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Empirical Study on Implementation of Sustainable Supply Chain Management: A Case of Textile Sector

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Abstract: Sustainable or Green Supply Chain Management (SSCM) has implications for environmental concerns, declining profitability, corporate social responsibility and intense global competition. (SSCM) aims at using environment friendly raw material, green production processes that and using distribution packaging that is also environment friendly. Such company's final products are recycled through reverse logistics to gain sustainable development. There are lots of barriers that affect the success rate of industries. Now there is a need to identify barriers related to (SSCM) implementation in the textile firms of Pakistan. The objective of the present study is focus on the identification and classification of these barriers. For this purpose, Fuzzy Analytic Hierarchy Process (FAHP), Fuzzy Technique for Order Preference by Similarity to an Ideal Solution (FTOPSIS) technique were used for the identification and ranking of these barriers. Primary data were collected by using questionnaire and interviews from textile firms. Environmental aspects were the major category acting as barrier for implementing (SSCM). Results, future scope and limitations have been discussed.

Keywords: Sustainable Supply Chain Management (SSCM), Sustainable Development, Fuzzy AHP, Fuzzy TOPSIS

1. Introduction

Environmental or Green or Sustainable Supply Chain Management (SSCM) is the emerging concept throughout the world. (SSCM) has grown in popularity for the academia and practitioners because of its main objectives are to reduce wastage and conserve product life cycle. Enhanced public awareness and government regulations have forced organizations to become sustainable towards the environment. A number of concepts have been evolved regarding (SSCM) since 1989 such as green production, green design, green operations, reverse logistics and waste management.

Sustainable supply chain management can be defined as a struggle towards reducing pollutants, increasing recycling and materials substitution [6]. (SSCM) considers the environmental impacts and resource consumption efficiency in the whole supply chain [1]. It is based on manufacturing theory and supply chain management that involves suppliers, manufacturers, distributors, retailers and customers focused

on minimizing negative effects on production processes on the environment. Companies practicing Sustainable supply chain management assist their upstream and downstream to optimize ecological benefits from product design, raw material selection and reusing, improving economic and ecological performances to attain sustainable development of the supply chain [11]. Reverse logistics, a concept relevant to Green Operations also emerged from green literature. The use of plastics and bottle recycling are mentioned in some of these articles. The use of plastics and bottle recycling were mentioned in case studies and article created a standardized model for reducing electronic waste without harming the environment.

Firms in this intense competition strive for excellence through environment friendly raw material, green production, green distribution and eco packaging. Green supply chain management considers effort towards reducing toxic waste, increasing recycling and materials substitution [1]. Sustainable supply chain management considers the environmental effects and resource utilization efficiency in the whole supply chain. It is based on manufacturing theory

and supply chain management that involves supply chain partners focused on minimizing negative effects of production processes on the environment [1]. (SSCM) main activity is to involve in developing an environment friendly design with suppliers, evaluating supplier's performance. [11] stated that companies involved in Sustainable supply chain management support their upstream and downstream to optimize environmental benefits from product design, raw material selection, improving economic and ecological performances to attain sustainable development of the supply chain.

(SSCM) initiatives are of great importance to the firms as well as for external environment because it generates financial benefits for the firm in the long term [3]. Utilizing ecofriendly raw material and green production reduces waste and eco material substitution. Firms seeking green initiative's implementation originate from financial performance. [10] presented an experimental proof for the firms to implement green supply chain to enhance competitive advantage and eco performance. The dimension of ecological factors needs to be taken into consideration while including activities relevant to supply chain of a firm.

According to recent researchers in the upcoming time, most producers will face ecological concerns in Asia. A large amount of the industries will modify their supply chain to environmentally sustainable supply chain through green procurement strategies. Green supply chain will be affected through purchase of such raw materials which are either reusable or already been recycled. Many hurdles can be anticipated while converting conventional supply chain management to green supply chain management which affects its overall performance and are called barriers. These barriers are to be removed in order to implement Sustainable supply chain management effectively. Although all the barriers can't be removed but essential barriers needs to be identified and eradicated which is the main objective of this research.

