization size categories and across industry sectors. Finally, a Structural Equation Model (SEM) was created with AMOS 29 to test the overall theoretical framework at the same time to be able to explain the model (fifth step). Eight observed indicators defined the latent constructs of SSCM practices and four observed indicators defined the latent construct for organizational performance in the SEM. The model fit was assessed based on several indicators, such as χ^2/df (), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Acceptable fit was defined as , CFI > 0.90, TLI > 0.90, and RMSEA < 0.08 (Hu & Bentler, 1999).

Lastly, Confirmatory Factor Analysis (CFA) was performed to test the measurement model for the observed items being valid indicators of the underlying constructs. Cross-verification was done using the CFA which was performed for each construct with factor loadings, composite reliability, and average variance extracted (AVE). Statistical analysis was conducted in SPSS 29, AMOS 29, R (Version 4.3) and the Microsoft Excel. All hypothesis tests used a significance level of . All tests of the hypotheses had a significance level of . The demographic characteristics of the sample are summarized in Table 1 below.

Table 1. Sample Demographic Characteristics (n = 978)

Characteristic	Category	Frequency	Percentage
Industry Sector	Manufacturing	598	61.2%
	Service	380	38.8%
Organization Size	Large	455	46.5%
	Medium	349	35.7%
	Small	174	17.8%
Respondent Role	Supply Chain Manager	312	31.9%
	Procurement Officer	215	22.0%
	Logistics Manager	195	19.9%
	Production Manager	138	14.1%
	Sustainability Officer	118	12.1%

Results

The EMPIRICAL FINDINGS which were obtained through the statistical analysis of the collected data is presented in the following section. Results are presented sequentially, starting with descriptive

statistics that include detailed information about the attributes of the samples, and the presence of sustainable supply chain practices, followed by the results of regression, correlation and structural equation modeling which test the hypothesized relationships between sustainable supply chain practices and organizational performance.

Participant Characteristics

Following the data cleaning procedure, the final number of valid responses obtained for the final analysis amounted to 978 (97.8% response rate in the sample target of 1,000 in total). A demographic profile of the sample is given in Table 1. This was accomplished by stringent data quality assurance procedures: 22 responses were dropped because of excessive missing data and are not part of the high retention rate.

At the industry sector level, of the 598 respondents belonging to manufacturing organizations, 61.2% were and of the 380 respondents in service organizations, 38.8% were. The manufacturing segment has been intentionally sampled with a higher frequency to adequately cover the more tangible aspects of the supply chain for manufacturing, and also to provide good representation of service sectors to allow meaningful cross-sectoral comparisons (Jr et al., 2012).

While answering the question about organizational size, the majority of the respondents were from Large organizations with 455 respondents (46.5%) marking the option of having 10 to 49 or more employees and annual revenues exceeding 20 million KD. Small organizations sent us 174 (17.8%) respondents, and then medium size organizations sent us 349 (35.7%). This imbalance towards larger firms is in line with the findings from earlier SSCM research, in which the larger firms were seen to host more formal and developed sustainability programs and to have more resources to implement sustainable programs (Adegoke et al., 2021). All three sizes however, enable the study of the mediating role of organizational resources in the analysis of SSCM practices adoption and effects.

Respondent roles varied, reporting several functional angles in the supply chain domain. The largest number of respondents, 312 (31.9%), were supply chain managers, followed by procurement officers, logistics managers and production managers, all with 215 (22.0%) each, and sustainability officers with 118 (12.1%). The benefit of this multi-respondent approach is that it reduces the influence of single-source bias effect because the perceptions of various individuals most responsible for the implementation of the sustainable supply chain are gathered and combined (Podsakoff et al., 2003). However, the proportion of sustainability officers is comparatively low as it can be assumed that sustainability officers are more common in larger organisations; this is consistent with the size distribution of organisations. The sample's composition by demographics yields a firm base for the relationship outcomes analyses that follow measuring the relationship between SSCM practices and organizational performance outcomes.

Sustainable Supply Chain Practices

The results indicate that, overall, the sampled organizations have high implementation of sustainable supply chain management activities. The results showed that green procurement policies are the most common practice, with 79.3% of organization implementing green procurement policies. This high prevalence is consistent with the increasing regulatory demands and market demands for more environmentally responsible sourcing (Jr et al., 2012). Likewise, 76.4% of companies had introduced energy efficient logistical operations, which signaled a wider strategy of minimizing carbon footprint and costs to do so.

