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GREENING THE INDIAN PHARMACEUTICAL SUPPLY CHAIN: A STEP TOWARDS SUSTAINABILITY

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Keywords:

Green supply chain management, Corporate social responsibility, Sustainable competitive advantage, Supply chain performance, Mediation, Structural Equation Modelling

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ABSTRACT: Environmental management is becoming the need of the hour due to rising pollution and environmental hazards. Incorporating green thinking into an organization will not serve the purpose in entirety. Therefore, we need to move towards greening the entire supply chain, here termed as Green supply chain management (GSCM). Adopting green supply chain management practices has been argued to enhance the environmental performance of many organizations, but its impact on the performance of the entire supply chain has not been studied so far in the context of the Indian pharmaceutical industry. The current study aims to identify the impact of GSCM practices on supply chain performance (SCP) and its ability to gain sustainable competitive advantage (SCA) and the mediating role of SCA on GSCM and SCP. For this, Structural Equation Modelling is applied using AMOS version 24. The results demonstrate a positive relationship between GSCM and SCA and SCP. This can prove beneficial to the managers of the pharmaceutical industry to justify the investments made in environmental initiatives and motivate them to voluntarily accept their responsibility towards the environment and society at large.

INTRODUCTION: India is one of the leading suppliers of generic drugs globally and is the third-largest drug market by volume in the world [1]. Being one of the largest producers, its wastewater from the production of bulk drugs is contributing considerably towards the increasing environmental problems in many locations [2]. Also, the release of Active Pharmaceutical Ingredients (APIs) mostly remain unmonitored by the environmental regulators in India, and since the pharmaceutical industry is directly linked to the community, it requires voluntary efforts from the manufacturing companies [2, 3].

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Thus, the Indian Pharmaceutical Industry is facing constant pressure from various environmental regulators and stakeholders such as consumers, suppliers, and even the community at large [4, 5, 6] for contributing towards the increasing pollution and release of hazardous substances in the environment [2, 7].

The increasing pressure from environmental regulators has forced many companies to make their organizations green [6]. Greening of the organization can become a source of eliminating waste, saving resources, and even improving productivity [8]. But in today's globalized world, the competition is between the supply chains and not just the individual companies [9,] and therefore, it is quintessential to green different phases of a supply chain, which is known as Green Supply Chain Management (GSCM) [10]. GSCM can give a firm the first movers advantage over its competitors, and

therefore, it can become a source of gaining sustainable competitive advantage [11, 12]. Greening the supply chain has proven to improve the economic performance and environmental performance of a firm as well [10, 13-15]. However, no relevant study has tested the impact of implementing green supply chain management on the performance of the supply chain as a whole and rather have focussed on a single organization at a time. Also, many authors believe that in order to make a supply chain green, it requires the integration of various supply chain members [8, 12, 16]. However, these relationships may differ from industry to industry and region to region [7, 12]. Therefore, the objective of this paper is to determine the relationship between implementing green supply chain management and integration and their further impact on sustainable competitive advantage and the performance of a supply chain with respect to the pharmaceutical industry in India. The following section deals with a brief review of literature on green supply chain management and its relationship with sustainable competitive advantage and performance.

Literature Review and Hypothesis Development: The concept of green supply chain management is derived from the literature on supply chain management as well as environmental management [8] and is considered a part of Corporate Social Responsibility (CSR) program [12]. It gained popularity in the early 1990s due to rapid globalization which is somewhere responsible for increasing environmental pollution and misutilisation of scare resources, leading to resource crunch [17]. GSCM being a consistent and holistic approach, encompasses the greening of different phases of a product's life cycle, including the disposal of a product [10].

It basically aims at minimizing the environmental and social impact of a product or service [10]. An organization may adopt either a reactive approach - where bare minimum resources are allocated towards environmental management; or a proactive approach - where steps are taken in advance to tackle environmental issues with moderate resource allocation; or a value-seeking approach - where companies integrate activities such as green purchasing, eco-friendly designs, ISO implementation, *etc.* into its business strategy [8].

