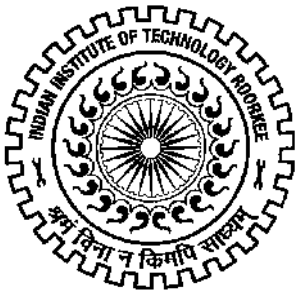
ANALYSIS OF SUSTAINABLE SUPPLY CHAIN MANAGEMENT PRACTICES IN INDIAN MANUFACTURING INDUSTRIES

Ph.D THESIS

by

KOTTALA SRIYOGI



DEPARTMENT OF MANAGEMENT STUDIES
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE - 247667, (INDIA)
DECEMBER, 2012

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A THESIS

Submitted in partial fulfilment of the
requirements for the award of the degree of

DOCTOR OF PHILOSOPHY
in
MANAGEMENT STUDIES

by

KOTTALA SRIYOGI

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DECEMBER, 2012

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in this thesis entitled **ANALYSIS OF SUSTIANABLE SUPPLY CHAIN MANAGEMENT PRACTICES IN INDIAN MANUFACTURING INDUSTRIES** in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy and submitted in the Department of Management Studies, Indian Institute of Technology Roorkee, Roorkee is an authentic record of my own work carried out during the period from December, 2009 to December,2012 under the joint supervision of Dr Rajat Agrawal, Assistant Professor, Dr Vinay Sharma, Assistant Professor, Department of Management Studies, Indian Institute of Technology Roorkee, Roorkee, India.

The matter presented in this thesis has not been submitted by me for the award of any other degree of this or any other Institute.

(KOTTALA SRIYOGI)

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

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Supervisor

(Rajat Agrawal)
Supervisor

Date: /12/2012

The Ph.D. Viva-Voce Examination of **Mr.Kottala Sriyogi**, Research Scholar, has been held on

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Signature of Supervisor's Chairman, SRC Signature of External Examiner

Head of the Department/Chairman, ODC

ABSTRACT

Economic liberalization and globalization projected India as industrialized emerging economy with large pool of talent i.e young engineers, scientists which are available for reasonable cost without compromising on the quality during the latest decade. Due to industrialization in 1991 there is amount up in production and consumption of different commodities which have negative implications on the society and environment. Because of the ever increasing climate change among the developed nations like the U.S.A, European Union have started outsourcing or start their new manufacturing facilities in the developing economies like India,china,Indonesia, Taiwan etc., Due to these coming up new manufacturing facilities which have both positive and negative effects on India positive effects are significant contribution for GDP growth, increase in IIP, job opportunities, negative effects are considerable amount of damage to the society, environment and a stressful work environment for the workforce. Thus the emerging issues have emplaced the need for greater emphasis on the concept called 'Sustainability'. As in the process of manufacturing it involves procurement of raw materials, production processes, work in process, finished goods, distribution and warehousing all these activities which can be quoted under the single umbrella term called "Supply Chain Management"(SCM).To minimize or to avoid the negative impacts across the processes in the manufacturing another emerging concept called the sustainable supply chains to sustain the economic growth while prioritizing the environmental and social issues.

In this present work, an empirical investigation has been presented on the analysis of sustainable supply chain management practices with reference to Indian manufacturing industries further analyzed the awareness, importance of sustainability, influencing factors and reasons to adopt this concept. The proposed factor structure for supply chain management policy, SCM performance, environmental impacts, social sustainable performance indicators and sustainability as business opportunity development with relevance to the Indian manufacturing industries. To observe the SCM performance of the companies practicing the concept of sustainability. To find some of the best sustainable supply chain management practices being practiced among the Indian manufacturing industries.

The proposed factor structure, frame work used for evaluation of SCM performance, case studies used for Sustainable supply chain management practices are original and has strong pragmatic pertinent and can be conformable by organizations with the minimum changes in their prevailing work structure.