In current era, barriers in textile sector relevant to implementing (SSCM) have attained significant importance for the practitioners, industry stakeholders and researchers. One of the main causes of implementing (SSCM) by the organizations is to get competitive advantage and sustainability while fulfilling environmental concerns. Brand image and Customer demand can be enhanced through green products for consumers which are concerned about products that are being produced in such a way that it protects the natural environment. Firms which adapted (SSCM) are mainly affected by financial performance of their organization.

The overall objective of this study will be to identify and rank the barriers in implementing GSCM in the textile industry. The specific objectives are
- To identify the common and essential barriers in (SSCM) implementation in the textile sector
- To rank essential barriers to eradicate for successful implementation of (SSCM)
- To present its managerial implications to industry stakeholders

2. Literature Review

[4] examined the barrier analysis for automobile industry in India using Interpretive Structural Modeling (ISM). The intent of the research was to determine the barriers faced by the automobile companies in implementing (SSCM) and find interrelationship among them. Various obstacles were identified and relationship among them. Lack of IT implementation, lack of organization praise, lack of human resource quality, low level green implementation practices, low top management involvement, lack of customer awareness, Financial constraints, low level Government support systems, lack of technology adoption, uncertain demand and intense rivalry and supplier hesitation in adopting (SSCM) were taken as independent variables whereas (SSCM) was considered dependent variable. Classification of obstacles was obtained with the help of MICMAC analysis. The Authors found that eleven barriers were relevant after discussion with industry experts. Lack of Implementing Green Practices; Intense Competition and Uncertainty; financial restraints, supplier hesitation towards adopting (SSCM) and Unawareness of customers were identified as dependent variables. Lack of IT Implementation; Lack of Top Management Commitment and Lack of Government Support Systems were recognized as driver variables. Lack of technology adoption, poor quality human resource and Lack of Firm's encouragement were taken as linkage variables. No independent variable was found. Researchers in this study developed hypothetical framework for (SSCM) implementation barriers whereas real barriers from literature can be used for the same study by using Structural Equation Modeling (SEM) was the limitation of this study. Same methodology ISM can be applied to other sectors like electrical and electronics industries of India and comparison among the industries can be made using Analytic Network Process (ANP) and Analytic Hierarchy Process (AHP) were the future research scope.

[8] explained the determinants affecting (SSCM) in the steel industry of Iran. The objective of the study was to find out the factors that pushed firms towards (SSCM) implementation. Green procurement, Green manufacturing, Green utilization, Green marketing, organizational culture and Reverse logistics were considered independent variables and (SSCM) as dependent variable. Factor analysis was applied to validate measurement scales. Data were collected from literature and industrial expert judgments through questionnaire survey and interviews from 379 respondents. Results showed that all the items fitted the data adequately proving its validity and reliability. Limitation of this study included that expert opinion may vary from country to country and industry wise. Implications of this study suggest that applying these all variables into practice in Iran steel and other industry sector can enhance performance of overall (SSCM).

[9] investigated the obstacles faced by pharmaceutical industries in (SSCM) implementation in India. The objective

of the study was to determine factors creating hurdles for (SSCM) implementation in pharmaceutical industries. AHP was applied to four variables named supplier management, life cycle management; product recycling and firm's involvement and rank twenty approaches (factors) from nine firms. The authors found that supplier performance, database of environmental products, product testing reports and top level management involvement were vital factors affecting (SSCM) in pharmaceutical industry in India. Future research can be conducted by using ANP for knowing interdependency properties using same variables and sub variables.