GSCM is, thus, defined as "integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final products to the consumers, and end-of-life management of the product after its useful life" [8]. Another definition by Carter and Rogers (2008) defines GSCM as "the strategic, transparent integration and achievement of an organization's social environment, and economic goals in the systematic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains" (as cited in 18). These two definitions will form the base of this study. It is also known by various names such as sustainable supply chain management, supply chain environmental management, sustainable supply network management, *etc.* [19]

Green supply chain management includes practices such as waste reduction, minimalistic packaging, reduced consumption of natural resources 20, development of eco-friendly products, reduction in the carbon footprint and water wastage, selection of suppliers based on their environmental consciousness, *etc.* [6, 21]

With such practices, GSCM can help in reducing environmental deterioration without hampering the quality and performance of the product [8, 23]. It also helps in meeting the environmental standards set by the regulatory authorities 17and improving the corporate image of the firm [11, 21-22]. Despite several benefits, the implementation of green supply chain management is not easy and is faced with several barriers such as lack of support from top management and the government, the resistance of supplier to change and adopt GSCM, lack of customer awareness, and the short-term focus on cost [5]. In order to implement green supply chain management, it is important to raise environmental awareness in the organization and beyond and make employees environment-conscious [10].

However, this must not be seen as a financial burden, instead, it should be considered as an opportunity to gain a first-mover advantage over its competitors, which can further become a potential source of creating sustainable competitive advantage [6, 24]. Thus, it is hypothesized that,

H1: Green supply chain management has a significant and positive impact on an organisation's ability to gain a sustainable competitive advantage.

Also, implementing GSCM practices has proved to improve the environmental performance of an organization by reducing harmful emissions and taking the necessary steps to combat environmental issues [24]. It, therefore, helps an organization in improving its image in the eyes of customers and society which further contribute towards enhancing the financial performance of the organization [11].

However, the majority of the studies have tested the impact of green supply chain management practices either on environmental performance or economic performance [12, 25-26,] and not the performance of a supply chain as a whole. Thus, the current study will focus on the impact of GSCM on the performance of the supply chain as a whole in terms of the following hypothesis,

H2: Green supply chain management has a significant and positive impact on supply chain performance as a whole.

Having said that, many authors have established a positive relationship between sustainable competitive advantage and firm performance [27, 28,] but this relationship is not tested with supply chain performance as a whole. Also, we need to test whether sustainable competitive advantage mediates the relationship between GSCM practices and supply chain performance; thus, it is hypothesized that,

H3: Sustainable competitive advantage has a significant and positive impact on supply chain performance as a whole.

H4: Sustainable competitive advantage mediates the relationship between green supply chain management and supply chain performance.

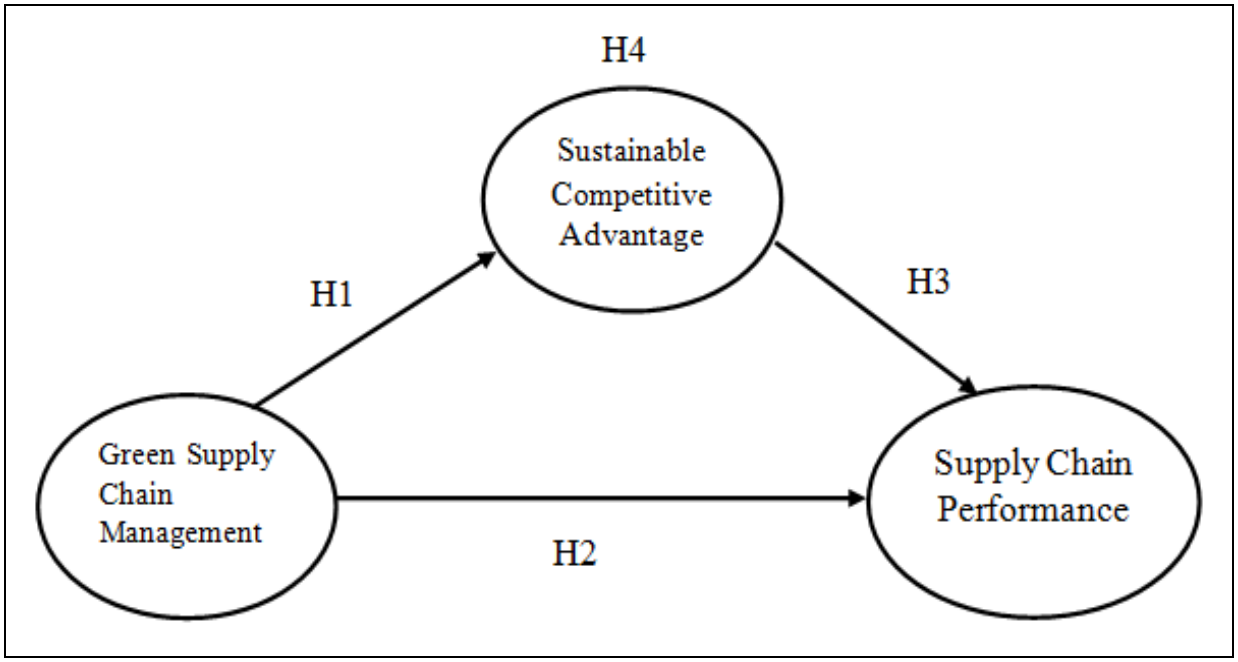

FIG. 1: THE CONCEPTUAL MODEL

Conceptual Model: Based on the above hypotheses, the following conceptual model is constructed **Fig. 1**.

