ANALYSIS OF SUSTAINABLE SUPPLY CHAIN BARRIERS IN AUTOMOTIVE INDUSTRY BY USING AHP TECHNIQUE

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Abstract

The paper proposes a system for identifying and rating small and medium scale firms that serve the automotive sector based on the sustainable supply chain. An increasing number of manufacturers are seeing significant and financial benefits from sustainable business practices. Sustainable production benefits, employees, the community and the product. The Indian subcontinent has a low level of understanding of these benefits, particularly among the small and medium sized firms (MSMEs). The literature was used to identify the barriers to a sustainable supply chain. understanding the factors that drive the sustainable manufacturing activities such as inhibitors and benefits is crucial. All the barriers have varied degrees of impact on the supply chain's long-term viability. As a result, these barriers must be rated. One of the Multi-Criteria Decision-Making techniques (MCDM) that can be used to weigh and rank these obstacles is the Analytical Hierarchical Process (AHP). On the basis of the ranking, important barriers are selected from the present list. Small and medium sized enterprises in the automotive industry have been choosen for this study and questionnaire on sustainable supply chain barriers sent asking them to score their level of agreement with the drivers, barriers and benefits of sustainable manufacturing activities. This research identifies three major aspects of sustainable supply constraints: Economic, Social, and Environmental. These three main elements of SSCM are referred to as the Triple Bottom Line (TBL) Concepts of Sustainable supply chains. These are analysed and ranked in this paper.

Key Words: Small and Medium Scale Enterprises, Barriers, Multi- criteria Decision Making, (MCDM), Analytical Hierarchical Process, Sustainable supply chain, Automotive Industry.

1. Introduction

In recent years, the term "Sustainability" has entered the corporate world. Increased knowledge of climate change, supply and demand characteristics in energy consumption and increasing openness in both environmental and social aspects of the organizational actions are some of the elements that contribute to the growth of sustainability [7]. Implementing sustainable supply chain management is a complex and tough endeavor due to its reliance and a wide range of circumstances. These aspects must be grasped in their whole as their interdependencies in order to execute SSCM effectively [1]. The priority methods to SSCM implementation in MSMEs are based on the respondent's assessment of the importance of SSCM, which has helped enterprises recognize their strengths and move towards continual improvement [2]. Both business management and operations have been described using the pharse "Sustainability" which refers to the integration of social, environmental, and economical responsibility. In addition, many practitioners and academicians are interested in supply chain management (SCM) [8][5]. The SSCM concept, which unifies environmental requirements corporate social responsibility (CSR) and supply chain management as a single intervention is gaining much more attention among Indian experts.[4]. The approach to adopting the SSCM in micro,

small and medium sized enterprises (MSMEs)should be revised in future studies to keep up with changing environmental requirements and customer wants. Adoption is hampered by supplier related constraints such as associated pricing, ease of use supplier legitimacy, and the novelty and execution of their offers, as well as intra administrative barriers such as organizational structure and culture. Supplier's activities, communications. And offers should be optimized and aligned to help to deactivate the hurdles.[3]. As a result, business managers are more effective at implementing sustainable practices, and facilities organizations in India are more effective at renovating current practices and developing new strategies [6]

2.Sustainable Supply Chain

Sustaining the network of supply chain or logistics of an organization is defined as follows: "A business issue that has an impact on a company's network of supply chain as well as logistics with sustainable components like wastage cost, risk involved, and the ecosystem. Environmentally responsible decisions are becoming increasingly important in supply chain arena. High level executives are increasingly aware that supply chain sustainability is critical to profitability on a long term, which has surpassed financial value, quality, and pace as the most frequently discussed components among the supply chain and purchasing experts. Early adopters and process innovators who take the advantage of value creation opportunities in sustainable supply chain will enjoy significant competitive advantages. When it comes to an organization, the supply chain is the link between its inputs and outputs. Lowering prices, ensuring Just-in – Time delivery, and shortening the transporting duration have all been traditional concerns in the past, allowing for quicker responses to corporate challenges in the present.

