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Empirical Research on the Effects of Green Supply Chain Management (GSCM) Strategies on Industry Performance

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Purpose – The objective of this article is to conduct an empirical investigation into the manner in which green supply chain management (GSCM) methods affect Indian industry performance. This empirical study evaluates the degree to which Indian organizations have embraced green practices in order to determine their competitiveness in the context of the expanding demand to put eco-friendly policies into place and improve performance. Organizations can use the results to pinpoint areas that need improvement and direct their efforts in those directions.
Design/methodology/approach – For data collection combine online and offline methods was used. The validity of the study was significantly influenced by the caliber of respondents and response rate. Since they were thought to be familiar with GSCM practices, corporate executives and managers from a range of departments, including operations, manufacturing, purchasing, sales and distribution, production, and materials, were among the target respondents. The automotive, machine tool, pharmaceutical, electronics, and plastics industries were the main subjects of the survey. Structural equation modeling was used analyse data collected from 156 industries across India.
Findings –This article offers a research approach that finds connections between GSCM practices and an organization's operational, financial, and environmental performance that are both good and substantial.
Research constraints and implications – This research article's findings are limited to specific industrial sectors, like electronics and electrical, machine tools, medicines, and auto industry. Hence, there may be limited applicability of the outcome of this research paper to other industries.
Practical implications – The results of the empirical research indicate that companies of all sizes, whether they are located in developed or developing nations, must adopt GSCM practices. Therefore, organisations should invest more in the implementation of a range of GSCM practices in order to achieve greater organisational performance.
Originality/value –Conclusions of this research paper are valuable because they shed light on the

significance of GSCM practices and how they affect organisational performance for decision-makers in businesses. Additionally, a multidimensional construct of GSCM practices has been constructed and validated by this study, which can help decision-makers assess how effective their existing GSCM practices are inside their organisations.

Keywords: Green supply chain management, Green Supply Chain Practices, Financial performance, Operational performance, Organizational performance.

1. Introduction

Green supply chain management (GSCM) is the process of supply chain management that reduces adverse environmental effects and promotes sustainability. It focus on number of tactics, including, using recyclable or renewable resources, and consuming less energy and water. To ensure that the entire supply chain operates in an environmentally responsible manner, GSCM also includes assessing the environmental practices of customers and suppliers. Businesses that implemented GSCM observe increases in staff happiness, better customer interactions, and financial rewards. Organisations are beginning to adopt green supply chain practices (GSCPs) more frequently as they realise how important it is to lessen the environmental damage that supply chain operations generate, as well as the accompanying economic and competitive advantages. These days, environmental management is thought to be an important strategic concern that can significantly affect organisational success. By lowering environmental hazards and giving priority to the use of resources with low depletion potential, SSCM promotes sustainable development. In the quickly changing global manufacturing scene, company management is beginning to prioritize social and environmental concerns. SSCM is a strategy to improve product and process performance in compliance with environmental laws.

With industrial waste making up over 50% of all pollution in the nation, India has serious issues in the area of industrial pollution. 24 businesses have been deemed environmentally harmful by the government, while 17 industries have been classed as severely polluting. The chemical and engineering sectors are principally responsible for the pollution caused by industry. Furthermore, India is the third-largest emitter of sustainablehouse gases (GHGs) in the world, while having the fourth-largest GDP. According to the Environmental Performance Index (EPI), which evaluates the success of national environmental protection initiatives, India came in last place in 2022, scoring only 180 out of 180 nations. This low score suggests that India has to embrace and raise awareness of SSCM practices more. Acknowledging the significance of environmentally sustainable industrial practices and their associated advantages, the Indian government is implementing measures to enforce regulations that mitigate environmental degradation. These actions could include creating a central fund to support research in sustainable manufacturing, requiring a certain percentage of electricity to come from renewable sources, enforcing regulations encouraging businesses to disclose their environmental sustainability performance, and offering low-interest loans to organisations to invest in clean/sustainable technologies or sustainable product manufacturing facilities. It takes a team effort to implement SSCM in the micro, small, and medium enterprise (MSME) sector. Manufacturers and the government must work together to overcome obstacles that prevent SSCM practices from being widely adopted in the Indian industrial sector.

Objective of this research paper is to create a theoretical framework for GSCP implementation and use structural equation modelling (SEM) to test the framework empirically in order to determine the links between GSCPs and organisational performance in Indian organisations.

2. Literature Review:

Nowadays, companies are using sustainable supply chain management (SSCM) as a proactive strategy to improve their environmental performance and gain a competitive edge. By lowering environmental risk and impact, sustainable sustainable corporate management, or SSCM, is a new, creative way for businesses to build a sustainable strategy that will benefit the environment and the bottom line at the same time. To seal the loop, SSCM integrates sustainable production, distribution, marketing, materials management, purchasing, and reverse logistics. In a study by Pathak and Verma [1], the three best key parameters for the sustainable development of the automotive industry with particular reference to Indian firms were found to be supplier willingness, adoption of technological advancement, and top management commitment.

Evolution of SSCM:

From sustainable purchasing, extensive research on the sustainable supply chain began in 1990. Numerous researchers examined how items affected the environment and developed the theory of "sustainable purchasing," which advocates for the selection of appropriate materials based on recycling considerations and environmental regulations. The term "sustainable supply chain" was initially used in a 1996 research by Michigan State University's Manufacture Research Consortium (MRC) titled "Environmentally Responsible Manufacturing." Beamon[2] provided a new supply network design and included a few environmental components to a supply chain model. Together with twelve other firms, General Motors Corporation established a sustainable supply chain working group in 1999. Their goal was to identify ways to enhance supply chain management's financial and environmental performance (Christmann,[3]). Numerous nations have made investments in sustainable supply chain management research. In this field, Europe outperforms both the US and Asia in terms of research and practice.

