Comparisons of sustainable supply chain management practices in the automotive sector

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Abstract: Sustainable supply chain management (SSCM) has gained huge attractions in the past decade in both academia and industries. Many developing countries have difficulty in adapting to emerging market trends and realise the need to shift towards sustainable supply chains. Yet SSCM related issues have not been investigated enough regarding different geographical areas. This paper compares SSCM practices focusing on differences in their adoption in differently developed environments. This study attempts to find where differences occur and why they prevail using statistical tools with input from industrial experts in relevant fields. The statistical analysis proved that the geographies are a main reason behind the pattern of adoption of practices due to differences in the scale of industrial development between the compared landscapes. It is found that industries in developed geographical locations find it easier to adopt SSCM practices than those in the developing and under developed geographies.

Keywords: sustainable supply chain management; SSCM; SSCM practices; empirical analysis; comparison.

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A. Noorul Haq is an Eminent Professor in the Department of Production engineering at National Institute of Technology, Tiruchirappalli, India. He has served as Dean of Faculty Welfare and served as the Dean-Administration and the Head of the Department, and Deputy Controller of Examinations. He is also the Editor-in-Chief for International Journal of Materials, Manufacturing and Optimization. Currently, he serves as a technical research paper reviewer of over eight international journals. He obtained his PhD in Manufacturing Management at Indian Institute of Technology, Delhi, India. His current research interests are sustainable and green supply chain management, optimisation and lean-agile system.
1 Introduction

Currently firms have realised that incorporating sustainable practices in supply chains is a necessity to achieve a competitive edge (Schulz and Flanigan, 2016). Increasing foreign investments and growing multinational firms in emerging economies like India face stiff competition from local firms (Esfahbodi et al., 2016). Globalisation is a main factor behind the increase in competition has also contributed to increasing awareness among firms towards environmental practices (Govindan et al., 2015). Reducing the environmental impact by adopting green practices alone will not lead to sustainability (Pagell and Shevchenko, 2014). Firms understand that inclusion of concerns in terms of societal dimensions in all strategic and operational activities along with economic and the environmental thinking alone will lead to sustainability (Huq et al., 2016).

The automotive sector, India’s largest industrial sector facing tough global competition (Xia et al., 2015) has forced Indian firms to move towards adopting sustainability concepts in their supply chains. These firms upgrade their traditional supply chains to sustainable ones through the adoption of specific practices called sustainable supply chain management (SSCM) practices (Carter and Rogers, 2008). Various stakeholders who push the firms to shift to SSCM include governmental stakeholders who set regulations and standards, organisational stakeholders who have directly impact the company financially, community groups, environmental organisations and the media, who influence society’s perception of a firm (Henriques and Sadorsky, 1996). These pressures are not the same throughout the country. Though these rules and regulations are the same throughout the nation, other stakeholder pressures vary from place to place. A highly developed environment say a well developed city will have customers from the higher end of the society who are will willing to pay more than the customers in the under developed areas. This economic imbalance between the different geographies and their differing market exposure leads to differences in the adoption patterns of the SSCM practices.

This study intends to investigate differences in the adoption of SSCM practices in differently developed environments in India. The study is based on a comparison of the adoption of practices between three major classifications of developed environments namely the urban, suburban and rural environments. Industries in developed regions face competition and market conditions that are tougher and demand higher standards than that of industries in the developing and under developed regions. Hence, strategies need to be different for all regions when adopting SSCM. This study describes the result of a survey of various automotive industries in Tamil Nadu, the southern part of India, a fast growing automotive hub in the country. Based on the survey responses statistical analysis tools ANOVA and Tukey’s test are carried out to identify and quantify the differences in the adoption policies followed in different geographical regions.

2 Motivation and research framework

SSCM is a popular and established area of research in the last decade (Burgess et al., 2006) as seen from the increased number of publications (Beske and Seuring, 2014). Over the years, a range of studies relating to the adoption and effect of SSCM practices were conducted. Previous literature in SSCM ranged from developing framework models (Dubey et al., 2016), empirical studies (Ageron et al., 2012; Carter and Liane Easton,
Due to continued globalisation, we feel there is a need for further empirical investigations of SSCM practices. Globalisation has also fuelled the adoption of SSCM practices in firms but, all organisations do not face the same pressures and the level of adoption and implementation of SSCM practices vary from region to region due to the target people while economies also vary from region to region. In the existing literature, so far there are no studies done in comparing the adoption patterns existing in terms of SSCM practices particularly in the perspective of different geographies. The intention of our study is to provide an addition to existing literature through an empirical study that compares the adoption of SSCM practices in Indian automotive industries in the urban, sub urban and rural regions of India. Hence, our hypothesis is

- “Indian industries in differently developed environments adopt different SSCM practices.”