In addition to environmental initiatives at the entity level, 72.8% of organizations adopted sustainable sourcing strategies, and 74.1% evaluated their suppliers' sustainability performance. Given that some of the difficulties in sustainable sourcing practices are accounted for in sustainable practices in the context of managing supplier relationships and implementing sustainability considerations into complex supply chains (Carter & Rogers, 2008), this finding may be an explanation for the slightly lower adoption rate of sustainable sourcing than sustainable practices within the company. Sixty-eight point five percent (68.5%) of organizations performed reverse logistics operations and enabled the reverse logistics system for product returns, recycling and remanufacturing. A relative lower adoption rate could be explained by infrastructure investments needed, since this concept of reverse logistics may not be suitable for the service sector because it may not have a lot of tangible products to manage by using these systems (Govindan et al., 2015).

These descriptive findings indicate that although SSCM practices are widely adopted, they are widely diverged in terms of how much they are being practiced per each SSCM practice domain. The comparatively high uptake across all practices suggests the importance of sustainability has become embedded as a core focus for today's organisations, but there are others which have relatively low uptake suggesting that they may require greater development and investment. Table 2 indicates that there are disparities in the adoption rates between working systems and shows the baseline for the analysis of the contribution of specific practices to the outcomes of organizational performance.

Organizational Performance Outcomes

To measure the actual results of the application of SSCM, the behavior of high and low SSCM implementation organizations was compared. The sample was split into two groups according to a Mediansplit on the Sustainable Supply Chain Management Index score for a comparative analysis. Table 2 shows significant and consistent gains in all the performance measures examined when looking at the results for high-adopting organisations.

Table 2. Performance Differences Between High and Low SSCM Adopting Organizations

Performance Indicator	Improvement (%)
Operational Efficiency	+24.8%
Financial Performance	+19.7%
Customer Satisfaction	+21.9%
Resource Utilization Efficiency	+26.3%
Environmental Performance	+28.5%

Operational efficiency was 24.8% higher for organizations that had extensive SSCM practices than for those with little or no practice, as outlined in Figure 2. The conclusion confirms previous studies which show "green procurement" and "sustainable procurement" can make production processes more efficient by minimizing waste and energy requirements (Jr et al., 2012). The positive financial performance improvement of 19.7% indicates that money invested in sustainability has shown economic benefits, which are likely in the form of cost reductions arising from sustainability benefits in resource efficiency and improved market positioning (Adegoke et al., 2021).

Customer satisfaction saw a 21.9% rise in the high-adopting category; this may be due to increasedness consumers' preference for environmentally responsible brands. With an improvement of 26.3% in resource utilization efficiency, the operational benefits realized due to application of circular economy principles like reverse logistics and waste minimization were highlighted (Govindan et al., 2015). Most importantly, it was found that environmental performance had the highest differential, at 28.5%, supporting that through carbon emissions reductions and waste management, comprehensive sustainability programs have a direct impact on reducing environmental footprints (Iansiti & Levien, 2002).

That the direction and magnitude of these advantages are the same in all five performance indicators gives strong reason to believe that SSCM is not compliance in disguise but that SSCM actually becomes a strategic process of creating value to the organization of several dimensions. Notably, the greatest gains were found in environmental and resource utilization metrics, which are the most direct targets for sustainability efforts, and the financial and customer related results were significant, but relatively smaller. This trend indicates that the environmental gains resulting from the reversal may come sooner than any financial advantages, possibly because the latter depend on the smoothness of SSE pursuit and the resulting improvements in market reputation, which can be measured over longer periods of time as benefits from running the business more efficiently arise.

This result is in line with the theoretical assumption that SSCM practices are specific organizational competencies that can provide competitive benefits by optimizing processes across three overlapping areas: operational, financial, environmental. One highlight of the 28.5% environmental performance improvement is the expectation that sustainability initiatives can have meaningful impacts on sustainability and maintain business results, and in this case actually drive them up.

Regression Analysis

In order to quantify how much the individual sustainable supply chain management practices influence the overall organizational performance a multiple linear regression analysis was performed. Organizational performance was the dependent variable and eight SSCM practices--green procurement, sustainable sourcing, eco-friendly transportation, waste management, carbon reduction, supplier collaboration, reverse logistics, and resource efficiency, were the independent variables used in the regression model. Multicollinearity was checked and the Variance Inflation Factor (VIF) values were all below the 5.0 limit, but were far below the 3.5 level; thus, there were no problems of redundancy between the predictors (O'brien, 2007).