Table2.1: SSCM-related research from 2013 to 2022

Author(s)	Research objective	Research Outcome
Dues et al. [3]	To assess earlier research on the connections and relationship between SSCM and lean methodologies.	Sustainable practices are advantageous when implemented with lean, while lean business practices themselves benefit from the adoption of sustainable practices.
Kumar et al. [4]	To determine and examine the SSCM enablers in the Indian automobile sector.	According to the paradigm, relative advantage is a top level enabler, whereas government support and regulations are lower level enablers.
Mohanty and Prakash[5]	An empirical investigation on the practices of sustainable supply chain management (SSCM) in Micro, small,	External stakeholders put a lot of pressure on Indian MSMEs to use SSCM practices. MSMEs in India

	and medium-sized enterprises (MSMEs) in India	are compelled to embrace SSCM practices due to internal pressures.
Diab et al.[6]	To evaluate how Jordanian food industries' organisational performance is affected by sustainable supply chain management practices.	Development of a hypothesis and a model based on the components of ecologically friendly supply chain management strategies.
Luthra et al. [7]	Investigates the significance of Critical Success Factors (CSFs) for SSCM implementation in the Indian auto industry	The primary factor in supporting the SSCP is regulatory CSF. CSFs for internal management and competitiveness are essential to achieving the desired performance results
Mangla et al. [8]	To evaluate the critical success factors (CSFs) related to the use of RL in India's industrial industries	The importance of regulatory factors (RF) and global competitiveness factors (GCF) for putting RL practices into practice is ranked.
Dube &Gawande [9]	To list the 10 barriers that are most likely to occur when SSCM is implemented, explain how these barriers relate to one another, and determine which of the 10 barriers is most important.	Robust Organizations can identify and eliminate the most significant hurdles with the use of knowledge and comprehension of these obstacles.
Ghandhi et.al [10]	Evaluation of sustainable supply chain management techniques and identify the next frontier in this emerging field.	The review is created to identify the main study subjects, interrelationships, and alliance patterns based on the literature.
Sophie Meager et.al.[11]	To investigate the elements that support and obstruct the implementation of sustainable supply chain management	Major obstacles are owners' financial obligation and logistics.
Santosh Rane et.al.[12]	To investigate how stakeholders are involved in making the supply chain more environmentally friendly.	The findings indicate that buyer collaboration on sustainable projects is critical to a sustainable supply chain, with worldwide consumers having the least impact.
Pathak & Verma[1]	To ascertain the critical performance elements for methods of sustainable supply chain management (SSCM)	The top three critical variables that have emerged are supplier attitude towards SSCM, adoption of technological innovation, and top management commitment.

Overview of Sustainable Supply Chain Practices (GSCPs):

The eight GSCPs are chosen based on the content analysis (Zhu and Sarkis [11], Hervani et al. [13], Zhu and Sarkis [14], Zhu et al. [15], Holt and Ghobadian [16], Ninlawan et al. [17], Diabat et al. [18], Laosirihongthong et al. [19], Aital and Vijay [20], Govindan et al. [21]), global issues covered in literature, and after consulting with industry experts. Furthermore, the order of the GSCPs does not denote priority or a rating of greater or lesser relevance; still, these practises create a SC organisation that is among the finest in the field. A solid foundation for GSC excellence will be created by putting these practises into practise. Klassen and Johnson [22], Zhu and Sarkis [11], Rao and Diane Holt [23], Chien and Shih [24], Zhu et al. [15], Darnall et al. [25], Eltayeb and Zailani [26], Rha [27], Zhu et al. [28], Ninlawan et al.

[17], Kirchoff [29], Wu et al. [30], Amit&pratik [31], Zhu et al. [32], Lee et al. [33], Luthra et al. [34]. Beamon [2] and Diab et al. [6] are two studies that have looked at the performance of sustainable supply chains. Zhu and Sarkis [35], Rha [27], Zhu et al. [28], Ninlawan et al. [17], Sustainable et al. [36], Zhu et al. [32], and Laosirihongthong et al. [19] are among the studies that have examined both GSCP and sustainable supply chain performance. With the aid of the available literature, as indicated in the table below, the selection of eight GSCP—External pressure (EPR), Top management commitment (TMC), Sustainable Design (GD), Sustainable purchasing / procurement (GP), Sustainable manufacturing (GM), Environmental training (ET), Customer cooperation (CC), and Reverse Logistics (RL)—was carried out.

Table 2.2: GSCP related research

Author	Sustainable Supply Chain Practices
Klassen and Johnson [37]	Certification for the environment preventing pollution Reverse Logistics Life cycle evaluation Creation of environmental design
Zhu et al.[15]	Internal environmental management Sustainable purchasing Customer cooperation Investment recovery Green design
Ninlawan et al.[17]	Sustainable procurement Sustainable manufacturing Sustainable distribution Sustainable logistics
Pandya and Mavani[31]	Internal management Sustainable supply Cooperation with customers Sustainable design of products Reverse logistics
Luthra et al. [38]	Sustainable product development Sustainable design Sustainable purchasing and sustainable raw material procurement Sustainable process planning Sustainable manufacturing Sustainable transportation and distribution

GSCPs AND ORGANIZATIONAL PERFORMANCE:

The academic literature has examined the outcomes and advantages of implementing SSCM practices. Previous study has revealed a link between SSCM practices and organisational performance, including environmental, economic, and operational performance. The idea that SSCM practices can "improve" environmental performance has been the subject of numerous studies. The process of tracking and enhancing the supply chain's environmental performance is known as SSCM. Collaborative relationships with suppliers can facilitate the adoption and expansion of environmental initiative practices, according to Geffen and Rothenberg's recommendation [39]. Additionally, joint research and development, partnership initiatives, and supplier-customer collaboration lead to improved environmental performance. Businesses that use these kinds of cutting-edge environmental practices usually do so primarily for financial reasons. It is yet unclear if SSCM practices have a beneficial or negative impact on financial success. There aren't many researcher's that demonstrate the beneficial relationship between operational performance and environmental practices. Environmental management practices are creative, strategic programmes and instruments used by business to improve operational performance.

Table 2.3: Research carried out on measurement of GSC performance

Author	Components of sustainable supply chain performance
Beamon [2]	Resource use Product recovery (remanufacturing, reuse, recycling) Waste emission and exposure hazard Economic Environmental
Zhu and Sarkis[35]	Components of organizational performance Environmental performance Economic performance
Rha [40]	Supply chain output Supply chain resources Supply chain flexibility
Zhu et al. [41]	Environmental performance Financial performance Operational performance
Ninlawan et al. [17]	Environmental performance Financial performance
Sustainable et al. [42]	Environmental performance Economic performance Operational performance
Zhu et al. [43]	Environmental performance Financial outcomes Functional effectiveness

The industrialised economies, particularly those in the USA, Canada, and Australia, provide empirical evidence on SSCM (Wu et al., 30). Emerging economies such as China and India have produced relatively little empirical evidence on SSCM (Liu et al. [44]). The majority of researchers who have studied and described SSCM practices have tried to investigate the effect of SSCM practices on environmental performance either verbally or empirically.