Many companies are turning to supply chain sustainability as a new criterion for establishing successful logistics management practices as a result of increased environmental expenses associated with these networks and rising consumer demand for environmentally friendly products. This paradigm change is reflected in the realization that sustainable chains are frequently profitable supply chains. Many of the organizations are only able to assess the long-term viability of their own operations, and are unable to do so for their suppliers or consumers. Their capacity to determine their genuine environmental costs is hampered by their inability to estimate their true environmental costs to eliminate waste from supply chain. The notion of supply chain sustainability has advanced significantly and benchmarking tools are now available to assist the organisations in developing and implementing sustainable action plans. In supply chain management, the multi-criteria decision-making process is a critical tool for decision makers. Since Bernoulli (1738) proposed the concept of utility function to reflect human pursuits like maximum satisfaction and Von Neumann and Morgenstern (1947) introduced the theory of game and economic behaviour model, which expanded studies on human economic behaviour for multiple attribute decision making (MADM) problems, there has been increase in the amount of literature in this field. In general, MADM procedure is given below.

In the first step we have to define the problem and its nature. Second step is the creation of a classification system for assessing it. Then deciding on an evaluation methodology that is most appropriate is the third step. Find the relative weights and performance scores for each attribute to determine which alternative has the best overall value in the fourth step. Now in the fifth step by using the synthetic utility values (the sum of relative weights and performance scores for each alternative) and the resulting performance scores choose the best alternative. Then adding step 6 to rank the options can help clarify any ambiguity in the final ratings for each alternative. Use the synthetic fuzzy utility values from step five for outranking the alternative.

By 1976, Keeney and Raiffa had defined five criterion parameters; they are fullness, usefulness, objectivistic, quasi and minimal size. By using the analytical hierarchical process (AHP) with the appropriate hierarchical structure was proposed to cope

with MADM difficulties. This chapter covers the eigen value technique, linear programming, lambda -mix technique and also geometrical mean technique for calculating weights from AHP data. When dealing with fuzzy numbers different strategies are used to deal with the AHP than the eigen value.

3. Analytical Hierarchical Process (AHP)

The Analytical hierarchical process (AHP) is a mathematical and psychological based method for organizing and analyzing complex decisions. According to AHP users must divide their decision-making problem into a hierarchy which are easier to understand the subproblems each of which can be examined independently. Any portion of the decision problem whether physical or intangible, rigorously measured or informally estimated well or very poorly understood or anything else can be referred to by the hierarchy's constituents. In general, AHP is having four steps.

1. Determine the unstructured problem's objective
2. Make a hierarchy from top to bottom with a list of options (objectives from a decision making stand point) maker's bottom (criteria on which subsequent levels are based). Make use of pair- wise comparison mechanism. To overcome this issue, a fundamental scale for pair-wise comparison was created.
3. The pair-wise comparison matrix X whose element x_{ij} represents the relative importance of the ith factor to the jth factor, can be calculated as

$$X=[A_{ij}]= \begin{matrix} 1 & x_{12} \dots & x_{1n} \\ \frac{1}{x_{12}} & 1 \dots & a_{12} \\ \frac{1}{x_{1n}} & \frac{1}{x_{12}} \dots & 1 \end{matrix}$$

4. For the development of the set of matrices in step3, n(n-1) / judgements are required. Each pairwise comparison where 'n' is the matrix size, is automatically allocated reciprocals.

4. Methodology

ABC is a large-scale Automotive industry based in Pune. The ABC is itself has established some 65% of the automotive components in the country. Hence forth ABC outsources some of its auto components material from Micro, Small, and Medium scale enterprises (MSMEs) in and around Pune industrial belt which is particularly called as Maharashtra Industrial Development corporation (MIDC). The contribution of these MSMEs to the ABC company is considerable. There are more than 500 MSMEs in and around Pune MIDC limit which are adopted by ABC company. But still these MSME sector is facing lot of challenges and problems like network inefficiency in supply chain, higher competition in domestic and global market, lot of uncertainties in domestic market conditions, legislations on environment, shortage of funds and growth of sustainability.

A detailed study was conducted for this ABC company to study the barriers both internal as well as external and also the drivers (Triple Bottom Line) for the sustainable manufacturing. This study is mainly to evaluate the impact of different factors and also the feasibility of implementation of sustainable manufacturing with due respect to the suppliers of the automotive industry. Based on the data some important factors can be selected which can be used to rank the industries based on their implementation of these barriers which are sustainable.

4.1 Solution Methodology

For the sustainable supply chain two main factors are affecting. They are Drivers and Barriers. The factors which encourage for the implementation of sustainable supply chain are the drivers. And the factors which exhibit obstacles or a problem from implementing the sustainable supply chain are termed as Barriers. Now the barriers are classified into three types. They are Social Environmental and Economical. (TBL)

MCDM Technique used
Analytical Hierarchical Process (AHP)
The Analytical Hierarchical Process (AHP) is a mathematical and psychological based method for the purpose of organizing and complex decisions.
The pairwise comparison data is given in table 2. The table 2 gives comparison data for AHP

and also for Fuzzy AHP tools. It is the data for comparison between three broad barriers of Triple Bottom Line (TBL) viz, Social, Economic and Environmental.