As seen in Table 3, the regression analysis results indicate that there are four variables that are statistically significant related to organizational performance. In this respect, green procurement was the most powerful (, 0.43) predictor of organizational performance, meaning that every increase in the implementation of GP practices by a standard deviation corresponds to an increase in organizational performance of 0.43 of a standard deviation, while keeping the other factors constant. This significant impact highlights the strategic significance of considering products from sustainability perspectives in purchasing decision making in order to achieve the overall firm success, which is consistent with earlier studies pointing out that the procurement function is a gateway for integrating sustainability into the firm (Jr et al., 2012).

Table 3. Multiple Linear Regression Results Predicting Organizational Performance

Predictor Variable	Standardized Beta (β)	p-value
Green Procurement	0.43	< 0.001
Sustainable Sourcing	0.39	< 0.001
Supplier Collaboration	0.34	< 0.001
Reverse Logistics	0.29	0.002

Sourcing sustainable materials was the second most influential predictor, showing that sourcing from those suppliers and managing their capabilities along environmental and social criteria is a contributor to the sustainability performance of the organization. This indicates that the resource-based view of the firm has more merit, because the development of sourcing capabilities that are sustainable is generally complex and difficult for other competitors to duplicate which are a source of sustainable competitive advantage (Wernerfelt, 1984). Collaboration amongst suppliers was close behind, and these results underline the critical importance of collaboration with supply chain partners when pursuing sustainability goals that lead to performance results. Buyers and suppliers working together to solve problems and middle-managing projects seems to have created synergistic value, which transcends the individual organization's capacity and capability. (Carter & Rogers, 2008).

Also, reverse logistics was significant, but somewhat smaller in significance in comparison to the other significant predictors. This indicates that although reverse logistics for product returns and end-of-life product flows is good for performance in an organization, the effect of returns and end-of-life product flows may be lower in some industries because manufacturing organizations with tangible products may have more significant gains from reverse logistics than service organizations. Interestingly, the remaining four practices (eco-friendly transportation, waste management, carbon reduction and the use/cessation of resources) were not found to be statistically significant given the other factors listed, but were included in the model based on the within-group correlation. To note, the other remaining four practices (eco-friendly transportation, waste management, carbon reduction, use/cessation of resources) were not found to be statistically significant in the presence of the other practices listed here but were included in the model because of the within group correlation. They have not been significant as they are part of the broader issues of green procurement and sustainable sourcing, and the impacts of them may be captured by the other operational practices that are significant. In general, the regression overall model was useful and highly predictive, with 74.1% of the organizational performance explained ($r^2 = .741$). The combination of these practices explains almost three-quarters of the difference in organizational performance among the sampled firms serving as a marker for the critical importance of sustainability efforts in driving success in today's business landscape. The number of predictors represents superseding values, yielding an adjusted value of 0.738, which is significantly the same from the unadjusted value (Cohen et al., 2013).

These regression results support the hypothesis that there are certain specific sustainable supply chain practices, which have been selected by certain reasons among various existing practices, that are having strong impact on the organizational behavior such as the practices of green procurement, sustainable sourcing, collaboration with suppliers and reverse logistics. Differential effects of the significant predictors would also be useful for business leaders: Investments in green procurement and sustainable sourcing may provide the biggest return on performance, but investments in reverse logistics and recycling may be more context-specific depending upon the type of firm's operation. The overall model fit supporting the results substantively supports the theoretical foundation of this study which treats SSCM practices as significant organizational capabilities with clear implications for organizational

performance: this is why the overall fit is high. The high overall fit validates the theoretical basis of this study, in that it treats SSCM practices as significant organizational capabilities with clear implications for organizational performance, which means it reinforces the strategic imperative for extensive implementation of sustainability practices across supply chain functions (Adegoke et al., 2021).

Correlation Analysis

The Pearson correlation analysis was performed to analyze the relationship between practices at the Sustainable Supply Chain Management (SSCM) and organizational performance dimensions, including the bivariate relations. This analysis helped to provide tentative evidence for hypothesized associations prior to more in-depth multivariate models. The correlation matrix generated was for the composite indices—sustainable supply chain management index (SSCMI), organizational performance index (OPI), environmental performance index (EPI) and customer satisfaction index (CSI)—described above in the methodology section (Jr et al., 2012).

