Sustainability Evaluation of Supply Chain and Value Chain Activities

Vishal Sharma[1], Sunil Giri[2]

[1]*The Managment School, Kathua Campus, University Of Jammu, Jammu & Kashmir, India.*
Email-id: vishalsharma027@gmail.com

[2] *School Of Business, College Of Management, Shri Mata Vaishno Devi University, Jammu & Kashmir, India.*

Abstract

As a developing nation, India has moved from an agriculture-based economy to an industrialized economy in which manufacturing is well thought-out to be the one of the key contributor towards environmental concerns. These considerations forces firms into seriously considering the environmental impact while doing their business. The study examines that how the various sustainable activities are done by different organization in the area of supply chain & value chain. A primary survey was carried out among 120 manufacturing firms in Jammu region.

Keywords: Sustainability, Supply Chain Management, Value Chain Activities.

1. Introduction

Supply Chain Management is an integrative philosophy to manage the total flow of a channel from the earliest supplier of raw materials to the ultimate customer; company's survival & growth are highly effected by their supply chain practices. Specifically the service level and cost when changes affect the performance of organization.SCM is "the integration of key business processes from end user through original suppliers that provides products, services, and information that adds value for customers and other stakeholders" Jimenez, J.B & Lorente, J.J.C.,(2001). It follows that SCM involves integration, co-ordination and collaboration across organisations and throughout the supply chain. It means that SCM requires internal (intra organisational) and external (inter organisational) integration.

Recent developments in the world economic climate create uncertainty in the business environment, which creates the

necessity for organizations to look at reconstructing and restructuring to enhance their strategy to sustain the business and profitability while remaining competitive in the marketplace. Additionally, organizations are facing increasing global community inquiries through media and non-governmental organizations (NGOs) pertaining to the sustainability aspect of their development Lambert, D.M(1998). According to Porter and Kramer Kleindorfer et.al (2005), companies are increasingly expected to extend their sustainability efforts beyond their own operations to include those of their suppliers and to meet their customer's sustainability expectations. Forward thinking companies are already taking steps to develop sustainability within their supply chains. According to Carter and Jennings Carter, C.R & Jennings, M.M(2004) , the supply chains need to be closed-looped, environmentally friendly and conserve and use as few resources as possible. Thus, many researchers claimed that the future of supply chain management is sustainability Carter, C.R & Jennings, M.M(2004). McKone-Sweet (2004) claimed that companies are under pressure to improve the social and environmental standards wherever they can exert their influence, for instance, at their suppliers and further along the supply chain. Most of these pressures focus on the outsourcing activities from large Western firms that source input from low cost manufacturers and service providers in developing countries by ignoring the social and environmental deteriorating issues with respect to supporting the short-term profitability of the organizations Johansson, A (1992). Sustainability is increasingly discussed by policy makers (President's Council on Sustainable Development, 1996; American Chamber of Commerce of Europe, 2004) and journals in various technical fields. While the first consideration of sustainability can be traced back to practices of many ancient cultures, more recent attention toward

sustainability and the environment can be found in the works of economists and philosophers Harding, G (1968).

2. Literature Review

According to Jimenez and Lorente(2001),environm entalpurchasing considers the issue of sustainability in their purchasing of inputs on top of the traditional purchasing criteria, which only focuses on cost, quality, and delivery Hoole, R (2005).. More holistic definition of Environmental Purchasing, which is also applied in this research: ‘‘Environmental purchasing for an individual firm is the set of purchasing policies held ,actions taken ,and relationships formed in response to concerns associated with the natural environment. These concerns relate to the acquisition of raw materials, including supplier selection, evaluation and development, suppliers operations, in-bound distribution, packaging, recycling,reuse Leenders et.al (2006). Supply chain performance has indeed become an important source of sustainable advantage in many industries due to the increase in global competition from the supply chain perspective Harding, G (1968).