[2] explained the implementation barriers for (SSCM) in Indian perspective. The aim of the study was to identify and rank the barriers in implementing (SSCM) in different sectors of India. Independent variables included outsourcing, Knowledge, Financials, Technology, Involvement and support whereas dependent variable was barriers to (SSCM) implementation. Forty seven in number (Sub-barriers) under five variables category were identified through in depth literature review, detailed discussion with industry experts and questionnaire survey. Out of forty seven, twenty six barriers were found to be essential ones by using AHP. The outcome of the study found that lack of adaption of technology was most significant barrier and outsourcing, financials and knowledge also affected (SSCM) implementation. Involvement and support of top management was least significant factor affecting it. Managerial implications of this study can assist multiple industries to eradicate technology on preference basis and other barriers for successful implementation of (SSCM) in India. More barrier category and sub-categories can be applied to more industries to comprehensively investigate barriers to (SSCM) implementation.

[7] examined the risk related to (SSCM) in textile industry of Pakistan. The aim of the research was to determine and prioritize risks related to (SSCM) implementation applied to a case of textile manufacturing firm. Procurement, Manufacturing, Logistics, Flexibility and Retailing were taken as independent variables and risks related to (SSCM) implementation as dependent variable. Twenty four (Sub-barriers) were taken from five variables. Authors of the study applied AHP to calculate the weight of category and sub category and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) method to rank these barriers under fuzzy environment. Results of the study showed that procurement was most significant hurdle followed by manufacturing, retailing, logistics and flexibility. Implications of this case study of textile manufacturing and retail outlet can assist in evaluating risk related to green supply chain through proposed fuzzy AHP-TOPSIS framework. Future orientation includes that same framework can be applied to any other firm who wants to eradicate risks related to (SSCM) implementation in textile industry depending upon varied expert opinion. Other techniques like, fuzzy ELECTRE, fuzzy PROMETHEE and fuzzy VIKOR can applied to results of this case study.

3. Methodology

Research was conducted in the city of Faisalabad because this city is hub of the textile industry and majority of the textile exporters can be found in this city. 14 major criteria were considered after consulting extensive literature review and discussion with textile industry experts. Study targeted specifically textile exporters because they have been doing this from many years, they know in depth what are the barriers such firms are facing in current scenario. Head of the departments or higher management like CEO who had at least 10 years relevant experience were taken as respondent. Respondents were taken from Research & Development, Merchandizing, Compliance and Audit Departments. Snow ball sampling technique was utilized by researcher for data collection purposes. These respondents were selected carefully keeping in mind the requirements of questionnaire to be asked. Their experience, exposure enables them to answer the questions in depth and with clarity. Primary data were collected through interviews, focus groups and structured questionnaires.

This section proposes a methodology for barrier assessment of implementing green supply chain initiatives or policies in the textile sector. The methodology consists of five main stages. The first step requires the firm to come up with a comprehensive hierarchy of the entire criterion which may affect the firm. This is done by thoroughly studying the considered chain and identifying potential loopholes. These are then analyzed for overlaps and categorized using similar characteristics. This exercise should be repeated whenever a major change is made in the chain. The second step in the process involves assigning weights to the criteria according to their importance. Fuzzy AHP is used for this purpose and expert views are taken as input. The third step involves determining the scores of different criterion by analyzing them under fourteen different criteria namely; Environmental aspects, economic aspects, social aspects, Government Aspects, Green Procurement, green production, green logistics and distribution, financials, suppliers, technology, green culture and involvement, green innovation and competitiveness, knowledge management and green marketing. In the fourth step fuzzy TOPSIS approach is employed to evaluate the organization's readiness to barriers of implementing sustainable supply chain management. Finally, comparison of results and managerial implications has been discussed.

4. Results and Discussion

4.1. Fuzzy Analytic Hierarchy Process (FAHP)

From the table given below, we infer that environmental category is the biggest barrier that needs to be removed in order to successfully implement (SSCM). Companies must consider environmental factors while implementing (SSCM) because they need to protect the environment in the surroundings and its stakeholders from any type of harm [1], [20]. Companies need to introduce cleaner technology and

development that helps organizations to improve their productivity, effectiveness and efficiency at the same time. These new practice can also help companies to reduce their wastages and conserve energy which is the need of the time.

