Measurement of Effectiveness of Flexibility in Sustainable Supply Chain

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Abstract

In today industrial environment, flexibility is considered as an important differentiator for sustainable management in supply chain. Several researches already emphasized the need for flexibility although little attention has been paid on flexibility factors in sustainable supply chain. In this paper, different flexibility in sustainable supply chain has been identified and analyzed. Clear understanding of these flexibilities will help organizations to manage their resources in an efficient and effective way for sustainable management in supply chain. The proposed competitiveness index will help practicing managers to understand the weak areas. The present research work has immense theoretical importance and helpful for practitioners working on flexibility in sustainable supply chain management.

Keywords: Sustainable supply chain, Flexibility factors, ISM.

1. Introduction

Supply chain management (SCM) is an effective approach through which links between the factors is established and the production of the company increased with cost reduction. In present business scenario, there is need of optimization of business activities. This gave rise to the adoption of SCM principles in service sectors (Pramod and Banwet, 2010). Supply chain management has different issues which affect the supply chain, like risk management, operational management and sustainable supply chain management. Sustainability in supply chain includes social, economical and environmental aspects and encourage for better improvement in life cycle of products and services. Sustainable supply chain management can be regarded as the improved management of supply chains regarding social, economic and environmental issues. Through the integration of these issues, SCM plays an important role both in supply chain and environmental management (Correia et al., 2017). The main drivers for this transition have the rapid consumption and increasing pollution of natural resources due to massive economic development and uncontrolled urbanization (Salmona et.al 2010). The sustainable supply chain management reduces the cost of the product and increased the customer's satisfaction, sales of the product and the overall efficiency of the firm (Kananan et al., 2016). Flexible production is the key of sustainable supply chain. Flexibility plays an important role in the production system. Flexibility is essential for sustainable management in supply chain with competitiveness. Managers need to focus on total flexibility rather than individuals. Today FMSs are not restricted to the machining parts, but is used in every phase of a manufacturing process (Rao and parnichkun 2009; Dubey & Ali, 2014). To produce products of global quality and according to the customer's need, Indian industries have to adapt flexibility in their manufacturing systems. Today there is emphasis on quality and variety than on quantity (Dubey & Ali, 2014). To beat competition in the market industries have to be agile and adaptable. According to the market needs Indian industries realizes the need for flexible sustainable supply chain. For the analysis of flexibilities in sustainable supply chain management, a method of effectiveness index is used. The main objective of this paper is

- To identify and analyze the impact of different flexibility in sustainable supply chain.

2. Literature Review

Sandeepa and Chand (2018) discussed the structural relationship among the flexibilities in supply chain. Dubey et al. (2017) suggested a SSCM framework contributing to knowledge-based view theory and systems theory (ST). Stephen and Brain (2003) present a framework for analyzing the benefits of flexibility in multistage supply chains, and develop a flexibility measure. Karen et al. (2012) developed a multifaceted scale for supply chain flexibility through an empirical investigation. They consider supply chain flexibility can be operationalized as a second-order factor model consisting of four dimensions, i.e. source, operations, distributions and information flexibility. Gong (2008) developed a model to measure supply chain flexibility with total system flexibility measured by an economic index. This flexibility model comprises labour flexibility, machine flexibility and routing flexibility. Kanchan Das (2011) firstly develops models for capacity, product mix, distribution and input supply flexibility and determines their optimal flexibility with mathematical programming model whose objective is profit maximization. Lee et al. (2010) present a method for measuring supply chain flexibility. Three unilateral flexibility measures (time, quantity and cash-flow flexibility) were put forward for each node enterprise. Then, the supply chain flexibility was integrated as a weighted sum of the three measures. Neural network method was used to determine the weights of the three unilateral measures. Before Lee et al. (2010) and Pujawan (2004) conducted a similar research in which presents a framework for assessing supply chain flexibility. Four dimensions of flexibility are identified including flexibility of product delivery system, production system, product development and supply system. Beamon (1999) measures supply chain performance using three indicators (resources, output and flexibility), and identifies four types of flexibility in a supply chain: volume flexibility, delivery flexibility, mix flexibility and new product flexibility. Sharma and Dagar (2015) identified the different type of flexibilities and analyzed them using W-ISM technique.