Organizations should focus on the overall supply chain performance as this is a direct indication of the firm’s performance , which means that supply chain management has a dual role to improve individual firm performance and also the overall supply chain performance King, A.A & Lennox, M.J, (2001).During the last two decades, the focus on optimizing operations has moved from a specific facility or organization to the entire supply chain. By optimizing along the entire sequence of steps that are involved in the production of a product whether it is a good or service, the greatest value can be produced at the lowest possible cost King, A.A & Lennox, M.J, (2001). In many cases, this approach requires organizations to operate sub-optimally from a cost perspective to create the greatest possible value along the entire supply chain Kleindorfer, P.R., Singhal, K. & Wassenhove, L.N.V (2005). A focus on supply chains is a step towards the broader adoption and development of sustainability, since the supply chain considers the product from initial processing of raw materials to delivery to the customer. However, sustainability also must integrate issues and flows that extend beyond the core of supply chain management: product design, manufacturing by-products, by-products produced during product use, product life extension, product end-of-life, and recovery processes at end-of-life. Techniques such as life cycle assessment Lambert, D.M(1998) are used to assist in the determination of how to design a product to minimize its environmental impact over its useable life and afterwards Kemp, R., (1994). This field at the interface of engineering, product design and engineering considers resource depletion as well as environmental impacts. Manufacturing by-products Consideration of the extended supply chain includes the reduction and elimination of by-products through cleaner process technologies Johansson, A (1992) and quality and lean production techniques King, A.A & Lennox, M.J, (2001).

3. Research Methodology

The review of literature suggest that in order to find various activities of an organization that have an impact on sustainable practises followed by an organization we adopted the quantitative method employing personal (direct) survey was selected and for this purpose the descriptive type of research has been done. The study is based upon the primary survey and data was collected from 120 manufacturing units in Jammu region from J&K state of INDIA with the help of a well designed pre-tested structured questionnaire. The present study is descriptive and conclusive in nature and the sampling technique used was convenience sampling. The function of descriptive statistical analysis has been performed for each of the section and also factor analysis was used to get the respective factor loadings; which signifies the respective important variable of that factor; with the help of SPSS.

The deduced variables are modelled as linear combinations of the potential factors, plus “error” terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. After getting the factor loadings we can quantify the relationship between quality and other selected variables. The linear regression model has been used; as stated in equation (i).

$$Y = \beta_0 + \beta_1 Y_{1+} \beta 2Y2 + - - - + \beta_n Y_{n+} \mu \quad (i)$$

$$\text{Here; } S = f(Y_1 + Y_2 + ---- Y_n) \quad (ii)$$

Where S is sustainability is variable. Then data is interpreted along with the analysis to make it more understandable to evaluate the impact of various variables.

Table 1: Reliability Statistics

Cronbach’s Alpha	N of Items
0.907	95

4. RESULTS

Table 1 shows the reliability of the data. The sample was first checked for the reliability using Cronbach's Alpha. A value of 0.6 or less generally indicates unsatisfactory results.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		***.796***
Bartlett's Test of Sphericity	Approx. Chi-Square	1677.182
	Df	120
	Sig.	.000

The acceptable score of reliability coefficient of Cronbach Alpha is 0.5-0.6 here the value of cronbach alpha for the sample selected for the study came .796 which is greater than .6; it implies that data collected was reliable.

4.1 Factor Loading Tables

Results of the factor analysis are shown below for the various considered variables.

Table 3: Environmental & Economic Variables

	Factor Loadings
Hazardous gases emission control is your concern.	0.909
Quality is one of the main concerns of manufacturing.	0.907
Being efficient is our concern always.	0.927
Being responsive towards demand is our priority.	0.826
Various kinds of quality norms are being followed by your organization.	0.918
We keep on improving and become more efficient.	0.77
Land & soil quality has degraded over the period of time.	0.934
Natural resources management need to be looked upon continuously.	0.904
Water usage is done properly in the manufacturing plant.	0.879
Climate is affected by the various manufacturing units.	0.828
We follow all the environmental norms strictly.	0.8

Table 4: Social variables

Health & safety should not be compromised for making profits.	***0.943***
Relationship with supply chain members is necessary.	0.908
Personnel management needs to be best for organizational growth.	0.877
You owe to the society for using its resources.	0.815
Noise and other kinds of manufacturing process are kept under the check.	0.787

Table 5: Environmental Purchasing Variables

Purchases recycled packaging	***0.745***
Purchase packaging that is of light weight.	0.795
Uses an evaluation system to find the environmental friendliness of products & packaging.	0.724
Asks suppliers to commit to waste reduction goals.	-0.38
Participation in the design of products for recycling or reuse.	0.37