Second biggest hurdle after environment is the economic aspects category; companies need a lot of heavy investment in order to implement (SSCM) for which they do not have sufficient resources. In the beginning, companies have to invest for building up the infrastructure of (SSCM) with high operational cost but return on investment might be low which do not motivate companies to opt for it. Financial institutions do not provide loans for implementing (SSCM).

Government regulations category are the third biggest barrier among the list of barriers according to its weight which needs to be removed with the support of Government. Actions like providing incentives to the organizations implementing (SSCM) also provide trainings, seminars, and workshops to create awareness among all the stakeholders regarding it. Lack of (SSCM) standards and regulations enforcement exists which motivates companies not to indulge deeply in sustainable supply practices [7], [27], [10]. Social aspects are the fourth major category which acts as hurdle against successful implementation of (SSCM). Lack of green attitude among the stakeholders and lack of its awareness (products and processes) causes low level of green behavior in the people [27], [19], [10].

Green Procurement is the fifth largest barrier category that companies are facing against successful implementation of (SSCM). Green raw material that is to be used in manufacturing process is not readily used. There is lack of technical standards or environmental certifications which assists in purchasing or procuring green raw material [16], [10]. Green production is the sixth biggest hurdle category according to its weight in the barrier category. Green production includes using such processes which do not harm environment or its stakeholders in any way. Green production practices includes proper disposal of waste and Environmental Management System (EMS) which are not currently implemented as per the requirements [18], [16].

Green Logistics and Distribution is the seventh hurdle as barrier category as per its AHP weight. Companies need huge investment for transforming their current logistics and distribution network to green one. Investing in this department can reduce the negative impacts of non-environment friendly transportation on society. Green Culture and Involvement ranks eighth in the barrier category due to its major criterion weight. There is lack of green culture in the organizations which means involvement of the bottom employee and higher management is weak. Organizations hesitate while converting their systems from traditional to green; poor organizational structure and weak resources do not allow firms to implement (SSCM) in proper manner.

Green Competitiveness and Innovation ranks ninth in the barrier category according to its major criterion weight. The company's focus on conventional product development rather than green products in Pakistan. They do not focus on

developing sustainable green products in the market and keeping environmental database of such products. Knowledge Management ranks tenth in the barrier category due to its major criterion weight. Lack of knowledge sharing among the different departments of an organization is one of the main reasons which acts as barrier for textile industry. Other reasons responsible for creating as hurdles are lack of environmental and compliance programs and its verifiers [12]. Green Technology ranks eleventh in the barriers category due to its major criterion weight. Many factors are responsible for this category to act as barrier such as adoption of new technology, its optimum use, lack of technological and human resource capabilities for advanced technology designed for developing green products [2], [5].

Suppliers ranks twelfth in the barriers category due to its major criterion weight. Suppliers play vital role in the (SSCM) implementation because supply chain starts from the suppliers. There are multiple causes of it acting as hurdle for the companies such as supplier's selection on the basis of green criteria, evaluation of the suppliers on the basis of green criteria and Reduction in lead time, proper delivery of green raw material [23], [13], [17]. Financials rank thirteenth in the barriers category due to its major criterion weight. Financial acts as barriers for the firms due to high innovation, sunk costs, high disposal cost for hazardous waste material. Other factors include high investment and less rate of return and high cost of (SSCM) certification/verification for any company in Pakistan [4], [8]. Green Marketing in the barriers category is fourteenth due to its major criterion weight. It acts as barriers for the firms due to multiple reasons which are Lack of customer's awareness towards (SSCM) and Green products, Green Customer satisfaction and loyalty, Difficult to find Markets for green customers, Customization according to green customers and brand image of green products [21], [20].

Table 1. AHP Weights for the barrier category.

