Assessment of Green Supply Chain Practices for Sustainable Organizational Performance for the Automotive Sector

Lokesh Vijayvargy and Saumyaranjan Sahoo

1Jaipuria Institute of Management, Jaipur, India
Email: lokesh.vijayvargy@jaipuria.ac.in; saumya.sahoo@jaipuria.ac.in

Abstract. The supply chain is the most significant network linking the supplier and buyer to the first raw material state and final product distribution. Because of the rise in global warming and environmental degradation, green practices have become important in every organization. There is a wide scope for adopting green practices such as green supply chain management (GSCM) in the automotive sector, as it contributes a large amount of air pollution and hazardous waste to the environment, especially in developing countries such as India. The study aims to evaluate GSCM in the Indian automotive industry. The data of the 69 Automotive Manufacturers were collected through a structured questionnaire. The study uses five GSCM activities and three performance metrics to assess GSCM’s impact on business performance. The study concludes that GSCM practices have a positive impact on organizational performance which improves the environment and leads to profitability & productivity.

Keywords. GSCM Practices; Environmental Performance; Green Purchasing; Automotive Sector

1. Introduction

Owing to the dramatic shift in manufacturing and consumer preference over the last decade, environmental and social sustainability has become critical to business management. In manufacturing businesses, particularly in the automotive industry, GSCM practices have gained more attention. Due to economic, environmental, and public awareness, the level of adoption of GSCM has increased in automotive manufacturing. GSCM is thus the most critical approach to enhancing organizational efficiency in the current scenario, in line with the need for environmental regulations [1,2].

GSCM integrates eco-friendly aspects into every operation of the business, such as product design, sourcing, production, logistics, marketing, final product delivery, and end-of-life product management in the supply chain [3]. The goal of GSCM is to ensure the suitability of businesses without causing or emitting emissions to the outside environment. Nowadays, people are more likely to save our environment from emitting emissions from the industrial area and to focus more on building GSCM in all sectors such as automotive, electronics, electrical, process, etc.

1.1. Automotive Sector and GSCM Practices

Back in 1885, when Karl Benz first invented a gasoline-powered engine, he did not know how much the automotive sector would be responsible for environmental issues. The automotive industry has not always been the cleanest. It has a major impact on the environment and is the main source of emissions and fossilized energy consumption. In addition to emissions from the use of vehicles, more problems have arisen from the growth of the industry at the level of production and consumption. The industry has only two options either to embrace its impact on the planet gracefully or to accelerate green initiatives through innovation [3]. Many businesses have retained their place and focused on green initiatives. Core programmes include initiatives like electric cars, conservation of energy and water, recycling and waste...
management, and greenhouse gas emissions reductions. For many years now the primary plan has been moving to more sustainable solutions that facilitate proposals for interaction with nature. The industry needs about 50 billion dollars in the next 5 years to achieve sustainability objectives. The sector's future only looks promising, if the time test survives this wave of obligation for sustainable greener initiatives. As a result, Indian Automotive Industry advocates green procurement practices, eco-design, green marketing, green environmental practice, investment recovery, and so on to green its supply chain presently. In this perspective, the purpose of this study is to analyze the environmental, organizational, social, and financial impacts of GSCM activities.

2. Literature Review
The scope of GSCM varies from the introduction of green practices in an organization to the development and regulation of practices arising from the use of sustainability’s 6 Rs: Reduce, Reuse, Recycle, Recover, Refurbish, Remanufacturing, and Reverse Logistics. It aims to incorporate green practices in that part which is considered to be the most detrimental to the environment: manufacturing and production processes. Lei et al. [4] examine the effect of various regulators and pressures on the implementation of GSCM in Indian industries. These results show that the degree of adoption of GSCM depends on the nature of the sector and the various pressures that affect the business of the sector concerned.