According to Luthra et al. [45], the Indian automobile sector now requires a literature review for reasons related to economics, the environment, or legislation. In their initial questionnaire-based study, Mudgal et al. [46] ranked the obstacles to SSCM implementation. Mathiyazhagan et al. [47] identified important hurdles among the 26 proposed barriers and ascertained the relationship between obstacles by the application of Interpretive Structural Modelling (ISM). Barriers were recognised and broadly categorised as financial, knowledge, and technological by Dube et al. [9].The implementation of SSCM in the Indian mining industry was examined by Muduli et al. [48] using a graph theoretic and matrix approach. These researchers examined the obstacles to the implementation of SSCM. The challenges associated with implementing sustainable supply chains management in the Indian setting have been well studied by academics. (Govindan et al. [49], Jayant and Azhar [50], Muduli et al. [48], Mathiyazhagan et al. [47]). However, the performance evaluation of GSCP from an Indian viewpoint has been the subject of very little research. This small study assessed the performance of the sustainable supply chain using data from a single industry.

The purpose of this study article is to assess organisational performance by examining the impact of GSCP on an organization's performance in the Indian context.

3. Data Collection:

The purpose of the survey and the SSCM concepts were briefly introduced to the targeted respondents through appropriate documents prior to the start of this work in order to ensure that they fully understood the items in the survey questionnaire, the overall goals and objectives of this research, and how the data would be used. Both an online and an offline mode were used to collect the data. The quality of an empirical study is influenced by two key factors: the caliber of respondents and the response rate. The target respondents were corporate executives and managers in the operations, manufacturing, purchasing, sales and distribution, production, and materials departments since SSCM was the area of focus. These employees were thought to possess the most expertise in the GSC field. The target industries are the automotive, plastics, electronics, pharmaceutical, and machine tool industries. The survey, which lasted six months from November 2022 to April 2023, was limited to India alone. The lists of Indian industries were gathered from several sources, including Bloomberg Market, CII, Indian Brand Equity Foundation, ET 500 list, Wikipedia (under the list of firms of India), and many more. Two methods were used to perform the survey. The industry that is within reach prefers the offline mode. The 210 printed questionnaires were distributed to different companies together with a cover letter summarizing the purpose and importance of the study. 53 people, out of 210, have finished the questionnaire and returned it. This translates to a response rate of 25.23%, or 53 out of 210. The web-based approach was also used to administer the survey. Target respondents received an email with the web-based questionnaire and a cover note outlining the goal and importance of the study, along with a web link (http://goo.gl/forms/CgkmUZ9npc). Regarding respondent anonymity and data confidentiality, the respondents received assurances. In order to boost the response rate, the respondents are also asked to forward the questionnaire link to other industries. Approximately 375 letters were issued to businesses spread across the nation. Twenty-three responses indicated that they were unable to reply because of data confidentiality. A total of 103 replies from the industries were obtained through the thorough follow-up. Since the responses were gathered in waves, the response rate for the online responses is not calculated. A total of 156 answers are gathered through both offline and online methods of data collecting.

4. Instrument Validation &Structural Equation Modeling (SEM)

Instrument assessment is a crucial first step in testing the research model. Confirmatory factor analysis (CFA) and structural equation modelling (SEM) were used to validate each of the constructs. Data was collected from 156 Indian groups. Eight GSCPs were found overall, and a methodology was developed to evaluate the effect of these practises on organisational performance.

Known as the Joreskog-Keesling-Wiley Model, or JKW Model, at the time, Keesling and Wiley[51] introduced the broad framework that integrates factor analysis and path analysis (Kline, 2011). One may argue that a major portion of the SEM's foundation was laid at this conference. Software known as "LISREL" was created by Joreskog and Thillo [52] in order to analyse the SEM. Numerous academic fields, including psychology, education, social sciences, behavioural sciences, business, and management have benefited greatly from these advancements (Bagozzi and Yi, 2003; Anderson and Gerbing, 2004). SEM is a multivariate approach that examines a variable's covariance structure. The two main models that comprise the structural model are the measurement model and the latent variable model. Although Covariance-Based SEM (CBSEM) is the most well-known application of SEM, Herman Wold's partial least squares method (PLS) can also be used to fit SEM data.When the sample size or normalcy assumptions of SEM are not met, PLS is typically used as an alternative to SEM (Vinzi et al., [55]).There are various ways in which the SEM method differs from other multivariate techniques (Bagozzi and Yi [53]). It first makes it possible to estimate several different but related causal linkages at the same time. Secondly, the model might have random errors or measurement inaccuracies, or it might not allow for estimation. Lastly, multicollinearity can be handled with effectiveness. However, it is highly recommended to conduct SEM using a theory-driven approach. SEM is a fairly broad statistical modelling method that is mostly cross-sectional and linear. Regression, factor analysis, and path analysis are examples of SEM special instances. SEM is primarily a confirmatory method as opposed to an exploratory one. That is, while though SEM analyses frequently include an exploratory component, researchers are more likely to employ SEM to ascertain the validity of a particular model than to identify a suitable model. Since a structural equation model implies a structure of the covariance matrix of the measures, "analysis of covariance structures" is another title for this topic. After the model's parameters are estimated, the resulting model-implied covariance matrix can be compared to an empirical or data-based covariance matrix. If there is consistency between the two matrices, then the structural equation model can be considered as a plausible explanation for the relationships between the measurements.