Major criterion	Major criterion Weights
Environmental aspects (E)	0.1362
Economic aspects (N)	0.1350
Social aspects (S)	0.1107
Regulation aspects (R)	0.1201
Green procurement (G)	0.0897
Green production (P)	0.0783
Green logistics and distribution (L)	0.0680
Green competitiveness and innovation (V)	0.0520
Knowledge management (K)	0.0437
Green technology (T)	0.0352
Green suppliers (S)	0.0301
Green culture and involvement (I)	0.0564
Financials (F)	0.0263
Green marketing (M)	0.0183

Authors own calculations

4.2. Fuzzy Technique for Order Performance by Similarity to Ideal Solution (FTOPSIS)

The results derived for the proposed TOPSIS framework show that *A*5 has the highest coefficient closeness value,

therefore implementation of (SSCM) in 12 months among the five alternative time windows should be recommended. Therefore, based on the (*CCi*) values, the ranking of alternatives in descending order are A5, A4, A3, A2 and A1. It is very difficult for the textile industry to implement (SSCM) at time zero or just now because a lot of potential gaps exist in capability and resources of supply chain. For instance, marketing-wise, the textile industry will generate more business opportunities if (SSCM) can be implemented at time zero since few competitors have already launched a similar green initiative. The implementation will not only improve the company's environmental performance, but also enhance the brand image in the market. Logistics-wise, it will also bring a substantial amount of uncertainty as it requires potential adjustments in internal and external operations which may increase the risk of experiencing adverse events across the supply chain. However, manufacturing-wise, the companies are less prepared in terms of manufacturing processes, production capacity and technical and innovation capabilities in implementing (SSCM) at the moment. Such a movement requires alterations in their internal and external operations and as a result, it may compromise the operations performance.

In fact, the company will be better positioned from the manufacturing perspective if implemented in 12-month time. The ideal solution is to implement the initiatives in 12-month time by which the company will still have the marketing advantages over its competitors while its operational resources are better prepared than now. It could be reflected in the further analysis of weighted performance ratings of five implementation time windows with respect to individual sub-criteria. It does not only indicate the important alternative ranking for implementing (SSCM), but also suggests the areas that the company is less prepared to handle the new requirements brought by the new (SSCM) initiative. Therefore, prompt actions and necessary modifications should be deployed to address these issues before the green initiative can be fully implemented. Based on the result analysis, demonstrated that (SSCM) is not only limited to the green technical aspects, but also on the non-environment criteria. In this way, the managers and decision-makers are able to understand and capture a complete picture of the context of (SSCM) implementation through the barrier assessment process. The proposed approach is useful for reviewing (SSCM) development, which can lead to improving productivity and sustaining the competitive advantages. The proposed hybrid fuzzy AHP-TOPSIS framework provides a practical decision support tool for (SSCM) implementation since it seeks to take explicit account of multi-criteria in aiding the decision making, and compares and ranks (SSCM) alternatives in indicator basis and as a system. The proposed model can be used for identifying improvement areas when implementing (SSCM) initiatives within the firm's operational conditions.

Table 2. *Fuzzy TOPSIS results and final ranking.*

Ranking of all alternatives by using CC formula					
Alternatives	D + Values	D – Values	Add D Values	CCj	Ranking
A1	1.1541	64.3596	65.5137	0.9824	5
A2	1.1341	64.3726	65.5067	0.9827	4
A3	1.0871	64.4363	65.5234	0.9834	3
A4	1.0769	64.4218	65.4987	0.9836	2
A5	0.3900	64.7344	65.1244	0.9940	1

Authors own calculation

5. Conclusion and Recommendations

5.1. Conclusion

Sustainable Supply Chain Management (SSCM) implementation is essential for industries. It needs cooperation from all the levels of employees of a firm, from low or bottom line to top management or decision making authority (Walker et al., 2008; Zhang et al., 2009; Zhu et al.2010). Recognition of essential barriers is complicated due to its several characteristics. This study is aimed at identifying common and essential barriers faced by the textile industry, presented a framework to be used by the field professionals and academicians for eradicating such hurdles. These barriers make successful implementation of (SSCM) difficult. Total 14 barriers were identified through extensive literature review and discussion with field experts. AHP has been used to rank or prioritize these essential barriers based upon their Global AHP Weight. These barriers cannot be removed at the same but will take time to be removed one by one for which time slot of 1year has been defined using TOPSIS which is considered to be best alternate time solution.