**Figure 1  Research framework**

Figure 1 represents the framework for the study which starts with a literature review regarding the collection of various SSCM practices relating to the automotive sector and questionnaire development for data collection. A survey sheet was prepared so that the respondents were asked to rate the significance of the practices in their industries on a five-point Likert scale adopted from Zhu and Sarkis (2006) with values indicating the significances. The questionnaire targeted three different sets of respondents from the automotive sector i.e., rural, suburban and urban based industries. The next step is a comparative analysis of practices using one way analysis of variance (ANOVA) followed by a pair wise comparison using the Tukey test. The tests reveal the differences in the adoption levels of each practice.
3 Application of the proposed framework

This section deals with the steps involved in testing the hypothesis considered. SSCM is like any other supply chain management system which involves following specific practices. The practices vary sector-wise. Some practices suited to the agriculture sector will not be as efficient in another sector (Xu et al., 2013). Hence, it is necessary to concentrate on the practices applicable to automotive sectors. Through literature study and the help of industrial experts from the automotive sector in south India, specially Tamil Nadu, ten common SSCM practices for the study were identified. The reason behind choosing Tamil Nadu for the study is that it is the leading manufacturing zone in the country. Industrial managers with reasonable experience in the automotive sector i.e., five years, were contacted through phone, e-mail and face to face interviews to consolidate the final list of practices. The list of SSCM practices considered for our study along with their notations and sources are listed in Table 1.

Table 1  List of SSCM practices with sources

<table>
<thead>
<tr>
<th>SSCM practices</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain orientation (P1)</td>
<td>Beske and Seuring (2014), Beske et al. (2014) and Zailani et al. (2012)</td>
</tr>
<tr>
<td>Reverse logistics (P2)</td>
<td>Carter and Rogers (2008), Lin (2013) and Brandenburg et al. (2014)</td>
</tr>
<tr>
<td>Management commitment towards SSCM (P3)</td>
<td>Jia et al. (2014), Pagell and Wu (2009) and Seuring and Müller (2008)</td>
</tr>
<tr>
<td>Standards and certifications (P4)</td>
<td>Beske and Seuring (2014), Diabat et al. (2014) and Jia et al. (2014)</td>
</tr>
<tr>
<td>Auditing suppliers (P5)</td>
<td>Jia et al. (2014) and Igarashi et al. (2013)</td>
</tr>
<tr>
<td>SC partner development (P6)</td>
<td>Gold et al. (2010) and Fossas-Olalla et al. (2010)</td>
</tr>
<tr>
<td>Life cycle analysis/assessment (P7)</td>
<td>Gold et al. (2010), Beske and Seuring (2014) and Ji et al. (2014)</td>
</tr>
<tr>
<td>Environmental awareness training (P8)</td>
<td>Jia et al. (2014), Wei et al. (2007) and Igarashi et al. (2013)</td>
</tr>
<tr>
<td>Measurement and reward systems</td>
<td>Pagell and Wu (2009) and Koplin et al. (2007)</td>
</tr>
<tr>
<td>linked to sustainability (P9)</td>
<td></td>
</tr>
</tbody>
</table>

4 Questionnaire development and data collection

To identify differences in adoption of SSCM practices, the level of implementation has to be measured on a scale which will serve the purpose. For this study we developed a questionnaire where the respondents had to rate the level of implementation on a five-point Likert scale adopted from Zhu and Sarkis (2006) with 1 = not under consideration, 2 = plan to consider it in the near future, 3 = currently considered for implementation, 4 = implementation initiated, 5 = successfully implemented). A sample questionnaire is provided in the appendix of this paper. Relevant experts from various dimensions of the society were targeted for the survey. Industrial experts at managerial levels in various automotive industries in urban, sub urban and rural areas of Tamil Nadu
were considered for the survey. Of the 35 experts targeted, some neglected the survey due to lack of time and official and personal commitments. We received a final tally of 17 responses from industrial experts, six each from urban and rural area and 5 from the sub urban area. Data from the survey was then classified based on the different locations the experts’ industries were situated. It was then used for further analysis.