GSCM practices have become a realistic solution to successful sustainable growth in Indian industries. Indian automotive industry is at an early stage in implementing GSCM practices compared to other sectors and has a major effect on environmental performance [5]. However, the automotive sector has a low level of acceptance of GSCM due to a low level of understanding of the benefits of GSCM. As a result, managers are concerned to upgrade their supply chain to meet the environmental challenges of the automotive sector, which leads to the adoption of GSCM in the automotive sector. Another research by Simpson et al. [6] indicated that green procurement plays a key role in improving environmental efficiency in the Australian automotive industry. But Thun and Müller [7] argued that GSCM increases financial efficiency by minimizing the costs of environmental incidents, scrap resale, material re-use, profitability, waste reduction, versatility, etc. when evaluating the GSCM practices in the German auto industry. Kushwaha et al. [8] indicated a positive relationship between green initiatives and organizational success in the automotive sector. Green procurement and eco-design are important practices for the automotive industry to minimize carbon emissions.
Many studies have shown that GSCM activities can enhance organizational performance and are negligible. As a result, many industries have adopted GSCM practices in their operation. Many studies [9, 10, 11, 12] have empirically explored the relationship between GSCM and business performance. As illustrated in Figure 1, they recognized a major effect on organizational performance by adopting environmental procurement & purchasing, eco-design, investment recovery and environmental management, green suppliers, green marketing practices, etc. Based on the literature review, the research framework (Figure 2) developed for this study consists of five major GSCM activities and their effects on environmental, financial, and operational performance.

Figure 1. Various GSCM Practices
The following manufacturing initiatives summarise GSCM activities in the current study:

- **Internal Environmental Management (IEM)** = Environmental Management + Green Certification + Green Manufacturing + Commitment of Management towards Green Practices
- **Green Purchasing (GP)** = Supplier environmental Collaboration + Green Supplier + Green Packing
- **Eco-Design (ED)** = Green Design + Design for Reuse/recycling/remanufacturing
- **Customer Cooperation (CC)** = Customer Environmental Collaboration + Green Marketing + Green Packing
- **Investment Recovery (IR)** = Reverse Logistics + Recycling/Reuse

Performance measurement is the outcome of the execution of GSCM activities in an organization [10, 12]. Three performance metrics are identified to determine the effect of GSCM on the sustainable development of an automotive organization.

- **Environmental Performance (EP)**: EP relates to the reduction of air emission, wastewater, and solid waste; the reduction of the use of toxic products; the reduction of environmental accidents, etc.
- **Financial Performance (FP)**: FP reflects various cost-benefit metrics that involve optimizing profits; reducing costs; rising sales and increasing market share.
- **Operational Performance (OP)**: OP measures the operational efficiency of the business and manufacturing process; including reduction of inventories; productivity; waste reduction; enhancement of process capability; reduction of cycle time, etc.

According to Zhu and Cote (Zhu & Cote, Integrating green supply chain management into an embryonic eco-industrial development: a case study of the Guitang Group, 2004) Feng et al. [2], GSCM practices can enhance the profitability, productivity, revenue, eco-friendly environment of an industry that will lead to sustainable development and the company's overall results [13]. To further examine these relationships in the automotive sector, the following three hypotheses are proposed to investigate the impact of the GSCM on organizational performance as illustrated in Figure 2.

To understand environmental problems, an organization must identify the source of these problems in their process such as manufacturing, purchasing, logistics, marketing, R&D, and the product itself [8,910]. While producing products and materials, the process consumes national resources and hazardous material which lead to pollution in the air, soil, and water. To reduce the environmental problems, the company is implementing GSCM practices in their process. GSCM practices reduce pollution issues by collaborating green initiatives with the different players of the supply chain such as GP, ED, CC, and IR [3,4,6,10]. Many empirical studies have suggested the GSCM practices have a strong positive relationship with EP. GSCM practices influence positively EP by reducing various waste which leads to pollution in the air, soil, and waste, also climate environmental accidents in the industry [9,10,11,12,13]. Based on these studies, the study proposes the hypothesis between GSCM and EP.