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My heartfelt thanks also go out to K.Srinivas Reddy, Dr.A.Dalpati, D.Venkateswaraulu, Imran Khan, Devander Singh, Amarnath Sarangalu, and Rajeev Gupta. I wish to thank all my friends in IIT Roorkee and outside who made my research journey fruitful and enjoyable. I gratefully acknowledge the support extended by father Sri K.Maheswara Rao & mother Smt K.Shayamala. My wife Smt .Sridevi and son.Kovid.

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Finally, I wish to thank my organization, Guru Ghasidas Vishwavidyalaya, Bilaspur Chattisgarh for extending the support in writing this thesis.

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CHAPTER 1
Introduction

1. Introduction

World all around us in a mad race of progress. The meaning of progress is considered to be material development. Since time immemorial, wealth creation is one of the important duties of human life. Development of subjects like management is also aimed towards developing, maintaining and improving systems which can produce outputs with minimum inputs, output can be increased. In last 100 years different management tools are helping in improving economic activities targeted towards high level of customer satisfaction. Supply chain management is integration of efforts of different partners of supply chain. These efforts are normally to achieve higher customer satisfaction, reduced cost of product, efficient use of resources etc., Unabted use of natural resources and increasing pattern of consumption of resources have started posing many threats to civilization. Sustainable supply chain management (SSCM) is a term came into existence to find newer ways to address various problems related to environment, society and economy with customer satisfaction.

1.1 Indian economy and policy reforms

In 1991, the Indian government has credibly altered its industrial policy approach. The need for a complete systemic change led to the liberalisation of state controls, a larger role of the private players and amplified competition to the aim of superior integration with the world economy (Goldar and Kumari, 2003; Goldar and Aggarwal, 2005; Gurtoo, 2009). In veracity, promotion of economic growth and maturity since new industrial guidelines made Indian economy as one of the best ever rising economies in the world. Indian government is highly focused on bringing changes into the economy and to promote economic growth, balanced region, sustainability and employment (e.g. Ahluwalia, 2002; Dongre, 2011).

Historically, India is the largest democratic country in the world and it has come a long way since independence in 1947. Its main strength is availability of copious manpower. The country has been on growth trajectory in all fields as a planned economy thus becoming a safe and attractive destination for foreign investment. Accordingly, policy reforms have been achieved a higher growth path, decline in poverty, made the external sector more comfortable, restored industrial growth and with economic constancy in the country. The economic reforms process has brought forth a rupture of new entrepreneurial energies across the board in almost all

sectors.

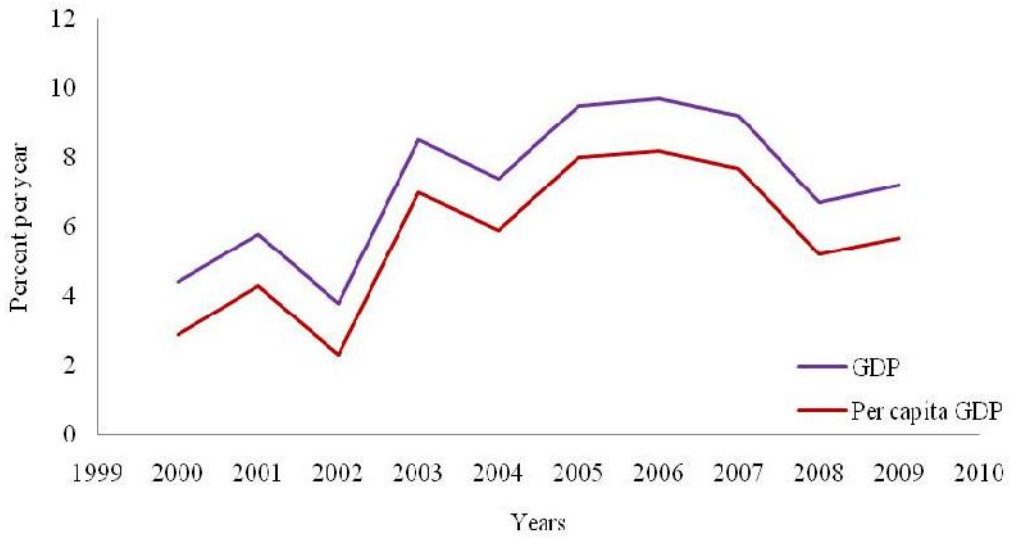


Figure no: 1.1 India's Recent Growth Path, 2000-2009

(Source: Estimated from data from the World Bank's Global Database, May 2007 and Government of India 2010)