According to the conceptual model given in **Fig. 1**, green supply chain management (GSCM) influences a firm's ability to gain and sustain competitive advantage, which further influences the performance of a supply chain as a whole, thereby establishing a mediating relationship.

Research Methodology:

Scope of the Study: The scope of the study is limited to the Indian pharmaceutical Industry. It is the third-largest market by volume and thirteenth largest by value in the world and is the largest supplier of generic drugs globally [1]. With such large-scale production, it is also one of the biggest contributors to environmental pollution, and thus, this industry is considered apt for the study.

Sampling:

Target Population: The target population for the current study is WHO GMP certified pharmaceutical manufacturing plants located in Himachal Pradesh and Tricity (Chandigarh, Mohali, and Panchkula) and their customers *i.e.*, the pharmacies/chemists located in the same area. Thus, as suggested by many researchers, this study used the dyadic relationship between buyers and sellers as a unit of sampling [29-30]. Convenience sampling will be used to collect the data as random sampling is not feasible.

Sampling Unit: Supply chain managers, logistic managers, purchasing managers, marketing managers, *etc.* of pharmaceutical companies will be taken as respondents for the study. From each firm, multiple respondents will be taken (minimum 3) so as to remove biasness in responses.

Sample Size: Sample Size for the current study is 293, which is considered sufficient for applying Factor Analysis and Structural Equation Modelling (SEM).

Data Collection Instrument: A questionnaire was developed by adapting the scales from previous studies on a seven-point LIKERT scale ranging from 1 (strongly disagree) to 7 (strongly agree). The scale on Green supply chain management (comprising internal environmental management, green purchasing, cooperation with customers, eco-design, and investment recovery) is adapted from Zhu *et al.*, (2008) [6].

The Scale on Sustainable Competitive Advantage Consists of Four Dimensions: Innovation Advantage - adapted from Lii & Kuo (2016) [31], Cost Advantage, Differentiation Advantage, and Institutional Advantage - adapted from Li & Zhou (2010) [32]. Lastly, the scale on supply chain performance is adapted from Qrunfleh & Tarafdar (2010) [33].

ANALYSIS AND RESULTS:

Analysis and Results of Exploratory Factor Analysis: Exploratory Factor Analysis (EFA) using IBM SPSS version 21 is conducted on all three constructs together: Green Supply Chain Management, Sustainable Competitive Advantage, and Supply Chain Performance. Maximum Likelihood Method of factor extraction is used along with Direct Oblimin rotation [34, 35,] and factor loadings below 0.4 were suppressed in order to get clearer Pattern Matrix [36]. Unidimensionality of the constructs is established using EFA as all the items loaded heavily on their respective constructs. The results of the EFA are shown in **Table 1** below.

TABLE 1: FACTOR LOADING AS PER PATTERN MATRIX (EFA)

	Factor										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
A	.925	.888	.905	.904	.905	.873	.888	.864	.865	.869	.880
IEM3	.821										
IEM2	.797										
IEM6	.765										
IEM1	.747										
IEM5	.734										
IEM4	.700										
IEM7	.681										
CA2		.781									
CA1		.708									
CA3		.698									
CA4		.514									
NonF2			.765								
NonF6			.763								
NonF3			.743								
NonF4			.720								
NonF1			.688								
NonF5			.657								
NonF7			.615								
NonF10			.586								
NonF8			.569								
NonF9			.568								
GP3				-.846							

GP2	-.813								
GP5	-.711								
GP4	-.705								
GP1	-.673								
Diff1		.952							
Diff2		.871							
Diff3		.665							
Diff4		.604							
IR1			-.845						
IR2			-.810						
IR3			-.731						
OT2				-.867					
OT3				-.816					
OT4				-.749					
OT1				-.711					
Fin3					-.813				
Fin4					-.783				
Fin2					-.721				
Fin1					-.617				
CC1						-.776			
CC2						-.733			
CC3						-.676			
Eco3							-.816		
Eco2							-.762		
Eco1							-.748		
IA2								.805	
IA4								.781	
IA3								.779	
IA1								.680	

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization. a. Rotation converged in 14 iterations.