Calculations and Observation

In the first step the pairwise comparison of the three categories of barriers viz, social, economic, and environmental was calculated.

In the second step by using the Analytical hierarchy Process (AHP), the barriers are ranked in broad classification. This ranking is given in table 2

In the third step 13 economical barriers are compared to the remaining 12 barriers resulting in a pairwise comparison matrix.

In the fourth step for ranking the economic barriers on its own weight, AHP is used.

In the fifth step, the same procedure will be followed for the remaining 10 environmental and 21 social barriers which will be compared using pairwise comparison and ranked by using AHP

Now in Table 3, the top ranks of the social, economic and environmental barriers are given.

5. Results and Discussions

In this study more than 100 ABC suppliers have been participated. All the suppliers were from small and medium scale industries. 20 influential factors of sustainable supply chain management are found and these factors were ranked and presented in Table 3.

The critical barriers which were identified are

a) Economic: Lack of infrastructure, Cost of implementation, Lack of Information Technology infrastructure, Uncertain benefits, Economies of scale and market share, Absence of Economic incentive policies, limited access to finance, Lack of potential to save money and remain competitive.

b) Environmental: Lack of Environmental awareness, expertise, and understanding of strategies for addressing the different environment issues, SME's perception on Environmental impact assessment, Very little awareness on present environmental laws and regulations, SME's challenge for influencing their suppliers for improvement in environmental or green practices.

c) Social: Resistance to change, lack of vision, lack of preparation, lack of standardization and data, organizational culture, lack of understanding and knowledge.

Table-I Social Economical and Environmental Barriers

Social	Economical	Environmental
Lack of vision	Technology	Issues related to Environment
Lack of preparation	Lack of infrastructure	Environment
Lack of standardization and data	Cost of implementation	Lack of Environment Awareness
Improper implementation	Lack of suitable tools	Management of wastages
Lack of knowledge and understanding of Sustainability	Uncertain benefits	Supply chain routes which are very long and energy intensive one
Resistance to change	Size of the organization	Lack of effective evaluation measures
Market competition	Limited access to financial matters	Poor level of understanding of basic principles of environment
Ethics, policies and procedures	Cost for eco-packaging	Being compliances – driven and reactive to environmental issues
Industry standards and Audits.	Very high cost for hazardous waste disposal	

Supplier commitment	Economic incentive policies absences	
Weak legislation	Market share and Economies of scale	
Credibility and ease of use	Lack of IT infrastructure	
Creativity and Execution	Competitiveness	
Law enforcement		
Low customer demand		
Organizational structure and culture		
Technological Risk		
Uncertain future legislation		

TABLE 2 Ranking the main criteria using AHP technique

Criteria/ Criteria	QDP	CC	RSST	Total	Root	WT	Rank
Economical	1	2	2	5	1.71	0.37	1
Social	0.5	1	0.33	1.83	1.22	0.27	3
Environmental	0.5	3	1	4.5	1.65	0.36	2
Total						4.58	

TABLE 3 Top ranking the main criteria using AHP technique

Social	Economic	Environmental	Ranking the criteria
Lack of preparation	Cost of implementation	Lack of Expertise and understanding of strategies to address issues of Environmental concerns	1
Lack of understanding and knowledge	Limited access to Finance	Lack of awareness of existing environmental regulations	2
Organizational culture	Lack of Infrastructure	Lack of environmental awareness	3
Lack of vision	Lack of potential to save money and remain competitive		4
Lack of data and standardization	Lack of IT infrastructure		5
Resistance to change	Uncertain Benefits		6
	Economic Incentive Absence		7

	Market share and Economies of share		8

Conclusion

The economic barriers are considered to be more substantial than the social and environmental barriers as a result of the findings. The major hurdles in each area are identified and included in a questionnaire based on the preceding findings. The future research will be based on the results of this questionnaire, which were issued to industries to rate them on the level of sustainability implementation and supplier assortment. Rankings and comparisons of criteria will be provided with ABC suppliers, resulting in a clear knowledge of which factors should be prioritised when creating a sustainable supply chain. Furthermore, a study of the elements that influence Sustainable Supply Chain will aid in the efficient implementation of Sustainable Supply Chain. The study's findings will also assist ABC's suppliers in better understanding of sustainable supply chain practices.

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