These reforms in industrial and trade policy were an innermost focus of much of India's reorganization attempt in the early stages. Hence, industrial policy prior to the reforms was branded by numerous controls over private investment that limited the areas in which private investors were allowed to operate and often also determined the scale of operations, the location of new investment and even the technology to be used (Ahluwalia, 2002, p. 71). The growth rate in recent years of 2002–2006, if sustained, will further reinforce India's position. This could make India the world's second fastest growing economy after China. However, despite the rapid growth for the past 26 years, in per capita terms India is still a very low income economy given the very late start of its development. The broad sectoral composition of growth by decades is shown in Table 2, for example agriculture grew the slowest, at only 2.6 per cent per year during 1950–2009. In contrast, both industry and services grew more than twice as fast, at about 5.8 and 6.0 percent respectively per year.

Table 1.1. India's Sectoral Composition of Growth, 1950–2009
(*Percent per year*)

	Agriculture	Industry	Services	Total
1950–60	3.0	6.2	4.3	3.9
1960–70	2.3	5.5	4.8	3.7
1970–80	1.5	4.0	4.4	3.1
1980–90	3.4	7.1	6.7	5.8
1990–2000	2.5	5.6	7.6	5.9
2000–2009	2.6	7.6	9.1	7.2
1950–80	2.3	5.2	4.5	3.6
1980–2009	2.8	6.8	7.8	6.3
1950–2009	2.6	6.0	6.2	4.9

(Source: World Bank Central Database, May 2007 and Government of India 2010)

1.2 Role of Manufacturing in India's Development

Manufacturing sector has performed exponentially in the last few years. With the remarkable growth in the different segments of the manufacturing sector, all eyes are set on how the future of the industry will shape up in India. A realistic assessment gives confidence that there is no dramatic decline in store for the sector—whether globally or in India. In fact, there are opportunities to tap into certain sectors for both champions of productivity and participants in global value chains. But at the same time, a churning is bound to happen on a large scale. There will be success stories alongside closures. Winners and losers would get separated—across sectors and within.

India becomes a base for export to third world countries. For example, Hyundai Motors is using India as export base for foreign markets, currently exporting to eight countries and looking forward to expand the same to markets in the European Union and Latin America. The company has also set up an R&D centre at its Chennai plant. India has world-class R&D facilities.

It has come out as a global manufacturing hub with the presence of MNCs such as LG, Samsung, Hyundai, Pepsi, GE, General Motors, Ford and Suzuki. India has increased implementation of state-of-the-art IT technologies and presently, the IT usage is approximately 15%. The sectors showing high potential are automobiles, textiles, steel, aluminum, cement, auto ancillaries, forging and pharmaceuticals.

The manufacturing sector in India has been pioneering value chain as well. Whether it is in automobiles or technology, a large number of MNCs see India as favourable destination for investment. For instance, various companies in automobile industry plan to set up plants in India and those having their base plan for major expansion of their existing units. The world's leading auto part makers have relocated their product lines to India. Many leading car manufacturers are currently using India as a manufacturing and export base for their products.

Indian textile industry is all set for a big leap in the global market and is in a very buoyant mood. In 2005, an additional Rs 20,000 crore was invested in the industry and in 2006, a further Rs 30,000 crore is expected to be invested, which means the textile entrepreneurs can foresee a very bright future. According to World Trade Organisation, 2005 onwards, India will grant product patent recognition to all new chemical entities i.e, bulk drugs. The Indian Government's decision to allow 100% foreign direct investment into the drugs and pharmaceutical industry is expected to aid the growth of contract research in the country. Apart from manufacture of drugs, the pharmaceutical industry offers huge scope for outsourcing of clinical research. India has enormous opportunities in exports, and the potential to become a global hub in the area of R&D-based clinical research outsourcing, particularly in biotechnology. The Indian pharmaceutical industry is also getting increasingly FDA-compliant to harness the growth opportunities in areas of contract manufacturing and research. Indian pharmaceutical companies are increasingly focusing on tapping US generic market, which is expected be more than US$51.7 billion by 2010 from US$28.1 billion in 2005.