Table 4.1: Model Fit Indices Used in SEM

Fit index	Description	Acceptable Fit
Chi-square	Chi-square statistics are only significant when the degree of freedom is taken into consideration. Recognized as a gauge of perfect fit and simplicity as well. Values near 1 signify a good fit, whereas values greater than 1 suggest an over fit.	Non significant at least p-value > 0.05
Ratio of chi-square to degree of freedom	Testing the null hypothesis that there is a deviation from the sample in the estimated variance-covariance matrix. Mostly determined by the sample size. The likelihood that the p-value will indicate a significant difference between the model and the data increases with sample size.	Value > 3[a] or >3-5[c]
Root Mean Residual Standardised (SRMR)	Displaying a standardized summary of the average residuals of covariance. The discrepancies between observed and model-implied covariance are known as covariance residuals.	Value < 0.05[a],0.05−0.10[b]
Root Mean Square	Calculates the difference between the degrees of freedom that the population is predicted to experience.	Value < :0.05[a],
Error of Approximation		0.05−0.08[b]
(RMSEA)		0.08-0.1[c]
Goodness-of-fit index(GFI)	Metric expressing the degree to which a given model replicates the covariance matrix between the indicator variables.	Value > 0.95[a],0.90−0.95[b]

Incremental Fit Indices		
Normed Fit Index(NFI)	Show a comparative index, not degree-of-freedom adjusted, between the more retracted, nested baseline model (null hypothesis) and the proposed one.	Value > 0.95[a],0.90−0.95[b]
Tucker-Lewis Index(TLI)	Comparative index between the null and suggested models that has been degree-of-freedom corrected. Can prevent significant overestimation and underestimation and is resistant to sample size variations. As the preferred index, it comes highly recommended.	Value > 0.95[a],0.90−0.95[b]
Comparative Fit Index (CFI) identical to Relative Non-centrality Index (RNI)	Comparative index between the null and suggested models that has been degree-of-freedom corrected. Similar to NFI interpretation, but possibly less impact	Value > 0.95[a],0.90−0.95[b]
Bollen's Incremental Fit Index (IFI)	Comparative index between the null and suggested models that has been degree of freedom corrected.	Value > 0.95[a],0.90−0.95[b]
Parsimony Fit Indices		
Akaike Information Criterion (AIC)	Index of comparison between different models	A value nearer zero indicates a better match and more parsimony.
Parsimony Normed Fit Index (PNFI) Parsimony Comparative Fit Index(PCFI)	Both the model under evaluation and the baseline model are taken into consideration by PNFI and PCFI.	A higher value denotes a better fit when compared to a different model.
Note: [a] is a good fit level, [b] is an adequate fit level and [c] Mediocre fit level Source: Adapted from (Kline, 2011; Byrne, 2010; Hair Jr. et al., 2010; Bentler, 2007; Hu and Bentler,1999; Anderson and Gerbing, 1988; Hu and Bentler, 1998; Maruyama, 1998; Hu and Bentler, 1995)		
Adjusted Goodness- of-fit Index (AGFI)	Fit quality that has been modified for the degree of freedom. Less frequently used since it doesn't work well in various situations. Value is not limited to 0–1.	Value > 0.95[a], 0.90−0.95[b]

SEM Sample Size

Sample size is one of the most significant SEM challenges, and there is no easy answer because it depends on many variables, such as theoretical background and model complexity. Sample sizes for structural equation modelling analysis often fall between 150 and 400, depending on the complexity of the model and the number of parameters that need to be estimated (Hair et al., 54). Taking into consideration the complexity of the model, a ratio of 10–20:1 of data to an estimated parameter is also advised (Kline, 2011), with a minimum of 5:1 (Hair Jr. et al.[56]). Three distinct sample size degrees are recognised in SEM, according to Kline [57]: small (sample < 100), medium (100 < sample < 200), and big (sample > 200). A large sample size (> 200) is typically recommended for a complex model (MacCallum et al.[58]). A critical sample size of at least 200 has been proposed and is frequently used for SEM analysis.

Responses are gathered for this study from 156 Indian organisations. We believed that the answers are suitable for a developing nation such as India, where there is a dearth of knowledge about survey research. Second, as table 4.2 illustrates, the sample sizes taken into consideration in this investigation still surpass or are equal to those employed by certain previous works on the analysis of GSCPs using SEM. Lastly, as suggested by Hair et al. [56], the sample size in our study falls between 150 and 300 for data analysis utilising SEM.

Table 4.2: Sample size and variables

Researcher	Country	Sample Size	Variables
Sadia Ali et al.[18]	India	54	22
Lee et al. [59]	Korea	223	39
Tan et al. [60]	Malaysia	144	28
Sustainable et al. [61]	USA	159	39
Masoumik et al. [62]	Malaysia	139	59
Lee[63]	South Korea	207	28
Cook et al. [64]	---	161	27
Jabbour et al. [65]	---	107	29
Ou et al. [66]	---	95	43

Convergent Validity

Its definition is the extent to which the measurement elements converge into a theoretical idea. The traditional method for evaluating the construct validity of measuring scales is CFA. AMOS allows for the specification, testing, and modification of the measurement model. Measures of multiplier fit were employed to evaluate the model-data fit. The overall model fit indices include chi square statistics, the root mean square error of approximation (RMSEA), the comparative fit indices (CFI), and the goodness of fit index (GFI). The GFI displays the proportionate amount of covariance and variance that the model jointly explains. A score of 0.9 or higher denotes an excellent fit, whereas a number between 0.8 and 0.89 is considered to denote an acceptable fit, according to Joreskog & Sorbom (1989). Because the RMSEA is expressed per degree of freedom and takes approximation error into account, it is sensitive to the number of estimated parameters in the model. According to MacCallum et al. ([58]), a good fit is indicated by a value of less than 0.05, a moderate fit is indicated by a value between 0.08 and 0.10, and a poor fit is indicated by a value larger than 0.10. A number as high as 0.08 suggests reasonable approximation errors in the population.

If the fit indices are not acceptable, the model can be improved by doing the following.

- Path Estimates
- Modification Indices

Standardized Residuals

Average Variance Extracted (VE): The 'VE' of the build item set is a summary convergence indicator. The following formula can be used to determine this value.

Comparing the estimated loadings is one of the simplest ways to spot possible issues with measurement theories. The path estimate should preferably be 0.7 or higher, but it should ideally be at least 0.5. Modification indices are the second metric for model rectification (MI). For each potential relationship that cannot be freely evaluated, a MI is computed. It illustrates the amount that releasing just one path would lower the measurement model's chi-square value. A high MI indicates error covariance, which indicates that two items may be redundant since they may share variation that can be explained (commonality). Eliminating an item with a high error variance is the corrective measure for error covariances. A MI of roughly 4 or higher indicates that releasing the appropriate path could greatly enhance the fit. Standardised residuals are the third metric for enhancing model fit. It speaks of the discrete variations between the fitted and observed covariance terms. Standardised residuals of less than 2.5

usually don't point to an issue. On the other hand, residuals larger than 4.0 indicate an error level that might be intolerable. removing one of the elements linked to a residual of more than 4.0, most likely.