Determination of Higher-Order Constructs: Confirmatory Factor Analysis (CFA) is conducted to confirm the model fitness of the sample data [37].

Before conducting CFA on the entire model, it is necessary to check whether the dimensions will form higher-order constructs or not.

A. Green Supply Chain Management: Second-Order Construct: From **Fig. 2**, it is clear that the covariance between the various dimensions is high, and the model fitness is also good; therefore, we can infer that Green supply chain management is a second-order construct in the context of the Indian Pharmaceutical Industry.

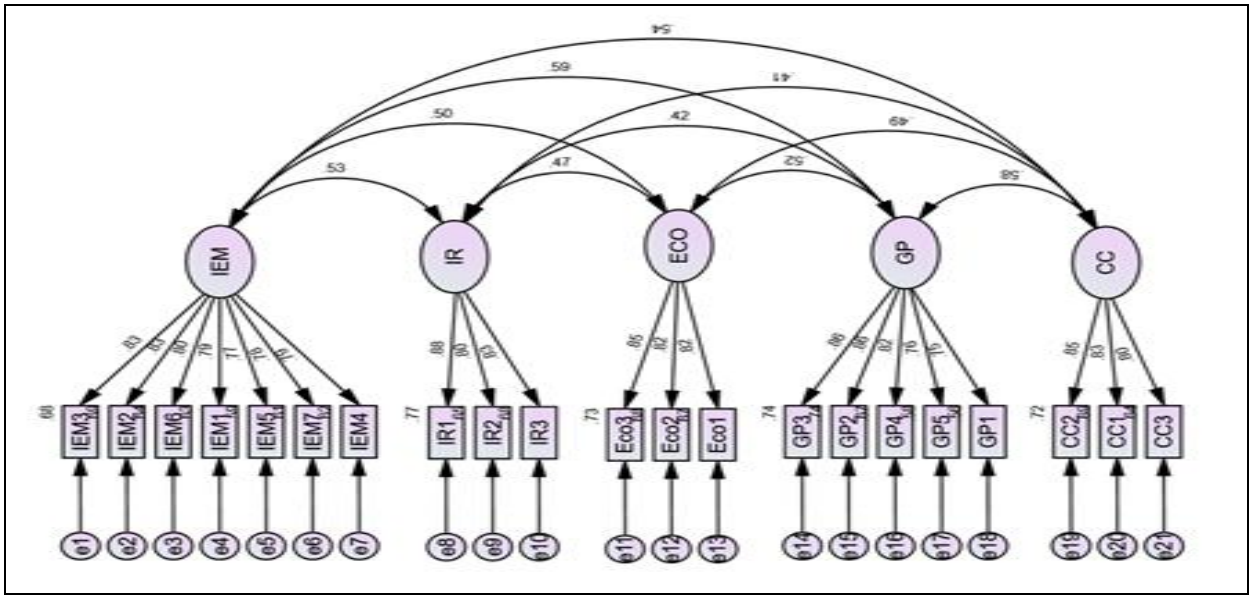

FIG. 2: GREEN SUPPLY CHAIN MANAGEMENT AS A SECOND ORDER CONSTRUCT

B. Sustainable Competitive Advantage: Second-Order Construct: Since the covariance between the different dimensions of Sustainable Competitive Advantage is above 0.50, we can treat it as a second-order construct and club the dimensions into one construct.