Electronic Manufacturing Service (EMS) is another sector that has been witnessing a lot of developments over the last couple of years. The EMS market in India is estimated to reach US$4.57 billion by 2010.

Table: 1.2 Facts: Manufacturing Sector in India

GDP(2005-06 E at Current prices)	US $ 711 billion
GDP growth rate (Real GDP)	8.4% (2005)
GDP composition by Sector (2005-06)	Agriculture-19.9% Industry-26.1% Services-54%
Average Annual Growth Rate (Manufacturing Sector)	9%(2005)

(Source: Central statistical Organisation, GoI)

India's economy grew 7.7% in the three months from April to June, compared with the same period of 2010. It was India's weakest growth for six quarters, but still better than had been expected. The gross domestic product (GDP) growth figure from the finance ministry compares with the annual rate of 7.8% in the first three months of the year. The slowdown is expected to continue as India's central bank continues to raise interest rates to control inflation. The Reserve Bank of India (RBI) has raised interest rates 11 times since March 2010. Farm output rose 3.9% which was down from the previous quarter but above the level of 2.4% in the same period last year. The manufacturing sector grew 7.2 %, an improvement from the previous quarter, but well below the 10.6% in the second quarter of 2010.

Industrial growth is driven by robust performance of the manufacturing sector, which has increased steadily from 8.1% in 2003-04 to 9% in 2005-06, when the Indian economy registered an excellent growth rate of 8.4%. The manufacturing sector played a significant role in achieving this higher economic growth rate. It has become a major driving force for the Indian economy and is well poised to create millions of new jobs.

The contribution of manufacturing sector to India's GDP today is just over 15%. The global trends reflect that manufacturing in low cost countries like India will gather momentum over the next decade. This in turn will improve the contribution of manufacturing sector to the GDP of the country. The industry is increasingly focusing on reducing cost through innovations at all levels to take on global competition

India's manufacturing sector is catching up but it is far behind the other emerging economies. In 2004, manufacturing sector's contribution to China's GDP was 36%, while in India it was only 16%. Therefore, manufacturing sector in China plays a crucial role in the robust growth of its GDP.
India has emerged as one of the world's top ten countries in industrial production as per UNIDO's new report titled 'Year book of Industrial Statistics 2010'. India surpassed Canada, Brazil, Mexico in 2009 to reach the 9^{th} position from the 12^{th} position it held in 2008.

The Index of Industrial Production (IIP) quick estimates data for October 2010 shows a growth of 11.3 percent in the manufacturing sector as compared to October 2009. The cumulative growth during April-October 2009-10 over the corresponding period of 2008-09 is 11 percent, according to data by the Ministry of Statistics and Programme Implementation.

1.3. Significance of Manufacturing Industry in Indian Economy

The secondary sector has attained an important place in the Indian economy over the years. Besides being a significant contributor to the GDP growth, it is the second largest employment provider to the country's skilled as well as unskilled labor force and a major export contributor. India needs a strong manufacturing sector for the following reasons:

The Indian population is estimated to grow by 2.15% annually, whereas the growth of agriculture the major employment providing sector has been a meagre 0.99% over past five years. Moreover, the availability of arable land in agriculture is also declining. Therefore, the surplus labor force in the agriculture sector can be absorbed only in the manufacturing sector. Thus, the workforce in manufacturing sector must be increased to off-set the pressure on agriculture sector and increase income levels, especially in rural areas.

Agriculture, engaging 60% of the working population, contributed only 19.9% to the GDP in 2005-06. This mismatch between distribution of workforce and value addition in agriculture, which is expected to further widen in the coming decades, is one of the main reasons for the high levels of poverty. Therefore, considerable shift of workforce from agriculture to manufacturing will help to improve rural incomes and reduce poverty levels.