The following metrics are used to test the concept's convergent validity (the form formed by the items that stay with the construct after CFA).

Path Estimates: High estimates on an item would suggest that they converge on a single point in the event of high convergent validity. Every element should, at the very least, be statistically significant. Generally speaking, all of the estimations ought to be more than 0.5, ideally 0.7 or higher.

Average Variance Extracted (VE): The 'VE' of the build item set is a summary convergence indicator. This formula can be used to calculate value of Variance Extracted (VE)

$$VE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

The standardised path estimates are represented by "λ" in the formula above, while the number of items is denoted by "i". Therefore, "VE" is calculated for n items by dividing the total squared standardised factor loadings by the number of items. As a general rule, convergent validity is considered satisfactory when VE is 0.5 or above. A "VE" of less than 0.5 means that, on average, the variance explained by the latent factor structure imposed on the measure is less than the amount of error still present in the items. It is necessary to calculate the "VE" estimate for every latent construct in a measurement model.

Reliability- A sign of convergent validity is reliability. Although it may underestimate reliability, the coefficient of alpha is typically employed in survey research to assess dependability. SEM is frequently employed with the slightly different construct dependability (CRL) value. The following formula is used to calculate the "CRL" from the sum of factor loadings (λi), squared for each construct, and the total of the error variance terms for a construct (δi).

$$CRL = \frac{(\sum_{i=1}^{n} \lambda_i)^2}{(\sum_{i=1}^{n} \lambda_i)^2 + (\sum_{i=1}^{n} \delta_i)}$$

A construct reliability estimate of 0.7 or greater is generally seen as indicative of good reliability. It is possible to accept a reliability between 0.6 and 0.7 if there are other strong evidence of the model's construct reliability. A high construct reliability value suggests the presence of internal consistency. This indicates that something is consistently represented by each of the metrics.

Discriminant Validity

Discriminant validity is the degree to which a construct truly differs from another. A distinct and capable of capturing certain occurrences that other measures are unable to is a construct with strong discriminant validity. A more efficient method of evaluating discriminant validity is to compare the square of the correlation estimates between any two constructs with the average variance-extracted (VE) for those constructs. The estimate of squared correlation ought to be smaller than the "VE." Passing this test provides compelling evidence of discriminant validity.

Validation of Second-Order Constructs

Rather than being dictated by the data, the second-order constructions ought to be put out in light of theoretical reasoning or empirical evidence. The assessment standards for the higher-order construct put out by Hair Jr. et al. (2010) are listed in Table 5.3.

According to the evaluation criteria for the higher-order construct, which is the second-order construct, there are two needs in this case: theoretical and empirical (Hair Jr. et al. 2010). In this work, the six first-order constructs "GD," "GP," "GM," "CC," "ET," and "RL" combined to generate the second-order construct, GSCP.

5. Confirmatory Factor Analysis Results

This section displays the results of confirmatory factor analysis for the following constructs: Financial Performance (FP), External Pressure (EPR), Environmental Design (GD), Sustainable Purchasing (GP), Sustainable Manufacturing (GM), Customer Cooperation (CC), Environmental Training (ET), Environmental Performance (EP), Operational Performance (OP), Financial Performance (FP), and Second Order Construct like GSCP. These constructs were evaluated using the instrument evaluation methodology described in the previous section. The tables that resulted are 1) Convergent validity, 2) Discriminant validity, 3) Reliability, and 4) The final collection of measurement questions for the construct.