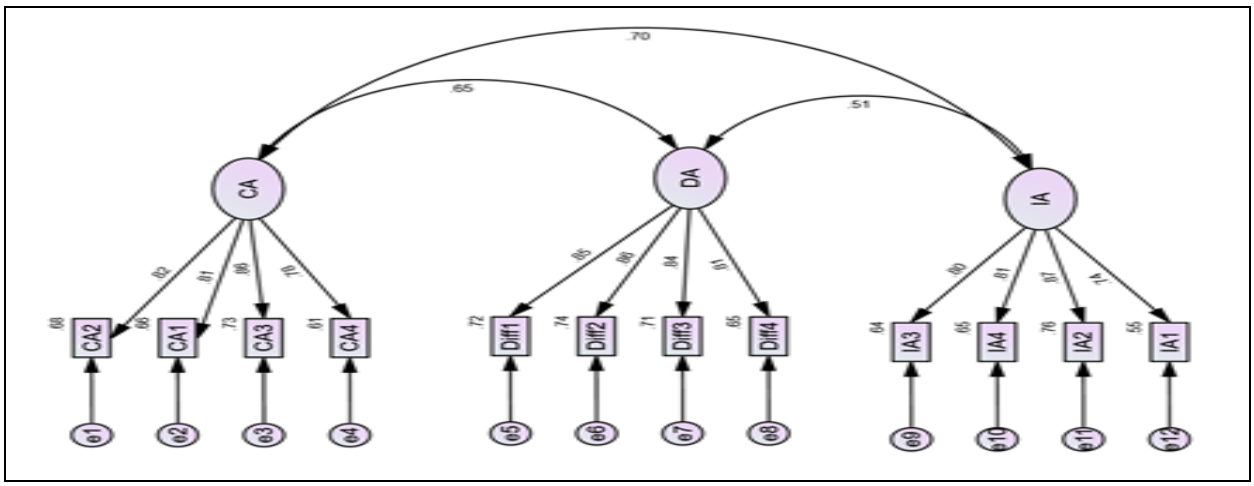

FIG. 3: SUSTAINABLE COMPETITIVE ADVANTAGE

C. Supply Chain Performance: Second-Order Construct: From **Fig. 4**, it is clear that supply chain performance is a second-order construct with three dimensions, namely: non-financial indicators, financial indicators, and other performance indicators.