Table 6: Sustainable Packaging Variables

Meets market criteria for performance and Cost.	***-0.111***
Maximise the use of renewable or recycled source materials.	0.52
Manufactured using clean production technologies& best practices.	0.879
Physically designed to optimize materials & energy.	0.885

Table 7: Inbound Logistics variables

Environmental collaboration with suppliers is necessary.	***0.931***
Supplier's requirements have the environmental certification.	0.924
Most of products purchased are eco labelled.	0.722
Adoption of environmental criteria for supplier assessment system.	0.678

Table 8: Production Variables

We go for alternative fuel usage.	***0.828***
We are concerned about the gases emissions	0.756
Adoption of cleaner technology is our concern.	0.649
We are concerned about the treatment of hazardous waste.	0.578

Table 9: Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df 2	Sig. F Change
1	.954	.910	.906	.14400	.910	230.400	5	114	.000

Table 10: β values

	Unstandardized Coefficients		***StandardizeCoefficients***		
	B	***Std. Error***	***Beta***	***t***	***Sig.***
(Constant)	2.782	.401		6.936	.000
Inbound Logistics	.121	.061	.200	1.973	.051
Production	-.006	.057	-.010	-.108	.914
Outbound Logistics	-.311	.066	-.509	-4.749	.000
Warehousing	.065	.052	.107	1.250	.214
Product Design and reuse	.153	.054	.251	2.847	.005
Sustainable Activities	.104	.066	.167	1.584	.016
Environmental Purchasing	.110	.061	.172	1.812	.073
Sustainable Packaging	-.153	.059	-.241	-2.584	.011

As the tabular value of R square is 0.910 which shows that we can ascertain a relationship between sustainability and different the variables selected in the study.

From the table 10 it can be easily concluded that some of the variables are significant at 5% of significance. The β-table shows that only the variables like inbound logistics, outbound logistics, product design and reuse, sustainable activities, environmental purchasing and sustainable packaging are significant factors that affects the sustainability.

Using the regression analysis; the equation between the quality and the other variables can be formulated as shown below:-

$S = 0.121\ X_1 - 0.006\ X_2 - 0.311X_3 + 0.065\ X_4 + 0.153\ X_5 + 0.104X_6 + 0.110X_7 - 0.153X_8 + 2.782 + \mu$ (error)

Where,

S = Sustainability; X1 = Inbound Logistics; X_2 = Production; X_3 = Outbound Logistics.

X_4 = Warehousing; X_5 = Product Design & Reus; X_6 = Sustainable Activities

X_7= Environmental Purchasing; X8= Sustainable Packaging.

5. Conclusion

As the connection between markets and sources, demand and supply has increased the strategic relevance of SCM, in today's competitive world maintaining an efficient and flexible supply chain became critical for every enterprise. With the increasing acceptance of ISO 14001 environmental standards, there is a greater role for supply chain management in organizational environmental practice (Sarkis, 2003). In order to retain and strengthen their competitive edge in the market, organizations need to coordinate and integrate all their business operations with sustainability considerations. A focus on supply chain is a step towards the broader adoption and development of sustainability, since the supply chain considers the product from initial processing of raw materials to delivery to the customer. However, sustainability also must integrate issues and flows that extend beyond the core of supply chain management: product design, manufacturing by-products, by-products produced during product use, product life extension, product end-of-life, and recovery processes at end-of-life (Linton et al., 2007).

Factor analysis & regression results shows that we can ascertain a relationship between sustainability factors (environmental, economic, social and operational) & various value chain & supply chain activities. Now-a-days,

sustainability is receiving a growing level of attention at both the local and global levels, which ultimately leads to questions on how to put together sustainability with industry operations and strategy. Sustainable supply chain management could be a good means to extend the responsibility of business organizations from being reactive in reducing pollution and waste and other sustainable related efforts, to proactively assuming full responsibility for their products from acquisition of raw materials to the final disposal of the products from a sustainability perspective. Sustainable practices will lead to a efficient use of resources, material and waste, thereby enabling better resource utilization, and play a significant role in achieving the 'triple bottom line 'of social, environmental, and economic performance, and, thus, contributing to sustainable development of the country. So if a little effort is put in the sustainability side of value chain & supply chain activities we can easily quantify the sustainability practices on the basis of these two activities; as our study shows that some of the supply chain and value chain activities are vital for assessing the sustainability of the various manufacturing units which is in concordance with the study by Kleindorfer, Singhal and Wassenhove(2005).

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