Share of the manufacturing sector in India's GDP has remained stable at around 15% while in China, the manufacturing sector accounted for over 36% of the GDP and in Thailand, for over 37% in 2003-04.

1.4 GDP Break-Up and Share of Manufacturing Sector

The Indian economy is experiencing a mixed trend in the changing equations of the importance of its constituent sectors (primary, secondary and tertiary). The importance of its primary sector is declining while secondary sector is gaining gradually, and tertiary sector is growing fast and emerging as a major contributor to the country's booming economy, as is happening world over. The sectoral contribution of the Indian economy from 1999-2000 to 2005-06 shows the definitive structural transformation that characterized Indian economy.

Table: 1.3 Sectoral share of GDP

Year	Agricultural and allied sectors	Secondary	Tertiary sector	Manufacturing sector	Share of manufacturing sector in secondary sector GDP
1999-2000	25.33	25.42	49.25	14.74	57.91
2000-01	24.27	25.90	49.83	15.22	58.75
2001-02	24.36	25.16	50.48	14.75	58.64
2002-03	21.86	25.94	52.20	15.19	58.54
2002-04	22.18	25.74	52.01	15.00	58.26
2004-05	22.78	26.00	51.22	15.01	57.97
2005-06	19.91	26.10	54.01	15.15	58.10

(Source : Ministry of statistics and programme implementation, GOI)

1.5 Growth Trends

India is ranked second in terms of manufacturing competence, according to report '2010 Global Manufacturing competitiveness index' by Deloitte Touche Tohmatsu and the US council on competitiveness. The report states that the country's talent pool of scientists, researchers, and together with its English speaking workforce and democratic regime make it an attractive destination for manufacturers.

As per the Industrial outlook survey conducted by the Reserve Bank of India (RBI) for October-December 2010 quarter the Indian manufacturing sector showed positive overall business sentiment in the quarter. The Business Expectation Index (BEI), which acts as a barometer of the overall health of the manufacturing sector, has gone up to 126.5 for the assessment quarter, its highest reading since April June 2007. Around 50 segments in the manufacturing sector grew by 39 percent, entering the 'excellent growth, during April-December 2010-11, according to a survey done by the Confederation of Indian Industry (CII) and ASCON. Segments in the excellent category included airconditioners, naturalgas, tractors, nitrogen fertilizers, ballbearings, electrical and cable wires, auto components, construction equipment, electric fans and tyre industry.

Further, 22 segments made it to the 'high growth' category, registering a growth of 17.3 percent during the first nine months of the 2010. Industries such as utility vehicles, crude oil, power transformers, energy meters, alcoholic beverages and textile machinery have registered around 10-20 percent growth.

1.5.1 Global Manufacturing Hub

India is fast emerging as a global manufacturing hub with a large number of companies shifting their manufacturing base to the country. Moreover, India has the largest number of companies, except Japan, that have been recognized for excellence in quality. As many as 21 companies have received the Deming Excellence awards; 153 companies have achieved Total Productive Maintenance (TPM) excellence award for their total productivity management practices by the Japan institute of Plant Maintenance (JIPM) committee.

1.5.2 Government Initiatives

The government has issued the new consolidated Foreign Direct Investment (FDI) Policy document, which has come into effect from April 1st, 2010.

Moreover as per Union minister of commerce and Industry, the government launched National Manufacturing Policy from January 2011. For setting up of National Manufacturing and Investment Zones (NMIZs).

Main objectives of NMIZ's are:

- To Promote investments in the manufacturing sector and make the country a hub for both domestic and international markets,
- To increase the sectoral share of manufacturing in GDP to 25 percent by 2022.
- To double the current employment level in the sector and
- To enhance global competitiveness of the sector.

1.6 Challenges of Indian Manufacturing Sector

Many India firms are building up the global supply capability model by accessing the China market for components, acquiring stake in foreign companies to facilitate marketing, servicing, and establishing local assembly and/or manufacturing units abroad (for example, TVS Motors and Bajaj in Indonesia). This is a completely new mindset of globalising Indian companies.