Based on the results, there was a significant positive correlation between the Sustainable Supply Chain Management Index and the Organizational Performance Index. Note that makes up the other two inches. The results showed a strong positive correlation between Sustainable Supply Chain Management Index and Organizational Performance Index—the other two inches. Naturally, this sizeable correlation coefficient suggests that there is a corresponding increase in the overall size of the organisation's performance as the organisation's level of implementation of SSCM increases. This relationship is remarkable when compared with the small scale of the correlations reported in previous SSCM studies which generally fall within the range of and (Adegoke et al., 2021). It is very strong, indicating that sustainability initiatives are not ancillary but are part of the everyday success measures of the organization.

In addition, the results of this analysis showed that the influence of SSCM implementation was also supported by the positive relationship between SSCM implementation and EPI, which means that those organizations that had higher SSCM implementation also performed better in terms of environmental performance. The strength of this positive association bolsters the evidence of direct ecological benefits from sustainable supply chain practices and supports the effectiveness of such measures as 1) green purchasing and 2) waste management and carbon emission reduction in delivering tangible environmental benefits (Iansiti & Levien, 2002). This correlation coefficient of 0.79 is especially interesting because the numbers indicates a near linear relationship where positive increases in the degree of sustainability, in this particular number set, are strongly correlated with the decreases in the ecological footprint that were measured.

Likewise, it was found that the practices of SSCM were significantly positively correlated to customer satisfaction. This discovery is consistent with other research that is emerging in the field, which shows that consumers are attuned to environmentally responsible organizations (Ero) preferences are also increasing (Carter & Rogers, 2008). This significant correlation confirms that customers become aware and value sustainability practice, which they may show in their behavior by loyalty; positive word of mouth and/or willingness to pay premium prices for goods from sustainable supply chains.

The high frequencies of positive correlations in each of the dimensions of performance offer preliminary support for the overall hypothesis that practices of SSCM improve practices related to organizational outcomes. Correlation coefficients are statistical significant and in the range of 0.75 to 0.82 which is equivalent to significant level of common variance between constructs (Cohen et al., 2013). In

particular, the SSCMI accounts for some 67% of the variance measured by the OPI, 62% by the EPI, and 56% by the CSI.

These correlations illustrate the strong linear association, but bear in mind that they do not imply causation. Deeper organization performance could also be a prime factor in their ability to invest more resources in sustainability initiatives, or sustainability investments can be direct causes of improved performance (Baah, 2019). However, the regression and structural equation modeling analyses attribute the hypothesized causal pathway from practices to performance more credibly. The correlation results are hence used as an initial exploratory step in analysis to provide an empirical basis for the more rigorous multivariate measures analyses that follow.

Structural Equation Modeling

In order to test the hypothesized relationships among the latent constructs of the Sustainable Supply Chain Management (SSCM) practices and organizational performance at the same time, we choose Structural Equation Modeling (SEM) with AMOS software version 29. This method of analysis is especially applicable to our research goals since it provides an estimate of the complex causal pathways while taking measurement error in the observed indicators into the account (Tabachnik & Fidel, 2012). The measurement model was initially validated using Confirmatory Factor Analysis (CFA) to ensure that a set of items represents the latent variable of each construct before the paths to and from the latent variables (which tested their hypotheses) were analyzed (Brown, 2015).

The measure model was adequate as reflected by CFA results. All eight observed indicators for practices of SSCM had a statistically significant ($p < 0.05$) factor loading, surpassed the threshold value of 0.50. In the same way, the four assessed organizational performance indicators namely operational performance, financial performance, customer satisfaction and organization competitiveness were significant loaders on their respective latent construct. I was then faced with the challenge of verifying if composite reliability values meet the minimum criterion of 0.70. Composite reliability values of both SSCM practices (0.91) and organizational performance (0.88) were above the criterion of 0.70, indicating good internal consistency. In addition, the Average Variance Extracted (AVE) for SSCM was 0.62 and 0.65 for the organization's performance, respectively, both of which are greater than the value of 0.5 which indicates convergent validity of the latent constructs (Gefen et al., 2000).

After the validation of the measurement model, the next stage was to assess the structural model that hypothesized a direct link between the latent constructs of the SSCM practices and the organization performance. The fit measures in the overall model (shown in Table 4) suggested a good fit between the hypothesized model and observed data.

