

Combined Traditional & Green Supplier Selection Criteria used in Indian Chemical Industries

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Abstract

Supply chain is a network of supplier, manufacturing, assembly, distribution and logistics facilities that perform the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these products to customers. With increasing concern towards environmental protection, industries in western countries have already started considering green factors unlike the Indian chemical industries which are still very much reliable on traditional factors than green factors in supply chain management. The objective of this study is to identify the traditional and green supplier evaluation criteria taken together, which are considered very important across the Chemical Industries in India. This paper also highlights the main important criteria for supplier selection by combining traditional and green criteria in supply chain management.

Keywords- Supply Chain Management, Green Supply chain, Traditional Supply Chain, Indian Chemical Industries, SPSS

I. INTRODUCTION

Supply Chain Management is defined as the expansive network of activities which are necessary to plan, control, and execute a product's flow, from procuring the raw materials then through production to its final customer in the most significant and cost effective way possible. The creation of Supply chain started in early 1940s and 50s where the main focus was to build a mechanization to improve material handling. The "Unit Load" concept was used in transport management [1]. Traditionally supplier selection has concentrated on single objective i.e. lower the cost, whereas green supply chain considers the crucial aspect of decrease the consumption of natural resources and energy [9]. Supplier selection criterion often involves multi-criteria decision making process, which involves several contradictory factors. Plenty of the research studies addressed a variety of traditional supplier selection criteria but in the past two decades, some researchers have been focusing on green (environmental) criteria in supplier selection. Dealing with traditional or green criteria will not give full fairness in supplier selection process.

This paper is an attempt to find out combined traditional and green supplier selection criteria for chemical industries based in India. Total five criteria, mainly cost, quality, delivery, Manufacturing according to environment requirement and environmental performance were considered along with 20 sub-criteria. After introduction, section 2 contains the reasons for selection of chemical industries. Review of relevant research is given in section 3. Section 4 contains the research methodology. The result and analysis of the various factors of combined traditional and green supplier selection criteria is given in section 5. Finally, the conclusion is presented in section 6.

II. CHEMICAL INDUSTRY

The Indian Chemical Industry comprises both small and large-scale units, and presently, there are about 70,000 chemical manufacturing units located in the country (Source: Dept. Of Chemicals and Petrochemicals-Draft National Chemical Policy-December 2013) a major component (in numbers) is covered in the small scale sector, which has helped it gain the sixth spot in the list of largest chemical producers in the world and the 3rd spot in list of Asia. Opportunities for the Indian Chemical Industries are increased demand for value-added products, expanding export in emerging markets and introducing green factors along with traditional factors.

The chemical sector covers hundreds of segments, to which supply chain and logistics are vital to chemicals companies' success because they represent a high share of cost and are critical for service level and top-line results. They are a means for

chemicals companies to fight back against the pressure imposed by fuel price increases. To alleviate such pressures and overcome challenges such as accurate asset management across its various segments, chemical companies must combine the traditional factors along with green factors to deploy a fully scalable and interoperable solution to gain an accurate view into their supply chain issues.

III. LITERATURE REVIEW

Arntzen, Brown, Harrison and Trafton (1995) have established comprehensive deterministic model for supply chain management. The objective function reduces a combination of cost and time related elements [2]. Ramdas and Spekman (2000) have put forth six variables that reflect various approaches in measuring supply chain management performance; which included, inventory, time, order fulfilment, quality and customer satisfaction [5]. Dickson and Weber et.al traditional supplier selection criteria was reviewed, ranked and compared by Ashish J. Deshmukh and Archana A. Chaudhari (2011) from 1992-2007 [7]. The very first green supply chain management came into context in 1989; Kelle and Silvers (1989) article was the first that developed an optimal forecasting system for organizations to forecast product that can potentially be re-used [4]. A. Deshmukh and H. Vasudevan (2014) considered a systematic and integrated approach for supplier selection and suggested that more concern is required towards environmental protection [8]. A. Deshmukh and H. Vasudevan (2016) examined the practices and issues related to the implementation of traditional and green supplier selection criteria among various MSMEs based in India [9]. The proposed approach consisted of 12 criteria.