There are several critical areas in the manufacturing chain that could derail India's effort to become a manufacturing centre, let alone competing and taking over from china in this regard.

The key obstacle for India is its poor infrastructure, especially in ports and shipping facilities and power. These are important entities and India need to invest significantly in infrastructure. Equally important but perhaps less challenging is the need of India to build the reputation of the "Made in India" brand label.

Many favourable factors resulted in significant progress in Indian Manufacturing sector. However, it faces several serious challenges, which thwart the expansion of its manufacturing sector. Nonetheless, despite these hindrances India has been able to achieve impressive growth in the manufacturing sector in recent years. (Ramaswamy, 2007).

65% of manufacturing goods are being exported which is a remarkable growth relatively impressive performance by Indian manufacturing sector.

India has clearly made a significant beginning towards creating an environment for sustained strong industrial growth. Indian policy makers and global manufacturers, however, must realize that sizable challenges remain in infrastructure, finance, regulation, income distribution, and labour surpluses. (Waldman, 2009)

China and India have grown rapidly in recent years. The rise of India and China over the last decade should in many respects be viewed as a return to the historical status quo rather than a recent phenomenon. When the ancient European civilizations of Greece and Rome were reaching their heights, the civilizations of China and India were already mature and prosperous.

The motor behind China and India's economic rise has been export orientated regional clusters specializing in particular activities. However this model of development is now coming under increasing pressure, particularly in the fastest growing regions. Shortages of skilled labor are generating double digit wage growth, while infrastructure often fails to keep pace with economic growth.

Combined with exchange rate appreciation and higher transport costs, China and India's low cost advantage is being eroded. Although they are optimistic about future prospects, Chinese and Indian businesses see a range of potential constraints on their future growth. This is driving more strategic overseas investments, mergers and acquisitions aimed at securing market access and improving their skills and innovation capabilities. (Mawson *et al.*2009).

Both countries are being adversely affected by the global downturn brought about by the credit crunch; China in particular is overly reliant on external demand to fuel growth. If the downturn were to lead to an increase in protectionism their export led growth model leaves them vulnerable. They need to re balance their economies; China towards domestic demand, while India cannot sustain its current rates of growth purely on the back of service sector exports.

A slowdown or reversal of china's reforms would lead to business activity being choked off by factors such as bureaucracy, corruption and lack of access to finance. They have a shortage of natural resources; China's per capita stocks of water, arable land and minerals are well below the world average, India is also highly dependent on imports of raw materials, in particular petroleum and its related products.

China's production methods are environmentally unsustainable, with a high energy intensity of GDP and pollution discharges per unit of output, India performs better in this regard, but its manufacturing sector is only now entering a high growth phase. Their advantage as low cost production centers is being eroded by rising wage costs due to shortages of skilled labor in fast growing regions.

The manufacturing sector faces several significant challenges: a shortage of lending, currency volatility, and fears over the sustainability of supply chains and downward pressure on prices.
While the crisis was a shock to manufacturing, it added to, rather than fundamentally changed the long-term structural changes and challenges that manufacturer's face. One clear trend is the shift of manufacturing activities from West to East. The entrance of China and other Asian nations into the world trade system has greatly increased industrial capacity.
This has led to downward pressure on wage costs, particularly in labor intensive low skill manufacturing sub-sectors; which has in turn forced many western companies to close factories and move production from their home country to offshore locations. (Thornton, 2010)

For India, whose savings rate is not high, the government has faced severe challenges in using investment to boost growth. The current savings ratio of India is around 26 per cent. To achieve the growth target of seven to eight per cent in the coming years, the ratio of gross capital formation to GDP should be in the range of 29 to 33 per cent, a ratio similar to those in Japan, the Republic of Korea and China when they achieved the same per capita GDP.

Low income countries tend to grow faster than mature economies for a long time. Then their growth rate levels off and declines drastically when they approach the technological frontier (Cooper 2005). Since China and India are not yet even halfway through the catching up period and their productivity gaps with leading economies are large, they are expected to enjoy high growth for the next three decades or more, provided that no major disruptions or external shocks occur. (Li and Zhang, 2008)

To sustain rapid economic growth, China and India must redress a multitude of imbalances and challenges. Though manufacturing and services have been the growth engines of the two countries respectively, it seems lopsided development could constitute a constraint to more broad based growth.