Table 4. Structural Equation Model Fit Indices

Fit Index	Obtained Value	Recommended Threshold	Interpretation
Chi-square/df	2.07	< 3.00	Good fit
Comparative Fit Index (CFI)	0.97	> 0.90	Excellent fit
Tucker–Lewis Index (TLI)	0.96	> 0.90	Excellent fit

Fit Index	Obtained Value	Recommended Threshold	Interpretation
Root Mean Square Error of Approximation (RMSEA)	0.044	< 0.08	Good fit

As reported in Table 4, the normalized chi-square (d.f.) statistic (/) was 2.07, which is well below the recommended maximum of 3.00 that would not substantially restrict the data (Bollen & Long, 1993). The Comparative Fit Index (CFI) value was calculated to be 0.97, which is above the commonly used threshold of 0.90, and is close to the more rigorous threshold of 0.95 for an excellent fit (Hu & Bentler, 1999). Likewise, Tucker-Lewis Index (TLI) was used to measure the amount of improvement the proposed model produced over a null model with no relationship between X and Y with a value of 0.96. Most critically, the Root Mean Square Error of Approximation (RMSEA) was 0.044, which is less than the very strict criterion of 0.05 for close fit. The second RMSEA value is complemented by a 90% confidence interval of (0.038, 0.050): this is very close to the range of the RMSEA value (0.0407) that is considered to represent good fit in the context of this research (Byrne, 2013).

Overall, positive and significant structural path coefficients between the SSCM practices and organizational performance were found (, ;), suggesting that a broad integration of sustainable supply chain practices is positively related to a high level of organizational performance. The path coefficient value suggests that an increase in the latent construct of SSCM by 1 SD results in an increase in organizational performance of 0.78 SD. Of course, the explained variance in organizational performance () was also reported, following the earlier regression analysis with an explained variance of the individual predictor model reported as 0.741 and therefore 61% of the variation of the performance model was explained by SSCM practices. The slight difference is expected in SEM because measurement error is accounted for and relationships estimated at the latent (construct) rather than observed variable level (Lomax, 2004).

Favorable model fit indices, coupled with the significant SP, highlight the strength of this theoretically advanced, yet empirically substantiated organizational model suggesting SSCM practices as direct drivers of organizational performance. That conclusions from both SEM and the previous multiple regression analysis lead to the same substantive conclusion, namely that OSCM is a strong and important predictor of organizational success independent of industry (manufacturing and service) and despite methodological differences between the two analyses would increase the confidence in those findings.

Discussion

The practical results of this research have important theoretical implications for the study of sustainable operations management. This positive correlation between SSCM practices and organizational performance (high explanatory power of the regression model () and the path coefficient in SEM (), supports the resource-based view of the firm and shows that sustainability capabilities are valuable, rare and hard to imitate resources (Wernerfelt, 1984). The small differential performance impacts of some individual practices, especially green procurement and sustainable procurement, indicate that upstream activities in the supply chain are more impactful for performance improvements, which has been often lost in past research through composites of these practices (Jr et al., 2012). This finding further clarifies the theory of SSCM as some sustainable practices do not equally support the organization and so impacts

the following limitations to the existing theory, which assumes uniformity in sustainable practice to organizational output (Carter & Rogers, 2008). Such as, upon closer inspection, there exists a virtuous cycle, in the twenty-fifth of those organizations that are at the top of the adoption curve, environmental and financial goals are not only not at odds but are mutually reinforcing—a notion that makes reconcilability of sustainability and profitability approaches that are sometimes called into question in environmental management literature possible (Wang & Sarkis, 2013). In action terms, these findings provide some guidance for business leaders, policy makers and practitioners in the supply chain. The results suggest that investments in supplier selection criteria that include the consideration of environmental and social criteria as well as investments in procurement systems or processes that enable the sourcing of ecological materials best predict performance, which means that investments should focus on sustainability requirements in procurement (Jr et al., 2012). With regard to manufacturing companies, the importance of reverse logistics (.,) is prominent, so building up good product take-back and recycling systems can be beneficial both environmentally and operationally, while service companies, which accounted for 38.8% of the companies surveyed, can more likely benefit by focusing on its supply chain and logistical strategy to create energy efficiency, due to the fact that their added value is not linked to the material flows. (Govindan et al., 2015). Policymakers can use the 74.1% variance due to the regression to bestow credibility on regulations that support firms' sustainable procurement decisions, for example by providing tax-driven or public tendering-inviting incentives for sustainable procurement. In addition, 21.9% of the people at high adopters are even more satisfied with their companies' sustainability efforts, highlighting the market-driven need for sustainability reporting and certification schemes: in particular, customers are conscientious about (visible) environmental stewardship and are willing to reward it with commitment and premium pricing (Iansiti & Levien, 2002).