5 Statistical analysis using ANOVA and Tukey’s test

The data collected from the questionnaire was then classified into three categories of responses namely, urban, sub-urban and rural which were then consolidated for further analysis. The mean and standard deviations were calculated and a standard procedure one-way ANOVA was used to evaluate whether the means of populations considered in the study differed. If ANOVA concludes the evidence of difference in the group then the different means are to be located. Here Tukey’s test which identifies differences between each pair of means was applied. The Tukey multiple comparison tests assume that observations tested are independent and that there are equal variations across observations. The means, standard deviations, F-statistics obtained from ANOVA and the multiple pair wise comparison of the ten SSCM practices across urban, sub urban and rural sectors are represented in Table 2.

Table 2 Comparison of SSCM practices in Indian automotive sectors in urban, sub urban and rural industries (see online version for colours)

<table>
<thead>
<tr>
<th>Practices</th>
<th>Urban (U)</th>
<th>Suburban (SU)</th>
<th>Rural (R)</th>
<th>F statistics</th>
<th>U and SU</th>
<th>U and R</th>
<th>SU and R</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>3.33 0.516</td>
<td>3.20 0.837</td>
<td>2.33 0.516</td>
<td>4.4491</td>
<td>0.9342</td>
<td>0.0375</td>
<td>0.0904</td>
</tr>
<tr>
<td>P2</td>
<td>3.33 0.516</td>
<td>2.20 0.447</td>
<td>2.00 0.632</td>
<td>10.3340</td>
<td>0.0103</td>
<td>0.0022</td>
<td>0.8182</td>
</tr>
<tr>
<td>P3</td>
<td>3.00 0.632</td>
<td>2.20 0.447</td>
<td>1.83 0.408</td>
<td>8.1862</td>
<td>0.0523</td>
<td>0.0038</td>
<td>0.4788</td>
</tr>
<tr>
<td>P4</td>
<td>4.33 0.516</td>
<td>4.20 0.447</td>
<td>3.67 0.516</td>
<td>2.9774</td>
<td>0.8985</td>
<td>0.0857</td>
<td>0.2153</td>
</tr>
<tr>
<td>P5</td>
<td>4.17 0.753</td>
<td>2.40 0.548</td>
<td>2.33 0.816</td>
<td>12.0045</td>
<td>0.0034</td>
<td>0.0176</td>
<td>0.9874</td>
</tr>
<tr>
<td>P6</td>
<td>3.33 0.516</td>
<td>3.20 0.447</td>
<td>2.00 0.894</td>
<td>7.2327</td>
<td>0.9411</td>
<td>0.0095</td>
<td>0.0246</td>
</tr>
<tr>
<td>P7</td>
<td>3.83 0.983</td>
<td>1.80 0.447</td>
<td>1.83 0.408</td>
<td>17.0691</td>
<td>0.0006</td>
<td>0.0004</td>
<td>0.9964</td>
</tr>
<tr>
<td>P8</td>
<td>3.83 0.753</td>
<td>2.40 0.548</td>
<td>2.17 0.753</td>
<td>9.7904</td>
<td>0.0117</td>
<td>0.0028</td>
<td>0.8480</td>
</tr>
<tr>
<td>P9</td>
<td>3.50 0.548</td>
<td>1.80 0.837</td>
<td>1.67 0.816</td>
<td>11.2327</td>
<td>0.0052</td>
<td>0.0020</td>
<td>0.9523</td>
</tr>
<tr>
<td>P10</td>
<td>4.17 0.753</td>
<td>4.00 1.000</td>
<td>2.67 0.516</td>
<td>6.8151</td>
<td>0.9313</td>
<td>0.0112</td>
<td>0.0304</td>
</tr>
</tbody>
</table>