Eco efficiency and remanufacturing processes are now important assets to achieve best practice according to Ashley (1993) and Srivastava (2007) [3]. Yeh and Chuang (2011) developed two multi objective generic algorithms for green partner selection. They have considered green image, product recycling, and pollution treatment cost and environment performance assessment as important criteria [6].

IV. RESEARCH METHODOLOGY

Based on the literature review and detailed discussion with the experts from the industry, major three traditional factors and two green factors were decided. The factors are- Cost, Quality, Delivery, Engineering Manufacturing Management and Engineering Manufacturing Assessment. Each major factor contains four sub factors. Based on these factors, a questionnaire was designed and prepared. Each criterion in the questionnaire was judged on a five point Likert Scale, where 1 = very low, 2 = low, 3 = moderate, 4 = high and 5 = very high were clearly mentioned. Reliability Analysis is done to study the properties of the scales of measurement and the elements that constitute them. The Reliability assessment was conducted on "Statistical Package for the Social Sciences (SPSS)" software. The test was conducted to find out its Cronbach alpha, mean and standard deviation. Mean or Statistical mean is the average that is used to derive the central tendency of the data. Standard Deviation is as statistical quantity which expresses how much a group of data differs from its mean value.

V. ANALYSIS AND RESULTS

The following are the results obtained on SPSS software from the data collected via the responses to the questionnaire by the industrial experts

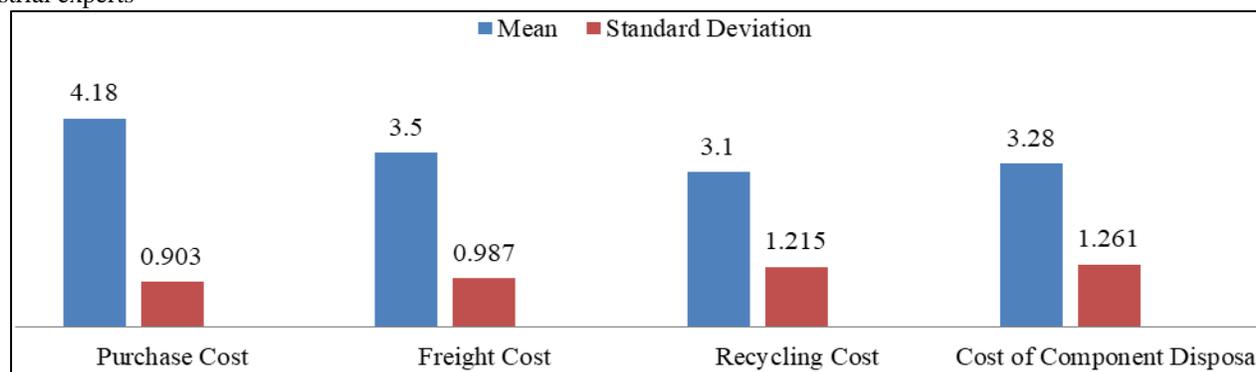


Fig. 1: Mean and Standard Deviation for Sub-Factors of Cost

The above figure no. 1 gives us a detailed view of how the mean and standard deviation varies among the four sub factors of Cost. We can observe that even though purchase cost has been the highest priority among the companies with a mean value of 4.18, Cost of Component Disposal with its mean value 3.28 is also highly practised suggesting that the companies are moving their focus on waste management. Freight cost has a mean value 3.50 which suggests that high priority is given to it since it is an important factor when it comes to keeping the supply chain flexible. Recycling Cost is being given a low priority compared to all other costs with a mean value of 3.10. Thus it is evident that the companies are still using their traditional factors for their supplier selection.