In the upcoming time, most producers will face ecological concerns in Asia. A large amount of the industries will modify their supply chain to environmentally sustainable supply chain through green procurement strategies. Green supply chain will be affected through purchase of such raw materials which are either reusable or already been recycled. Many hurdles can be anticipated while converting conventional supply chain management to sustainable supply chain management which affects its overall performance and are called barriers. There is a need to remove these barriers in order to implement (SSCM) effectively. These barriers are the real problems faced by the exporters of textile industry. Although all the barriers can be eradicated with the passage of time. Eradicating essential barriers is the need of textile industry in order to implement (SSCM) successfully.

5.2. Recommendations

Government can provide financial incentive to the firms following (SSCM). Such green practices would lead to more commitment from top management. Government needs to make customers aware about the green products and how they are beneficial and helpful to them. Advertisement campaigns by government departments should be made to increase awareness level of customers. when customers would be aware about the green products, they would prefer it. when a company would be successful locally then it can compete internationally and target foreign customers who are well aware about green products and (SSCM) concepts. ISO14001:2004 (Environment management system) and ISO 26000:2010 (Guidance on social responsibility) should be promoted by Pakistan Government.

Innovative green practices needs to be adopted in order to improve product design and find new market opportunities. Textile industry needs to adopt Green product development which considers environment friendly raw material and processes in developing a product. Sixteen, using green procurement can help the textile industry in acquiring green raw material which is to be used in the production processes. Seventeen, making the use of such cleaner advanced technology that minimizes waste and conserves energy. Eighteen, developing environmental and technical standards for purchasing green raw materials. Ninteen, suppliers with Environmental certifications needs to be preferred while purchasing green raw material. Twenty, using cleaner production processes that consider environmental impact through the use of manufacturing processes.

Investing in Research & Development of Green Products in order to sustain in the market and gain competitive advantage. Increasing the number of patents of green products would enable companies to acquire first mover advantage. Textile industry should promote green practices or green culture in their respective firms through employee's trainings, seminars and workshops. Green suppliers should be evaluated on green criteria. Twenty eight, green raw material needs to be easily available and at affordable prices. Green products should be developed according to the needs and wants of green consumers through proper marketing research. Green Technology can help in reducing the need for cutting more trees as most of the work would be done electronically. Top management can provide trainings to the employees on regular basis to create awareness about (SSCM), green practices and its complications.

5.3. Limitations and Future Research Scope

Same research can be applied to different industries and sectors of Pakistan like automobile, electrical and electronics, plastic and regions like Gulf and Asian Countries. Industry wise comparison can be made in order to know status of (SSCM) in Pakistan. More variables and sub-variables which have not been included in it like green supplier selection criteria, environmental and operational performance. Other multi-criteria techniques such as Decision Making Trial and Evaluation Laboratory (DEMATEL), Structural Equation Modeling (SEM), Analytic Network Process (ANP), fuzzy PROMETHEE, fuzzy ELECTRE, SAW and fuzzy VIKOR can applied to results of the textile industry. This study is based upon expert opinions which can vary from industry to industry depending upon their experience, knowledge and exposure. This research focused on manufacturing textile firms, same research can be carried out on services sector and comparison can be made between manufacturing and services sectors to know status of (SSCM) and its barriers. Drivers of (SSCM) can be also researched in the textile industry and other industries. Comparison can be made between manufacturing and services sectors to know status of (SSCM) and its drivers.

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