Table 1: Flexibility with their definitions

S. No.	Flexibility	Definition
1	Environmental flexibility	Firm ability to response to change in its environmental to rapidly and slow cost.
2	Technological Flexibility	The dimension of process flexibility refers to the ability of a technology's technical and management processes to accommodate change.
3	Manufacturing Flexibility	A flexible manufacturing system (FMS) is a manufacturing system in which there is some amount of flexibility that allows the system to react in case of changes, whether predicted or unpredicted.
4	Sourcing Flexibility	Sourcing flexibility is an increasingly important building block of supply chain flexibility
5	Vendor flexibility	Vendor flexibility. Vendor flexibility refers to the collective types of flexibilities offered by different vendors in the supply chain.
6	Logistics flexibility	Flexibility in logistics management is one of the most important challenges. It includes quickly response as per industry requirement.
7	Supplier flexibility	Suppliers' flexibility is considered as a tool to cope with the environmental uncertainties. It includes providing the row material as per demand fluctuations.

8	Machine flexibility	Machine flexibility is the ability to create different product types or change the order in how processes are operated.
9	Employee flexibility	Flexibility in the workplace allows employers and employees to make arrangements about working conditions that suit them.

3. Evaluation of effectiveness index

For the evaluation of effectiveness index, a questionnaire was designed on a five-point Likert scale. It consists of different flexibility of sustainable supply chain. Nine flexibilities are considered through literature and discussions with experts which are shown in Table 1. The respondents were asked to indicate the level of difficulty in managing these flexibility in sustainable supply chain, on the Likert scale, 1 for not at all and 5 for very important.

For computing the effectiveness index the mean score with their rank of flexibility factors has been calculated on the basis of Table 2. After this rank, inverse rank and weight for each factor is to be finding out. For assigning weight to different factors of effectiveness index, the highest and lowest values of five point Likert scale i.e. 5 and 1 are mapped 100% and 0% respectively. For each of the issues of effectiveness a weight is assigned. The criteria for weight (W_i) is as under:

$W_i = +1$ (Strength), when percentage score $> 60\%$ (Mean value > 3).

$= 0$ (Neutral), when percentage score is between 40-60% Mean value between 2 and 3).

$= -1$ (Weakness), when percentage score $< 40\%$ (Mean value < 2). This framework was given by Cleveland et al 1989 is $C_j = \sum [W_i \log K_i]$. Chand and Singh (2010) have also used this model for study the select issues of supply chain management.

Sum of entries of last column ($W_i \log K_i$), will give effectiveness index i.e. 5.257. Theoretically, effectiveness index value may range between -5.558 to +5.558. Computation of effectiveness index for this study is illustrated with the help of a worksheet as shown in Table 2.

Table-2: Rank Distribution

S. No.	Flexibility	Mean	Rank	Inverse Rank(K_i)	Log K_i	Weight (W_i)	$W_i \times \log K_i$
1	Environmental flexibility	4.21	1	9	.954	+1	.954
2	Technological Flexibility	4.05	2	8	.903	+1	.903
3	Manufacturing Flexibility	3.89	3	7	.845	+1	.845
4	Sourcing Flexibility	3.61	4	6	.778	+1	.778
5	Vendor flexibility	3.49	5	5	.698	+1	.698
6	Logistics flexibility	3.26	6	4	.602	+1	.602
7	Supplier flexibility	3.16	7	3	.477	+1	.477
8	Machine flexibility	2.98	8	2	.301	0	.000
9	Employee flexibility	2.83	9	1	.000	0	.000

4. Results and conclusion

Based on response from questionnaire survey on various flexibility factors, effectiveness index for the flexibilities in sustainable supply chain has been evaluated (Table 2). Effectiveness index has been found to be 5.257. Maximum value can reach up to 5.558. Presently effectiveness index of this study among these factors is quite high. It has been observed that organizations are doing quite well in environmental flexibility, technological flexibility, manufacturing flexibility, sourcing flexibility, vendor flexibility, logistics flexibility

and in supplier flexibility but still there is a need of improvement in machine flexibility and employee flexibility. This approach can be utilized by the organization to benchmark its performance with national and international standards. It can also help in strength and weakness analysis of the organizations. The identified factors need to be overcome by the management of the firms. This research indicates that different supply chains have different flexibility. We need to identify what is the most appropriate magnitude of flexibility to specific supply chains, and how to obtain the flexibility.

5. References

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