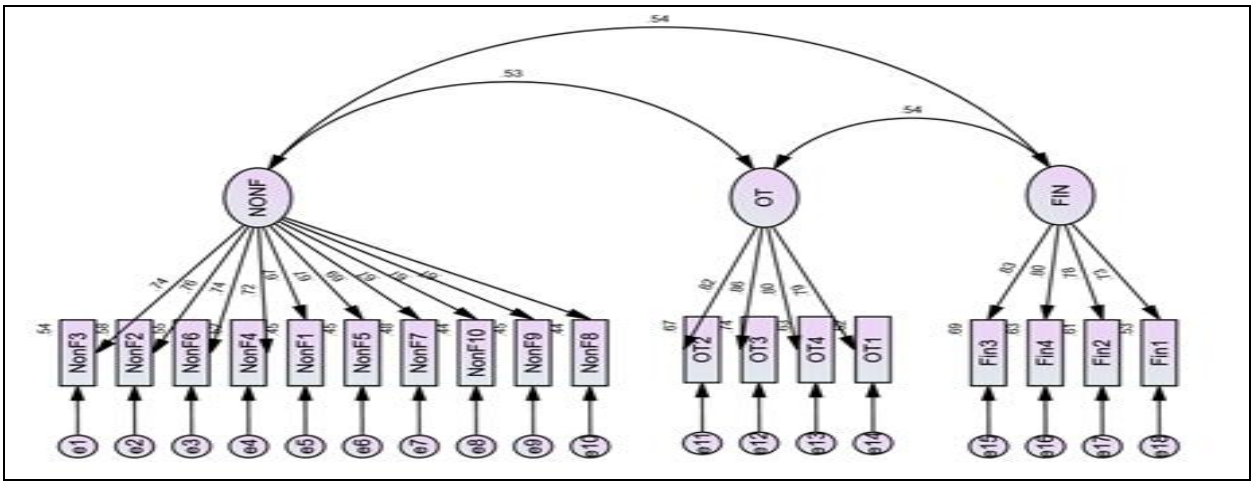

FIG. 4: SUPPLY CHAIN PERFORMANCE

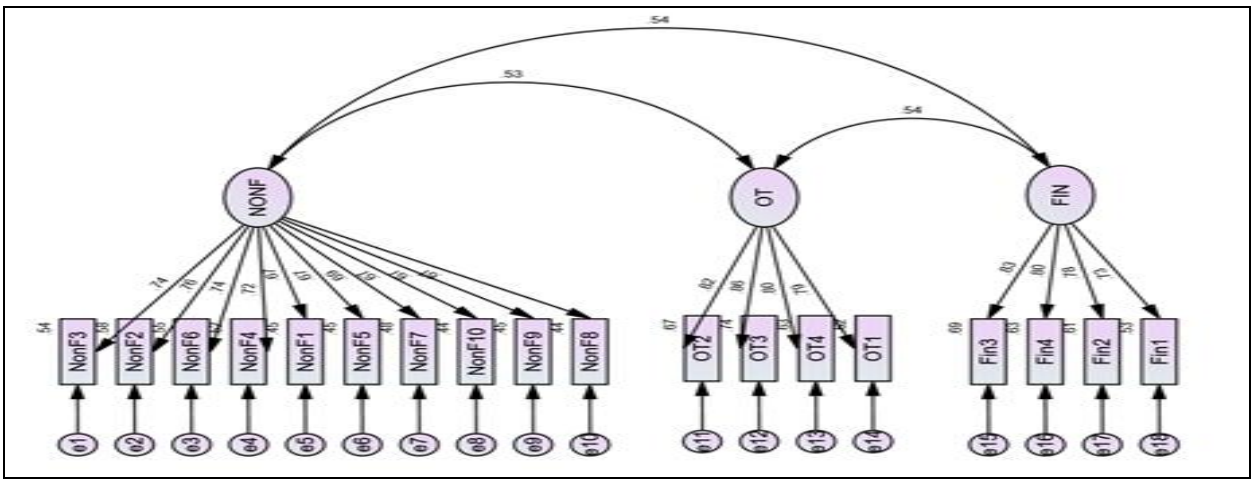

FIG. 5: MEASUREMENT MODEL (CFA)

Construction of a Measurement Model: A measurement model is constructed using all three higher-order constructs and is checked for model fitness and validity and reliability. **Fig. 5** depicts the measurement model. The above model has a satisfactory fit with CMIN/d_f = 1.493, CFI = .937, TLI = .933, RMSEA = .041, PCLOSE = 1.000, GFI = .809. All the fit indices are within the acceptable range except for GFI, which is still acceptable as it varies with the sample size [37].

Model Validation: Convergent and Discriminant Validity: Convergent and discriminant validity is calculated using Macros by Stats Tool Package. The criteria for establishing convergent and discriminant validity is given in **Table 2** below [38]:

TABLE 2: CRITERIA FOR CONVERGENT AND DISCRIMINANT VALIDITY

Convergent validity	Discriminant validity
Composite Reliability (CR) > 0.7	AVE > Maximum Shared Variance (MSV)
Average Variance Explained (AVE)> 0.5	AVE > Average Shared Variance (ASV)
CR > AVE	

The results of the validity tested through macros are given in **Table 3** below which clearly shows that the model has both convergent and discriminant validity.

TABLE 3: CONVERGENT AND DISCRIMINANT VALIDITY OF THE MODEL

Construct	CR	AVE	MSV
Green Supply Chain Management (GSCM)	.837	.508	.047
Sustainable Competitive Advantage (SCA)	.838	.638	.047
Supply Chain Performance (SCP)	.778	.538	.041

Testing for Common Method Bias: Since the data on dependent and independent variables are collected at same point of time using same method, there are chances of the presence of common method bias. For this, a new latent variable called Common Latent Factor (CLF) is added to the model and is connected with all the observed variables with the help of regression lines.

This model is also known as the unconstrained model, which is compared with the model where the regression paths are constrained to 0. The latter model is known as a zero-constrained model.

The chi-square difference test is conducted, and if the difference between the two models is significant, we can say that there is a common method bias present in the model. **Fig. 6** shows the unconstrained model with a Common Latent Factor.