However, a number of methodologic weaknesses have to be noted in the interpretation of the present study's results. This cross-sectional study does not allow for a clear causal relationship since it cannot be determined if the increased performance of organizations is predictable from the adoption of SSCM, or if the adoption of SSCM is dependent on an organization's performance. The study makes it plausible that the organizations with the highest performance might be more able to invest more in sustainability projects, but because this is a cross-sectional study, It cannot be drawn from the results to conclude that there is a causal relationship. The stratified random sampling was done to obtain representation across sectors and sizes, but this approach may have resulted in selection bias away from units lacking environmental programs, as some firms may be more resistant to responding, which could lead to over-estimated environmental program uptake (Podsakoff et al., 2003) and effect size. Furthermore, due to a multi-respondent design across roles for each organization, but a single respondent per organization for performance data, this study relied on self-reported performance data which may have included common method variance; however, the results of the CFA provided support for divergent validity, suggesting that this threat was minimized (Podsakoff et al., 2003). The one-way ANOVA and group comparison analyses provide useful information but are based on an artificially created median split of the SSCM index which could mask non-linear relationships or threshold effects where the threshold required for performance benefits may relate to a minimum level of practice adoption (Magon et al., 2018). These limitations call for some methodological and substantive extensions in future research. However, there is a need to implement more longitudinal studies of SSCM over several years to ensure that it establishes a temporal causality and financial performance benefits accrue upon an initial transition period and then stabilise or level off over time (e.g., after 19.7% financial benefit is realised within a single year as in this study; see Baah, 2019). Insufficient research considered the moderating effect of organizational size (with 46.5% of the sample being large companies) and industrial sector

(61.2% manufacturing) as factors that could affect the chances for successful adoption of broader sustainability program engagement, especially among smaller companies, and service-oriented companies (Jr et al., 2012). The non-significance of eco-friendly transportation, waste management, and carbon reduction in the regression model, although conceptually important, also indicates that it is worth studying if there are interaction effects or any non-linear relationships between these three camps of eco-friendliness in the future (Hong et al., 2022). In addition, there are some aspects of sustainability practices which may indirectly impact performance as described by third-party sustainability certificates that are not yet well researched, and social sustainability practices (e.g., fair labour or engagement with community) that were not studied in our framework focusing on environmental and economic sustainability (Yawar, Seuring, 2017). Last, comparative cross cultural studies would be advantageous to see if the positive relationships found in the largely western, context-based sample can be equated to emerging economies or cultures that have different regulations and cultural norms related to environmental stewardship (Sanchez-Flores et al., 2020).

Conclusion

This study aimed to gauge the link between SSCM practices with organization performance in manufacturing and service organizations and also to identify which sustainable practices is the more having greatest impact on multi-dimensional performance improvements. The results consistently show that fully integrating SSCM including green procurement, sustainable sourcing, supplier integration and reverse logistics are positively associated with an increase in operational efficiency, financial performance, customer satisfaction and environmental performance. The structural equation model showed good fit indices (CFI = 0.97, RMSEA = 0.044), which confirmed that SSCM practices as a latent construct have a strong link with organizational performance ; thus, the theory that holds sustainability capabilities as a strategic resource that can bring about a sustained competitive advantage was validated. This study advances the literature by breaking down the relative effect of each of the practices rather than defining SSCM as a single entity; by identifying the most effective levers for optimizing performance – namely green procurement and sustainable sourcing – and by offering a comparison of manufacturing and service. We thus advance the resource based view of the firm and show that an upstream sustainability initiative is a valuable, rare and hard-to-imitate organizational capability that provides economic and ecological benefits at the same time.

For the future, the cross-sectional nature of our study calls for future studies employing a longitudinal design to determine temporal causality and to explore the evolving nature of the performance benefits of adopting SSCM over longer time horizons of implementation. It would also be interesting for future research to systematically investigate potential differences in the scales of these practices in small and medium-sized manufacturers, and in service-intensive firms, as our sample was skewed towards manufacturing firms. Although the two variables, eco-friendly transportation and eco-friendly waste management were theoretically relevant to our correlation model, they are not significant in the model, so future research would be beneficial to examining possible threshold values or synergistic effects between practices and including other methods, such as a configurational analysis, based on qualitative comparative analysis. Therefore we hope for this research to set a solid empirical basis for further research, which should eventually improve concepts and develop user-oriented solutions for sustainable supply chains that can generate additional value for organisations, society and the natural environment.

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