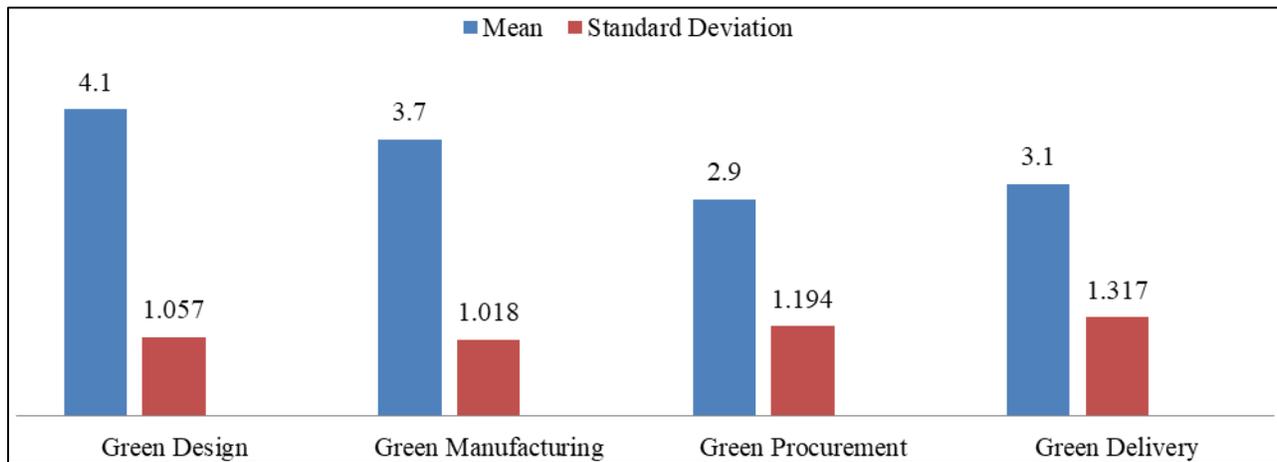


Fig. 2: Mean and Standard Deviation for Sub-Factors of EMM

Since customers are interested in environmental sustainability, the companies are giving more priority to green design with its mean value 4.10 and green manufacturing (3.70). Green manufacturing can help reduce harmful emissions and can work towards preserving resources that are finite and non-renewable. Green delivery comes third when being practised by chemical companies with a mean value of 3.10. It deals with transportation of the product to the customer keeping in mind the environmental effects the delivery process can have. Since Green Procurement is difficult to execute because of less green raw materials being available, it has been given the lowest score in terms of practice. The value of Green procurement is 2.90.

Similarly, we carried out the analysis for factors of Quality, Delivery, and Environmental Manufacturing Assessment. The figures 3, 4 and 5 below depict the results of quality, delivery and environmental manufacturing management.