China needs to boost the service sector in order to generate jobs and expand domestic demand, while India needs the manufacturing sector to stimulate economic growth. The insertion into the international supply chain carries the risks of locking into low end and labor intensive manufacturing or service provision if relying too much on foreign capital and technology. Thus, technology upgrading is essential for their long-term economic growth. (Li and Zhang, 2008)

The manufacturing sector, especially the organized manufacturing, has failed to generate adequate employment. The primary reason for this is widespread automation and decline in labor intensity, principally in response to the prevailing policy regime, in both organized and unorganized sectors.

India's prospects for successfully making the transition to mass manufacturing and emerging as a hub for manufacturing exports. The main challenges in doing so are the low level of R&D and scarcity of skilled personnel in India. Other impediments to the realization of this transition, essential for generating the required employment opportunities, are inadequate infrastructure, entry and exit barriers and low volumes of foreign direct investment.

Sustaining a rapid growth of manufacturing and achieving the transition to mass manufacturing requires another major push to the reform agenda. In the absence of these reforms, the manufacturing sector will continue to retain its dualistic structure and be unable to address the apparent trade-off between growth and equity that can be best addressed by massive expansion in manufacturing sector employment. (Kumar and Gupta, 2008)

The Indian manufacturing scene is marked by enterprises producing at competitive prices and quality though the sector is yet to access the vast marketing possibility available at the bottom of the income pyramid. India is the fourth largest economy in the world with an average growth of 5.7 per cent for nearly last quarter of a century; the country is also the global leader in software development and also in business process outsourcing. The challenges before the manufacturing sector in the country are varied and include the case of high import duty, high incidence of direct taxes and low operating efficiency.

Challenges faced by the Indian manufacturing warrant appropriate responses from both the government as well as the industry for improving the competitiveness of the sector.

- There are a few areas where both the government and the industry need to put in efforts through a well-designed Public-Private partnership mode:

  The manufacturing sector needs to access the vast market possibilities available at the bottom of the income pyramid in the country.
- The first essentiality for ensuring manufacturing competitiveness is macroeconomic stability.
- Lowering the cost of manufacturing and improving the quality are essential for competitiveness.
- The inverted duty structure caused by Free Trade Agreements (FTA) as well as in all cases even otherwise needs to be rectified.
- Domestic indirect taxes are often singled out as a major reason why Indian manufacturing is uncompetitive.
- Each labor legislation has a separate inspector and visits of inspectors are not synchronized across all labor enactments.

Procedures connected with export incentives/ subsidies continue to be cumbersome. These need to be simplified on a priority basis. Steps should be taken to attract FDI. There is no denying that India has underperformed in attracting FDI. High interest rates and availability of credit are problems which hinder the growth of the industry. Innovation holds the key to increasing productivity. The government should consider establishing technology parks. The manufacturing sector is critically dependent on the infrastructure facilities particularly, in transportation sector - roads, railways, ports, airports etc. for movement of goods. It is estimated that power shortage alone contributes to the production loss of at least one percent of GDP.

1.7 Supply Chain Management

Supply chain: A supply chain is a network of (physical and decision making) activities connected by material and information flows that cross organizational boundaries. The aim of the supply chain is to produce value for the ultimate consumer whilst satisfying other stakeholders in the SC.

The supply chain is often referred to as a value chain. A typical supply chain includes information, funds and physical material flows, which run parallel to the Value chain.