**H1: GSCM positively influences EP.**

FP is a crucial performance indicator for any organization to know its wealth. FP is related to profitability, cost and revenues. Many past studies did not found any direct impact of GSCM practices on FP in the short-run period. In the initial stage of GSCM implementation, the industry requires investment to change processes and materials [4, 7, 9, 10]. But Vijayvargy et al. [12] suggested a positive relationship between GSCM and FP in a large-sized firm. Therefore, the study proposes the hypothesis between GSCM and FP.

**H2: GSCM positively influences FP.**
Given the industry perspective, OP is the primary deciding factor for GSCM implementation because OP is lead competitive advantage to an organization with lead overall business performance. It represents various measures like an increase in productivity and quality, cost reductions, increasing delivery time [9, 10]. Some studies found no direct impact of GSCM practices and OP, because of a lack of understanding of the implementation of green manufacturing initiatives, green packing, and green logistics in their process. While, Shukla et al. [5] and Simpson, et al. [6] indicate that GSCM practice has a positive impact on cost reduction and quality which leads to operational performance in the automotive sector. Base on the above discussions, the study proposes the following hypothesis between GSCM and OP.

H3: GSCM positively influences OP.

3. Research Methodology
The Random Sampling approach was used to obtain the desired data by sending a questionnaire to 100 recognized automobile manufacturers. The method of collecting the sample was through an online database. Personal visits, mailings, interviews, and follow-ups provide 69 available responses with a response rate of 69%. The majority of the response is from the northern part of India with 53%, while 37% is from the western part. The survey is divided into three sections. In Section A, demographic data on the respondents was obtained. Section B collects information on activities of GSCM, and Section C collects information about the organizational performance. The researchers used the scale developed by Zhu and Sarkis [10] to evaluate the extent to which the GSCM is implemented in the automotive sector by measuring its effects on organizational performance. The measures reflecting GSCM practices and performance dimensions were captured on the Likert scale of 5 points. To test study hypotheses, the survey data was analyzed using descriptive statistics, bivariate co-relation, and ordinary least square (OLS) linear regression.

4. Data Analysis
The data in the survey was collected from the various management positions in the organization. 44 percent of the respondents are from the senior manager level, 34 percent are from the operational i.e. lower executive level, and the remaining 22% are from the middle managerial level. The average experience and age of the respondents are 17.36 years and 40.84 years respectively.

| Parameters | Items | Mean | Std. Dev. | Kurtosis | Skewness | Cronbach α | KMO |
|-----------|-------|------|-----------|----------|----------|------------|-----|
| IEM       | 7     | 3.32 | 0.71      | -0.13    | 0.60     | 0.94       | 0.90 |
| GP        | 4     | 2.92 | 0.47      | 0.08     | 0.21     | 0.77       | 0.72 |
| CC        | 3     | 3.02 | 0.46      | 2.68     | 0.89     | 0.71       | 0.64 |
| ED        | 3     | 3.13 | 0.69      | -0.44    | 0.42     | 0.81       | 0.72 |
| IR        | 3     | 3.23 | 0.52      | -0.27    | 0.06     | 0.82       | 0.70 |
| EP        | 6     | 3.84 | 0.64      | 0.12     | 0.91     | 0.92       | 0.88 |
| FP        | 5     | 3.34 | 0.54      | 0.59     | 1.09     | 0.89       | 0.85 |
Nunnally and Bernstein [14] suggested that Cronbach's alpha value be more than 0.70 for acceptable data reliability. Similarly, KMO value of higher than 0.60 is suggested for acceptable data validity (Nunnally & Bernstein, 1995). Table 1 shows that the alpha and KMO values of all the constructs are more than the threshold value, indicating adequate construct reliability and validity. Table 1 shows that the acceptance rate of GSCM practices has lagged, with a mean value of 3.12. Activities of Green Purchasing are adopted at a deficient level (mean value of below 3.00) among all other GSCM practices. The higher standard deviation shows that the GSCM adoption rate is unbalanced across the auto sector. IEM is the most widely adopted practice in the automotive sector, with a mean value of 3.32.