6 Results and discussions

Ten SSCM practices adopted in Indian automotive industries on three different geographical bases i.e., difference in the adoption levels between industries in urban, sub-urban and rural areas were compared in the study. To identify if there were significant differences in the adoption levels among industries, a one-way ANOVA was performed. Further, industries in different geographical locations differing in the policies of adoption of SSCM practices were considered through a multiple comparative Tukey’s test. We see that industries in differently developed geographical locations have different levels of
SSCM adoption practices. Table 2 represents the results obtained. The highlighted cells have values less than ‘0.05’ which indicate that according to the Tukey test the groups have significant differences in adoption levels. It was also found that the practice ‘P4’ (standards and certifications) is the only practice which does not have any significant difference in the adoption levels in urban, sub-urban and rural industries. Practices like reverse logistics (P2), regular auditing of supplier (P5), using life cycle assessment (P7), Environmental awareness training (P8) and measurement and reward system related to sustainability (P9) are mostly implemented in industries in the developed/urban parts of the country.

Industries in rural and sub-urban areas are yet to implement the practices. They definitely have a plan to implement them in the near future. This may due to lack of competition from other industries in these areas unlike urban areas where industries face global competitions. Stringent rules and the high standards followed in urban areas show that these industries are way ahead in adopting practices like supply chain orientation (P1), supply chain partner development (P6) and specially practices ensuring worker safety and human rights (P10). The top management’s commitment towards SSCM (P3) is very high in urban industries. This may be due to the exposure they experience through competitors in global markets. Yet, it is not conclusive from the study as to which factor is responsible for differences in the adoption levels of SSCM. Globalisation is definitely a critical driver behind various competitive pressures. Hence, industries in the developing and under developed geographical areas find it hard to switch over to SSCM similar to those in developed/urban areas.

7 Conclusions and future scope

This paper presents the results of multiple comparative studies on SSCM practices in Indian automotive industries in three different geographical locations. The Indian automotive sector is rapidly expanding and industries which wish to continue in market competition have the urge to implement sustainability concepts in their supply chains. It is found that industries in sub-urban and rural areas have lower in standards though they realise that this is the peak time to implement SSCM practices. This study represents the differences in the adoption levels of SSCM practices in urban, sub-urban and rural industries through a survey-based statistical analysis concentrating on the automotive sector. Further research can be conducted by comparing the differences in the adoption of SSCM practices in different sectors through which the sector-based practices can be identified. The numbers of respondents in the current study are only 17. Considering a larger sample size will increase the accuracy of results. A study on the pressures and drivers responsible for the implementation of the practices will ensure a detailed picture of the root cause for the differences.

References


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Appendix

Questionnaire

This is the questionnaire intended for the research study on the differences in the adoption of SSCM practices in the automotive sectors in different geographical locations. SSCM can be explained as giving equal importance to the economic, environment and societal aspects in the supply chain of a firm.

In this context, please indicate the significance of the ‘ten’ listed practices on a five-point Likert scale based on the preference of a firm in general. The scale values are given below,

(1) Not under consideration
(2) Planned consider it in the near future
(3) Currently considering implementation
(4) Implementation initiated
(5) Successfully implemented

1 Supply chain orientation (Consider the sustainability aspects in whole supply chain for decision making)
   □ 1 □ 2 □ 3 □ 4 □ 5

2 Reverse logistics, using Product recovery techniques
   □ 1 □ 2 □ 3 □ 4 □ 5

3 Management commitment to SSCM
   □ 1 □ 2 □ 3 □ 4 □ 5

4 Adhering to environmental and social standards of society through certification
   □ 1 □ 2 □ 3 □ 4 □ 5

5 Regular auditing of suppliers to ensure sustainability standards
   □ 1 □ 2 □ 3 □ 4 □ 5

6 SC partner development
   □ 1 □ 2 □ 3 □ 4 □ 5

7 Life cycle analysis/assessment
   □ 1 □ 2 □ 3 □ 4 □ 5

8 Environmental awareness and training of employees
   □ 1 □ 2 □ 3 □ 4 □ 5

9 Measurement and rewards system linked to sustainability to encourage employees
   □ 1 □ 2 □ 3 □ 4 □ 5
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10 Implementing and following safety aspects and laws of government regarding employment

☐ 1  ☐ 2  ☐ 3  ☐ 4  ☐ 5

Respondents are requested to provide the following information

1 Designation of the respondent ________________________

2 Experience (no. of years) in the sector ________________________

3 Locality where the firm is situated Urban/suburban/rural