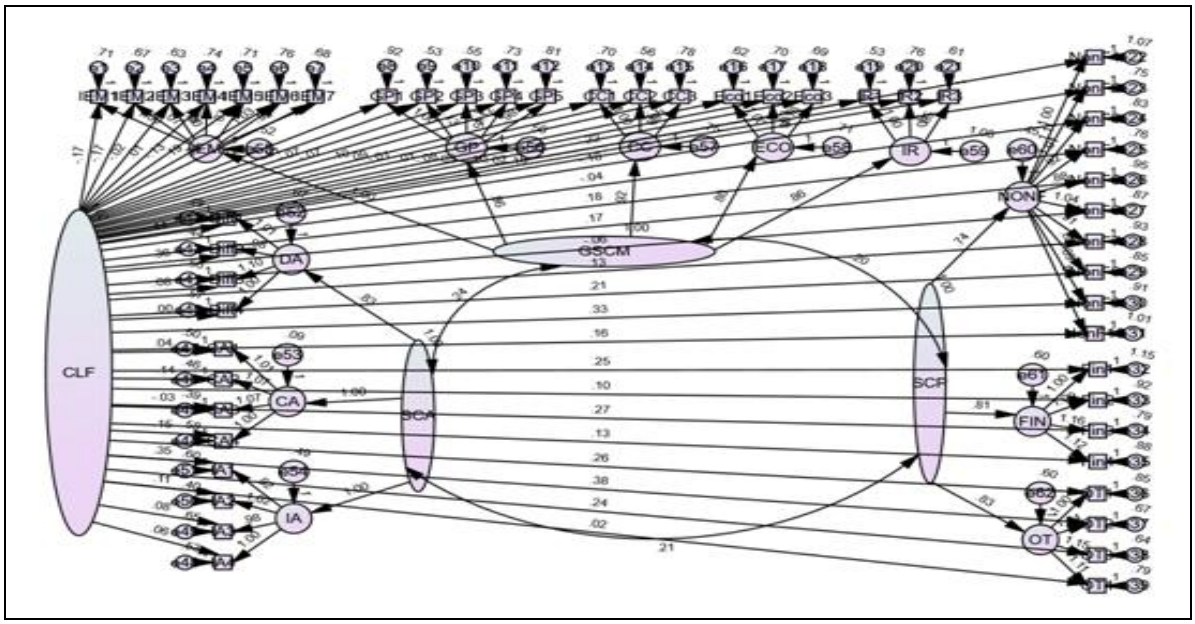

FIG. 6: MEASUREMENT MODEL IN THE PRESENCE OF A COMMON LATENT FACTOR

On conducting a chi-square difference test, the unconstrained model had a chi-square of 1677 at 1161 degrees of freedom, and the zero-constrained model had a chi-square of 1818.30 at 1212 degrees of freedom, and their difference was significant at p-value <0.05. This indicates the presence of

common method bias, and in order to correct this bias, we will have to include Common Latent Factor while testing the hypothesis. The inclusion of a common latent factor makes the model very complex, and therefore, it is usually advised to impute the unconstrained model and then test the hypothesis.

Hypothesis Testing and Findings: After establishing the validity and fitness of the model, we can move forward to test the hypothesis. The relationship between the constructs/latent variables is depicted through the path diagram, which is imputed to get a summarised solution of the dimensions [39]. **Fig. 7** below shows the imputed path diagram along with their beta values.

The hypotheses are accepted or rejected on the basis of p-values of the regression weights of the model. Mediation in hypothesis 4 is analyzed through the bootstrapping method at a 95% significance level in AMOS. The indirect effect between GSCM and SCP must be significant in order for it to have a mediation effect. The results are given in **Table 4** below.

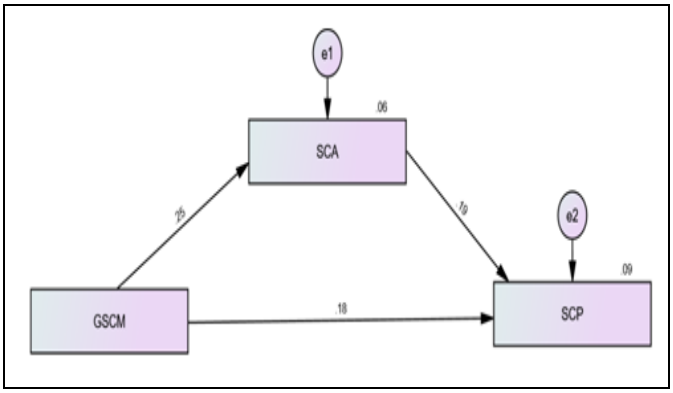

FIG. 7: PATH DIAGRAM

TABLE 4: RESULTS OF HYPOTHESES TESTING

Hypothesis	Relationships	Estimates	p-Values	Result
H1: Green supply chain management has a significant and positive impact on an organization's ability to gain a sustainable competitive advantage.	GSCM and SCA	.245	.000	Accepted
H2: Green supply chain management has a significant and positive impact on supply chain performance as a whole.	GSCM and SCP	.180	.001	Accepted
H3: Sustainable competitive advantage has a significant and positive impact on supply chain performance as a whole.	SCA and SCP	.185	.001	Accepted
H4: Sustainable competitive advantage mediates the relationship between green supply chain management and supply chain performance.	GSCM and SCP through SCA (Standardised Indirect Effect)	.045	.003	Accepted

From the above table, it is evident that all the hypotheses are accepted, and Sustainable Competitive Advantage mediates the relationship between GSCM and SCP, but we need to identify the type of mediating role played by SCA in this model. For this, the bootstrapping method at 95% significance level is used, and both standardized direct and indirect values are checked along with their p-values. This is shown in **Table 5** & **6** below.