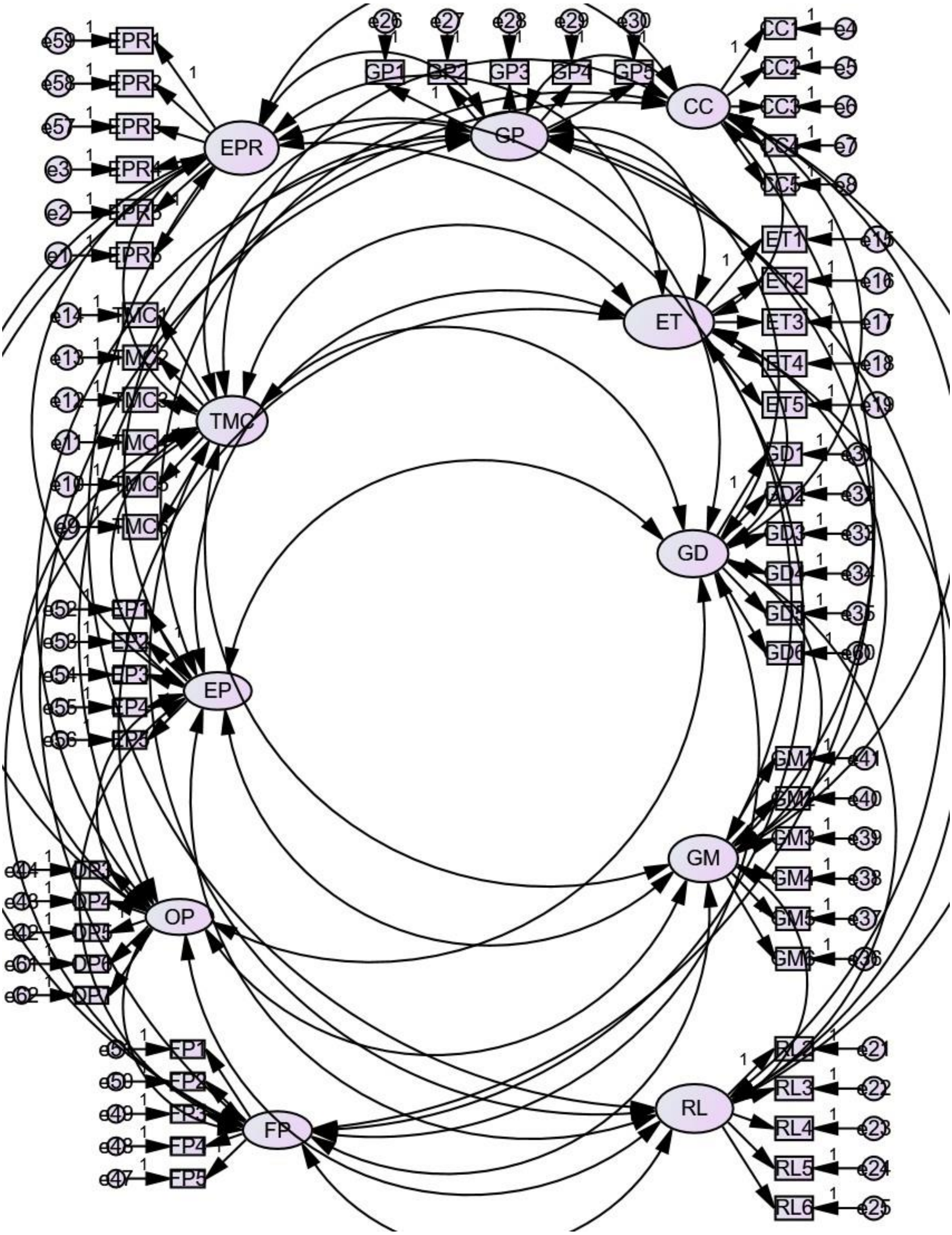

Figure5.1 Covariance Structure Variables

Sustainable Supply Chain Practices (GSCP)

Total 33 elements , comprising six dimensions and three categories—sustainable design (GD) (6 items), sustainable purchasing (GP) (5 items), and sustainable manufacturing (GM) (6 items)—represented the "GSCP" framework. Customer Cooperation (CC) (5 items), Environmental Training (ET) (5 items) and Reverse Logistics (RL) (6 items).

Sustainable Design (GD)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the six "GD" items. Every path estimate has a value that is greater than 0.5. The values of variance extracted (VE=0.51) and construct reliability (CRL=0.86) are found well above the acceptable limit. Considering all the measures, the 'GD' construct shows sufficient convergent validity.

Sustainable Purchasing (GP)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the five "GP" items. Every path estimate has a value that is greater than 0.5. The values of variance extracted (VE=0.61) and construct reliability (CRL=0.89) are found well above the acceptable limit. Considering all the measures, the 'GP' construct shows sufficient convergent validity.

Sustainable Manufacturing (GM)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the six "GM" items. The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.58) and construct reliability (CRL=0.89) are found well above the acceptable limit. Considering all the measures, the 'GM' construct shows sufficient convergent validity.

Customer Cooperation (CC)

In this construct, the 5'CC' items was submitted for checking of measurement model to check model fit indices for each sub-construct. The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.65) and construct reliability (CRL=0.90) are found well above the acceptable limit. Considering all the measures, the 'CC' construct shows sufficient convergent validity.

Environmental Training (ET)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the five "ET" items. The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.65) and construct reliability (CRL=0.90) are found well above the acceptable limit. Considering all the measures, the 'ET' construct shows sufficient convergent validity.

Reverse Logistics (RL)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the six "RL" items. Since the original model fit indices for "RL" were not discovered to be closer to the acceptable range of the fit, additional model modification was done using standardised residuals, modification indices (MI), and standardise path estimates for every item. Based on model rectification measures, 'RL1', was dropped. The concepts of 'RL1'– know the life cycle of all our products is already captured in part by Sustainable Design. The sustainable design concept cannot applicable without knowing product life cycle, and was therefore dropped in the next phase.

Every path estimate has a value that is greater than 0.5. The construct reliability (CRL=0.83) and variance extracted (VE=0.5) values are discovered to be much higher than the allowable limit. When all the metrics are taken into account, the "RL" concept demonstrates enough convergent validity.

External Pressure (EPR)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the six "EPR" items. Every path estimate has a value that is greater than 0.5. The construct reliability (CRL=0.85) and variance extracted (VE=0.5) values are discovered to be much higher than the allowable limit. When all the metrics are taken into account, the "EPR" concept demonstrates adequate convergent validity.

Top Management Commitment (TMC)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the six "TMC" items. The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.66) and construct reliability (CRL=0.92) are found well above the acceptable limit. Considering all the measures, the 'TMC' construct shows sufficient convergent validity.

Sustainable Supply Chain Performance

Environmental Performance (EP)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the five "EP" items. The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.55) and construct reliability (CRL=0.86) are found well above the acceptable limit. Considering all the measures, the 'EP' construct shows sufficient convergent validity.

Operational Performance (OP)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis of the seven "OP" items was conducted. Since the original model fit indices for "OP" were not discovered to be closer to the acceptable range of the fit, additional model modification was done using the standardised residuals, modification indices (MI), and standardise route estimate for each item. The model rectification steps led to the removal of "OP1 and OP2". The notions of "OP1"—a greater quantity of items supplied on schedule—and "OP2"—a reduction in inventory levels—were omitted from the following phase as financial performance already partially captures them.

The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.53) and construct reliability (CRL=0.85) are found well above the acceptable limit. Considering all the measures, the 'OP' construct shows sufficient convergent validity.

Financial Performance (FP)

To verify model fit indices for each sub-construct in this construct, a measurement model analysis was performed on the five "FP" items. The values of all path estimates are found above 0.5. The values of variance extracted (VE=0.63) and construct reliability (CRL=0.89) are found well above the acceptable limit. Considering all the measures, the 'FP' construct shows sufficient convergent validity.