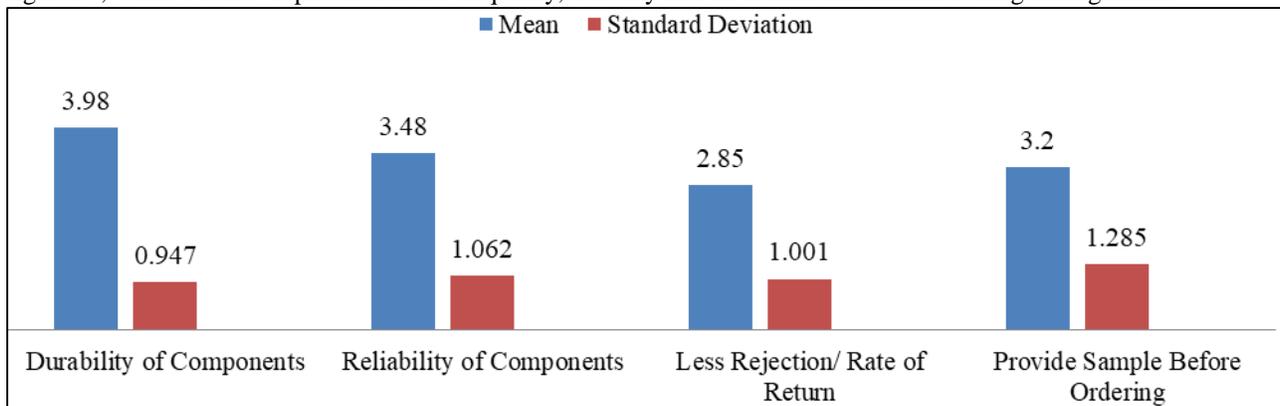


Fig. 3: Mean and Standard Deviation for Sub-Factors of Quality

We have observed that Durability and Reliability have been given utmost importance with mean values of 3.98 and 3.48 respectively since they are the basis on which a customer decides if the product has been satisfactory or not. The practice of providing a sample before ordering ranks 3rd among the other factors and has a mean value of 3.20. These practices have been used for a long time to reduce losses if the product fails to meet its requirements. The rate of return is the lowest practice executed with a mean value of 2.85.

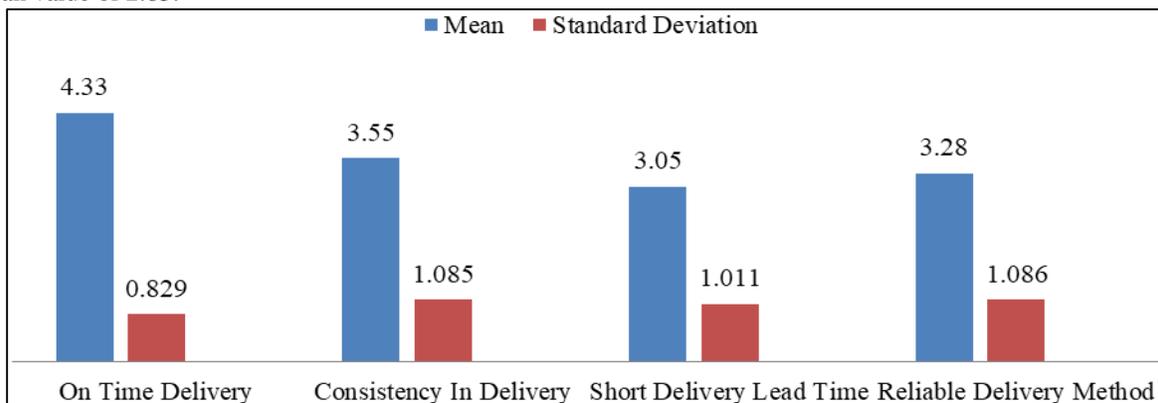


Fig. 4: Mean and Standard Deviation for Sub-Factors of Delivery

When it comes to Deliverance, On Time Delivery has been emphasized more over other delivery factors. The mean value of On Time Delivery is highest with a value of 4.33. Since customer's value consistency from their providers, Consistency in Delivery (Mean Value-3.55) is given a high priority over Reliable Delivery Method (Mean Value-3.28). . Although Short Delivery Lead Time can have an impact on customer's satisfaction, it is very difficult to achieve which is also being reflected in the graph denoting that it is being practiced on a low priority basis (Mean Value-3.05)