The analysis shows that FP reflects a significantly lower improvement in performance parameters as compared with EP and OP. Table 1 shows that the highest effect of GSCM was on EP with a mean value 3.84. The study also showed that all performance metrics are rated higher after the introduction of the GSCM in the automotive sector. Bivariate Spearman rank coefficients correlation is performed to determine the link between GSCM practices and performance indicators. Table 2 reveals strong correlations between the variables.

| Table 2. Bi-variate Correlation |
|--------------------------------|--|--|--|--|--|--|--|--|
| IEM   | GP   | CC    | ED    | IR   | EP    | FP    | OP   |
| GP    | 0.57 | 1     |       |      |       |       |      |
| CC    | 0.49 | 0.42  | 1     |      |       |       |      |
| ED    | 0.72 | 0.55  | 0.43  | 1    |       |       |      |
| IR    | 0.65 | 0.39  | 0.38  | 0.53 | 1     |       |      |
| EP    | 0.69 | 0.39  | 0.34  | 0.59 | 0.65  | 1     |      |
| FP    | 0.45 | 0.33  | 0.38  | 0.40 | 0.43  | 0.61  | 1    |
| OP    | 0.49 | 0.29  | 0.40  | 0.51 | 0.51  | 0.55  | 0.57 | 1    |

5. Results of Hypotheses Testing
The result presented in Table 3 shows that H1 (GSCM → EP), H2 (GSCM → FP), and H3 (GSCM → OP) have been endorsed in the current study. GSCM has a stronger positive influence on EP ($\beta = 1.275$) at $p<0.001$ relatives to FP ($\beta = 0.668$) and OP ($\beta = 1.020$). The auto sector is improving its environment through green initiatives in its supply chain [5, 15]. The government has imposed stricter regulatory policy and the changing demands of consumers have led to environmentally friendly innovative goods being sold by the automobile industry. It reflects that automotive companies feel a great deal of extrinsic pressure to follow GSCM practices in their operations [5, 6, 15]. By introducing GSCM, the Auto industry would see major ‘win-win’ benefits for all supply chain participants in the future.

| Table 3. Hypothesis Testing |
|-----------------------------|--|--|--|--|--|
| Hypothesis | Brief Description | $\beta$ | t-value | p-value | Result |
| IEM → EP | | | | | |
| IEM → FP | | | | | |
| IEM → OP | | | | | |
| GSCM → EP | | | | | |
| GSCM → FP | | | | | |
| GSCM → OP | | | | | |

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The research shows that the adoption of GSCM in the automotive industry enables environmentally friendly movements, improves flexibility, improves productivity and efficiency, reduces environmental accidents, and boosts organization effectiveness at cost-effective levels.

6. Conclusion

The level of adoption of GSCM practices is currently at a progressive stage in the Indian automotive sector. Indian automotive sector is actively implementing all the GSCM practices with a mean value of above 3.00. However, they need to focus on areas such as green procurement/purchasing and customer cooperation with environmental considerations. As a result, there is a growing concern among managers of automotive firms to upgrade their operating systems to meet the tough challenges that outsourcing should bring with its greater environmental awareness. Government and industry should also work together to develop an appropriate green strategy for the automotive sector to support the adoption of GSCM Practices [15]. Government should also regulate GSCM practices by creating an environmental conserving policy and organizing GSCM awareness-raising training for automotive organizations. The results of the research provide valuable insights for manufacturers to adopt GSCM practices in their organizations.

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Abbreviations
GSCM: Green Supply Chain Management
IEM: Internal Environmental Management
GP: Green Purchasing
CC: Customer Cooperation
ED: Eco-Design
IR: Investment Recovery
EP: Environmental Performance
FP: Financial Performance
OP: Operational Performance