Table: 5.1 Model Fit Indices

Item Code	Item Description	Path Estimates	VE	CRL
GD1	We are giving suppliers design specifications that contain environmental specifications for the product they have acquired.	0.59		
GD2	We create goods with lower material and energy use in mind	0.73		
GD3	Our designs aim to maximise material recovery, recycling, reuse, and component part recovery.	0.58		
GD4	We create products that minimise or eliminate the usage of dangerous materials and/or their production processes.	0.74		
GD5	We improve the total environmental effect of our products through design or redesign.	0.80	0.51	0.86
GD6	In order to extend the items' lifespan, we create or remodel them.	0.80		
GP1	We select suppliers which are having environment friendly operations	0.72		
GP2	We collaborate with our suppliers to meet environmental objectives	0.82		
GP3	We conduct environmental audits for our suppliers	0.78		
GP4	We buy products with features that are good for the environment (recyclable, nontoxic, etc.).	0.72	0.61	0.89
GP5	We cooperate with our suppliers to have environment friendly product/raw material	0.86		
GM1	We use lean/flexible manufacturing to reduce waste	0.60		
GM2	We use cleaner technology	0.73		
GM3	We use environment friendly materials/ components/ products/ process	0.79	0.58	0.89
GM4	We adopt manufacturing process/method, which reduces energy consumption	0.84		0.89
GM5	We focus on using alternative sources of energy	0.78	0.58	
GM6	We are using eco- friendly materials for packaging	0.79		
CC1	Our manufacturing process is flexible to anticipate the customer requirement related to environmental issues	0.70		
CC2	We cooperate with our customer for reducing energy required for logistic	0.75		
CC3	We collaborate with our client to foresee and/or address environmental issues.	0.86	0.65	0.90
CC4	We work with our client to lessen the product's negative environmental effects.	0.86		
CC5	Our customers and we work together to minimise the need for product packaging.	0.85		
ET1	We use written materials to inform our vendors about environmental standards.	0.77	0.65	0.90
ET2	Our clients have visited and conducted educational sessions			

	with us to share their knowledge about environmental improvements.	0.85		
ET3	We host seminars and workshops to inform our suppliers on laws and regulations pertaining to the environment.	0.85		
ET4	We provide environmental training to our employee	0.78		
ET5	We conduct competition among our employee on environmental standards	0.78		
RL2	We use back loads on transport to return material to us	0.63	0.50	0.83
RL3	Our original packing or pallets return to us from our customers	0.59		
RL4	For overhaul and remanufacturing, we retrieve items and/or components from the customer.	0.72		
RL5	We instruct consumers to return things to their original locations after their useful lives.	0.82		
RL6	We recover end of life products (e-waste, pharmaceutical, chemical, and agricultural products) from retailer/ wholesaler/customer for proper disposal.	0.75		
EPR1	We are committed to follow central government environmental regulations and legislation	0.72	0.5	0.85
EPR2	We follow strict environmental standards to comply with state government legislation and regulations	0.74		
EPR3	Our organization maintain environmental responsibility towards society	0.83		
EPR4	Environmental management system (ISO 14000) exists in our organization	0.67		
EPR5	Sustainableing our Supply Chain would enable us to sale more products than competitors	0.72		
EPR6	We could lose opportunity to export our product, if sustainable SC is not implemented	0.52		
TMC 1	Our top management is committed and supportive in all sustainable manufacturing activities	0.72	0.66	0.92
TMC 2	Our top management has provided adequate financial support for adoption of cleaner technologies	0.87		
TMC 3	Our organization facilitates seamless communication between top management and employees onimplementation of sustainable practices	0.90		
TMC 4	Our top management has allocated adequate funds for implementing sustainable practices	0.88		
TMC 5	Our managers have power, authority and autonomy in decision making on sustainable practicesimplementation	0.81		
TMC 6	We are giving reward and incentive for environmental initiatives taken by our employee	0.69		
EP1	Reduction of air emission/waste water/solid waste	0.65	0.56	0.86
EP2	Decrease of consumption of energy	0.71		
EP3	Improved organizations eco friendly reputation	0.80		
EP4	Decrease of consumption of hazardous material	0.80		
EP5	Decrease in number of environmental accident	0.75		
OP3	Reductions in the scrap rate	0.44	0.54	0.86
OP4	Raising the caliber of the product	0.84		
OP5	Prolongation of the product's life	0.85		
OP6	Improvement in capacity utilization	0.81		
OP7	Increase in productivity	0.63		
FP1	Margin of profit on sales	0.68	0.63	0.89
FP2	An increase in return on investment	0.80		

FP3	Overall competitive position	0.80		
FP4	Increased market share	0.85		
FP5	Increase in sales	0.82		
RMSEA = 0.081, GFI = 0.906, CFI = 0.870, and CMIN/DF = 2.024 are the model fit indices.				