TABLE 5: STANDARDISED DIRECT EFFECT VALUES AND THEIR P-VALUES

	GSCM/p-value	SCA/p-value
SCA	.245/ .001	-----
SCP	.185/ .004	.185/ .006

From **Table 5**, it is evident that there is a significant direct relation between GSCM and SCP (.185/.004) as the p-value is less than 0.05, therefore, in order to determine the type of mediation, we have to look at the standardized indirect effect values see **Table 6**.

TABLE 6: STANDARDISED INDIRECT EFFECT VALUES AND THEIR P-VALUES

	GSCM/p-value	SCA/p-value
SCA	.000/---	.000/----
SCP	.045/ .003	.000/----

From **Table 6**, it is evident that there is significant indirect effect between GSCM and SCP. Therefore, this is the case of partial mediation. In other words, sustainable competitive advantage (SCA) partially and positively mediates the relationship between Green Supply Chain Management (GSCM) and Supply Chain Performance (SCP).

Discussions, Research Implications and Limitations of the Study: The current study found a positive and significant relationship between GSCM and SCP which means that adoption of GSCM practices can positively enhance the performance of a supply chain as a whole, despite of it being costly at initial stages. However, the value of R2 as shown in **Fig. 7** is only 0.09, which means that there are several other factors/practices that an organization must integrate into its system so as to have a higher impact on supply chain performance. Examples of such factors include sensitizing the manpower towards the environment, focusing on reverse logistics [20, 23] unrelenting support from the top management and the government [20, 40]; supplier-environmental collaboration and carbon management, *etc.* [41] Having said that, adopting GSCM practices can considerably reduce product lifecycle costs, environmental risks [42], energy consumption, *etc.* 43 associated with the pharmaceutical industry. This study may also motivate managers of pharmaceutical companies to adopt GSCM practices, which can be considered as a proactive strategy to environmental management and sustainability [10]. Managing the environment proactively will also fulfill an organization's Corporate Social Responsibility (CSR) [12].

Also, GSCM practices can become a source of gaining sustainable competitive advantage (SCA) (acceptance of hypothesis 1). However, a firm should not solely rely on GSCM practices due to low R2 value (0.06) and must find other sources of gaining a competitive advantage as well. Thus, it is clear that the adoption of GSCM practices in the pharmaceutical industry will not only enhance the performance of the organization but that of the entire supply chain since it helps the companies in meeting their regulatory requirements by undertaking innovative and environmental friendly practices proactively [17], which may later be claimed as a significant part of their CSR practices as well.

This study has used an integrated scale for GSCM practices which have tried to include almost every aspect of greening the supply chain such as support from top management, the cooperation of customers, inculcating green purchasing, having an environmentally friendly design of the product, ISO certification and lastly the recovery of investment at the end of product lifecycle6. Since the current study has taken the GSCM scale as a whole, future studies can test the relationship dimension wise so as to gain greater insights into the implementation of such practices. Also, this study has taken both financial and non-financial indicators, including environmental performance indicators to measure supply chain performance. This can be of great use for researchers as well as managers.

One major limitation of this study is the low sample size as well as the scope of the area covered due to feasibility. This makes the generalization of results a bit sceptical. Future studies must be extended to much broader areas of the Indian pharmaceutical industry. Also, there are several other factors that have a significant impact on the performance of a supply chain, and hence, these must be included in future studies.

Another limitation of the study is the use of cross-sectional design to measure the perceptions towards supply chain performance and sustainable competitive advantage. Future studies must try and incorporate longitudinal data in their research.

CONCLUSION: To conclude, this study can prove useful for managers who are suspicious about the positive impact of GSCM practices on performance as a whole. Implementing GSCM practices improves not only financial performance but also non-financial performance such as improving the image of the company [19], meeting regulatory norms [2], fulfilling CSR criteria [12], reducing environmental risks and pollution [6], minimizing energy consumption, *etc.* [43]

This will act as a motivator for the companies to justify their investment in greening activities to their shareholders and will also give an impetus to Environmental Organisations (NGOs) in promoting their agenda through companies. Also, society is in dire need of companies to own up to their responsibilities towards the environment, and society at large and green supply chain management can act as the appropriate method.

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CONFLICTS OF INTEREST: The authors declare that there are no conflicts of interest.

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