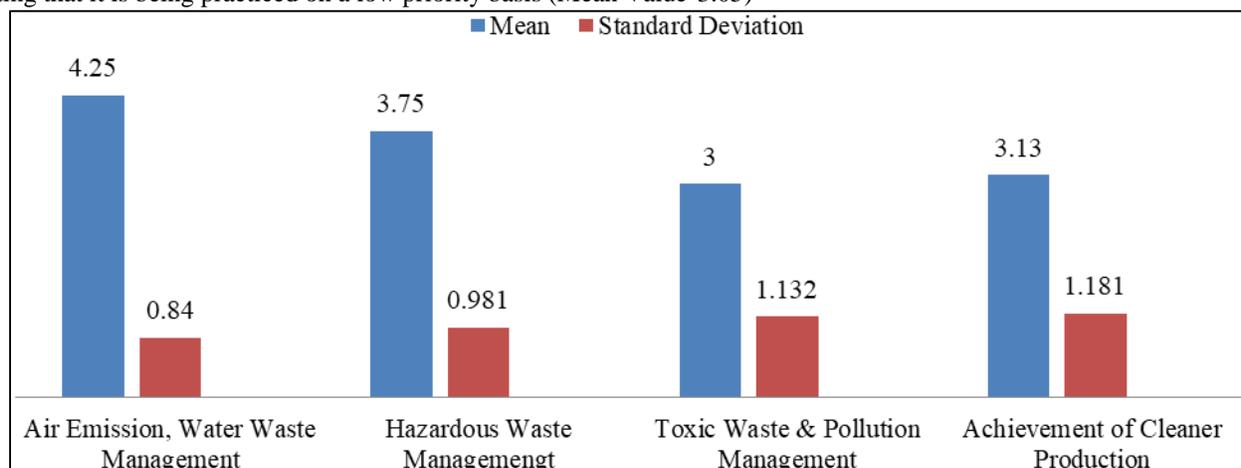


Fig. 5: Mean and Standard Deviation for Sub-Factors of EMA

EMA ensures a high level of protection of human health and environment. There have been incidences where casualties were caused due to harmful emissions in the air as well as in water. Hence chemical companies give higher priority to Air Emission, Water Waste Management having mean value of 4.25 compared to other factors. Among the other factors considered, we can observe that Management of Hazardous (Mean Value-3.75) waste has been one of the main practices being executed as Hazardous substances can be a real threat to the environment as well as human life. When compared to Toxic Waste and Pollution Management, the companies today are investing more in Achievement of Cleaner Production which is also evident in the figure as it has a mean value of 3.13 while Toxic Waste and Pollution Management has a mean value of 3.

VI. CONCLUSION

Supply Chain Management is an area of importance in the field of management researches. The environmental and social issues have become very important for managing any business. Green supply chain management considers ecological causes as well as economic concern as their objective, while traditional supply chain management concentrated only on economic aspect. However there have been very few efforts being made to combine techniques of traditional along with green supply chain management. From the study it is evident that the industries and organisations in India focus more on traditional criteria on large scale than green aspects for the supply chain management. With the growing environmental awareness it is the need of the hour to include green criteria in the supply chain management techniques. Therefore, we conclude that there is an utmost need to consider the green criteria in supply chain management. We also observed that although Indian chemical industries give priority to traditional supplier selection criteria in their supply chain management process; nowadays, slow and gradual change in the focus from traditional to green supply chain management is evident. With the implementation of traditional and green criteria, the combined effect will effectively improve the industry's supply chain management.

REFERENCES

- [1] Adam Robinson (2015), (Infographic) the Evolution & History of Supply Chain Management.
- [2] Arntzen B. C., Brown G. G., Harrison T.P. and Trafton L. (1995), Global Supply Chain Management at Digital Equipment Corporation, Interfaces, Vol. 25, No. 1, pp-69-93
- [3] Ashly, S. (1993), Designing for the environment, Green Supply Chain Management: A Literature Review, Otago Management Graduate Review, Vol. 7, pp.53-54
- [4] Kelle, P., Silver, E.A., (1989), Forecasting the returns of reusable containers, Journal of Operations Management, Vol. 8, No. 1, pp. 17-35.
- [5] Ramdas k, And Spekman, R.E. (2000), Chain or Schackles: Understanding what drives supply chain performance, Interfaces, Vol. 30, No. 4, pp. 3-21.
- [6] Yeh and Chuang (2001) Using multi objective genetic algorithm for partner selection in green supply chain problems, A Study on Green Supplier Selection in Dynamic Environment, pp. 2-3
- [7] A. Deshmukh and A. Chaudhari, (2011), "A Review for Supplier Selection Criteria and Methods" Technology System and Management, Springer, 145, 283-291.
- [8] A. Deshmukh and H. Vasudevan, (2014), "Emerging supplier selection criterion in the context of traditional and green supply chain management", International Journal of Managing Value and Supply Chain (IJMVSC), Vol. 5, No.1, pp.19-33.
- [9] A. Deshmukh and H. Vasudevan, (2016) "Analysis of Supplier Selection Criteria in Traditional as well as Green Supply Chain Management in Indian MSMEs, International journal of Business Quantitative Economics and Applied Management Research, Vol. 3, No. 3, pp. 73-85.