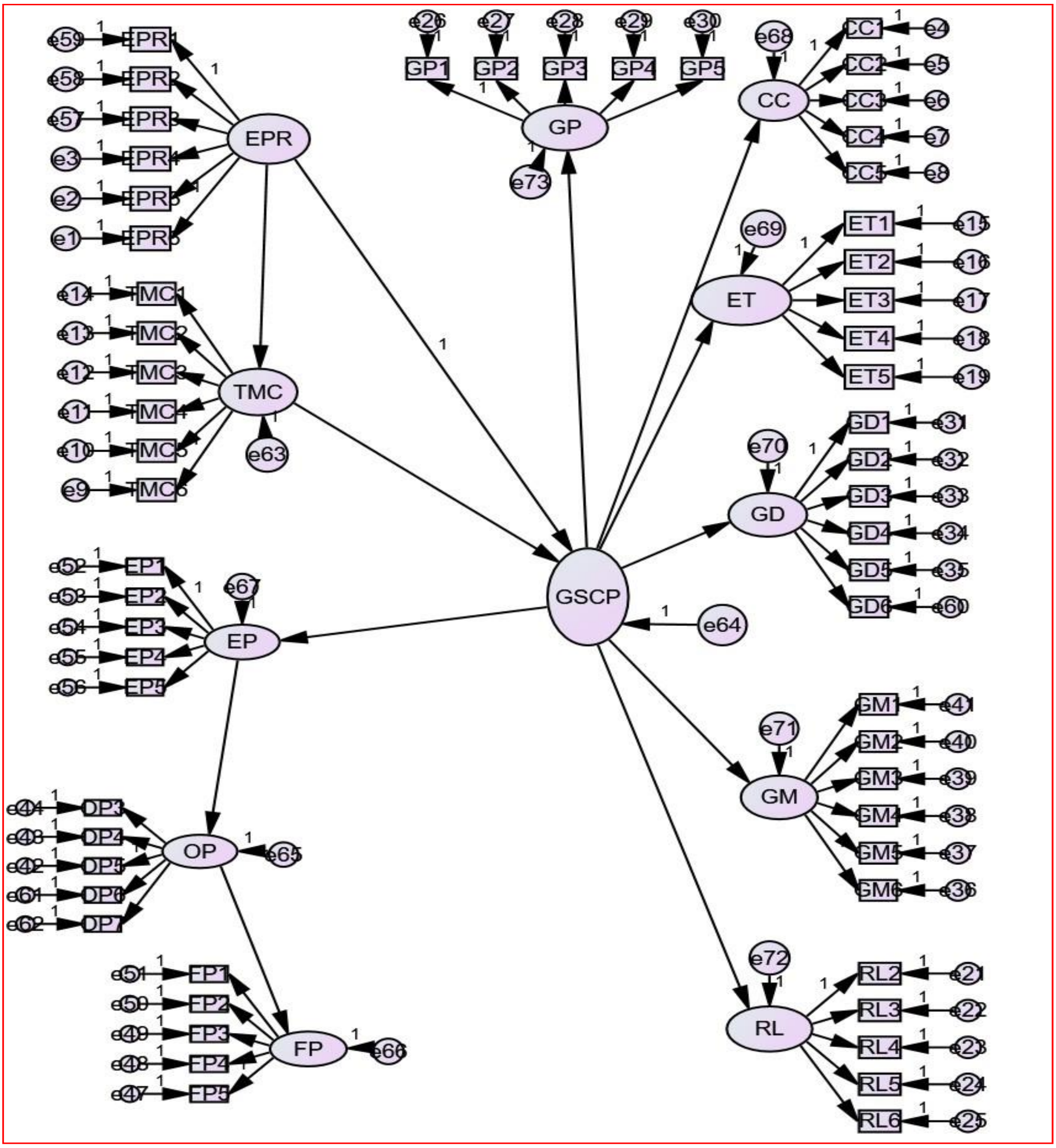

Figure 5.2: Measurement Model

Evaluation of Discriminant Validity

Discriminant validity refers to how much one construct actually differs from another. High discriminant validity constructs are unique and capable of capturing certain phenomena that other measures are unable to.

A multi-construct CFA model with all the constructs correlated was assessed in AMOS for exogenous variables using the refined individual constructs. Assessing the discriminant validity was the aim of this. The model was run to get the correlation matrix between every single component. The variance-extracted (VE) for any two constructs is compared to the square of the correlation estimates between these two constructs in order to ascertain the discriminant validity from the AMOS result. Ideally, the squared correlation estimate is smaller than the "VE." Getting through this test with a passing grade is compelling evidence of discriminant validity.

Table 5.2: First Order Correlation Matrix

	GD	GP	GM	CC	ET	RL	EPR	TMC	EP	OP	FP
GD	1										
GP	0.65	1.00									
GM	0.67	0.69	1.00								
CC	0.69	0.66	0.74	1.00							
ET	0.52	0.70	0.60	0.78	1.00						
RL	0.52	0.64	0.58	0.63	0.65	1.00					
EPR	0.62	0.70	0.70	0.65	0.66	0.43	1.00				
TMC	0.63	0.73	0.72	0.75	0.74	0.55	0.74	1.00			
EP	0.53	0.63	0.65	0.67	0.65	0.47	0.67	0.72	1.00		
OP	0.56	0.62	0.68	0.65	0.55	0.34	0.53	0.59	0.66	1.00	
FP	0.55	0.60	0.65	0.66	0.63	0.51	0.58	0.62	0.66	0.75	1.00

The significance level for all correlations is 0.01.

Table 5.3 : Discriminant Analysis

	GD	GP	GM	CC	ET	RL	EPR	TMC	EP	OP	FP
GD	**0.51**										
GP	0.42	**0.62**									
GM	0.45	0.48	**0.58**								
CC	0.48	0.44	0.55	**0.65**							
ET	0.27	0.49	0.36	0.61	**0.65**						
RL	0.27	0.41	0.33	0.39	0.42	**0.50**					
EPR	0.39	0.49	0.49	0.42	0.43	0.19	**0.50**				
TMC	0.40	0.54	0.52	0.57	0.54	0.30	0.55	**0.66**			
EP	0.28	0.39	0.43	0.45	0.43	0.22	0.45	0.52	**0.56**		
OP	0.32	0.39	0.46	0.43	0.30	0.12	0.28	0.35	0.43	**0.54**	
FP	0.30	0.36	0.42	0.43	0.40	0.26	0.33	0.39	0.43	0.57	**0.63**

Diagonal = Variance Extracted (VE) Lower Matrix = R2

For every variance extracted (VE) estimate in Table 5.1, the squared inter component correlation estimates are all higher than the corresponding values. This suggests that compared to other constructions, the indicators share more traits with the associated concept. Consequently, there is strong discriminant validity in the proposed model.

6. Conclusions:

A questionnaire was created to assess each GSCP's implementation status in an Indian organisation. To provide a starting list of measurement items for each of the constructions' components, a thorough assessment of the literature was done. The measuring items were framed, and then their content validity was examined. The questionnaire was pretested by academics and industry specialists once it was framed. A pilot research of 35 manufacturing organisations was carried out. In order to investigate the connections between different practices and the effects these practices have on organisational performance, the causal model was developed using eight GSCPs. Six hypotheses were produced by the model, which was tested using SEM. According to the research, a company's financial, operational, and environmental performance will all improve with greater use of GSCPs. It is clear from the previous explanation that when the GSCPs are applied more skillfully, an organisation performs better.

Through extensive data collection and AMOS validation, this study seeks to discover the GSCPs and imperial investigations of these practises on the performance of the organisation. This research article established a framework using eight GSCPs. SEM was used to test the same hypothesis and investigate how GSCPs affected organisational performance. The results are helpful in educating decision-makers inside the organisation about the significance of GSCPs and how they affect performance. A multi-dimensional construct of GSCPs has been constructed and verified by this study, which can help Indian organisations' decision makers assess the effectiveness of their current GSCPs inside the organisation.

This research gives findings from an instrument that is reliable and valid for the context of the current investigation in order to assess the GSCPs. It also evaluates the construct using the organization's financial, operational, and environmental performance as the outcome. The research framework presented in this paper shows a favourable and significant association between the organization's financial, operational, and environmental performance and its GSCPs.

This is one of the few research that looks into the possibility of a connection between organisational performance and GSCPs. The research aids in informing organisational decision-makers about the significance of GSCPs and their impact on performance. Empirical research findings suggest that implementing GSCPs is crucial for organisations, irrespective of their location in developed or emerging economies. Thus, for improved organisational performance, more work needs to be put into implementing various GSCPs inside the company.

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