Supply chain management:

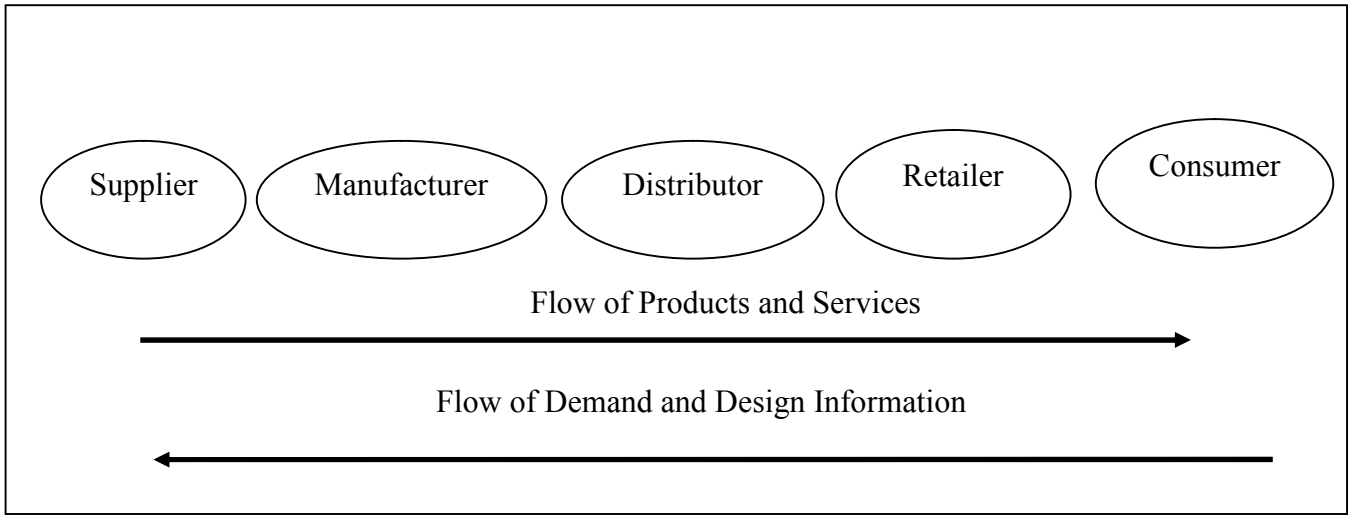
The term 'Supply Chain Management' (SCM) first appeared in logistics literature in 1982 as an inventory management approach with an emphasis on the supply of raw materials.

Four characteristics of SCM:

1. SCM views the SC as a single entity. Therefore, it does not delegate fragmented responsibility for various segments in the SC to functional areas such as purchasing, manufacturing, distribution and sales.
2. Supply is a shared objective of practically every function in the chain. It is of particular strategic significance because of its impact on overall costs and market share.
3. SCM provides a different perspective on inventories, which are used as a balancing mechanism of last, not first, resort.
4. SCM requires a new approach to systems: integration, not simply interface, is the key.

According to Beamon (1999), " a supply chain is an integrated process where in raw materials are manufactured into final products, then delivered to customers (via distribution, retail, or both)." The supply chain includes all activities in the flow and conversion of goods from raw material to final consumer (Handfield & Nichols, 1999). A typical supply chain is shown in Figure 1.1.

Figure 1.2: Typical Supply Chain



(Source: Midha et al. (2007)

Some supply chain models omit the customer, arguing that the customer does not add value. However, customers do add value by providing feedback to the supply chain about quality, cost, delivery, and other measures. It is important for supply chain members to understand the needs of their customers in order to provide value-added features.

The concept of supply chain management is defined as "the systemic, strategic coordination or the traditional business functions within a particular company or across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (Mentzer et al., 2001; Mentzer, Myers, & Stank, 2007). It includes all activities from concept to consumer. According to Handfield and Nichols (1999), supply chain management – the integration of all the activities in producing a product – is used to create a competitive advantage by strengthening relationships among supply chain members.

Supply chain management (SCM) is a promising area in achieving sustainability. The management of the supply chain is an important element in attempts by business to lower its environmental and social impacts (Wycherley, 1999). The conventional supply chain model was vertically integrated in the past, where the processes and activities were managed within the same organisation. In addition companies supplied their own parts and services, and environmental and social impacts came from a single company. But the current models have changed and companies nowadays depend on a much more complex and fragmented supply chain to acquire their product components, services and even labor,

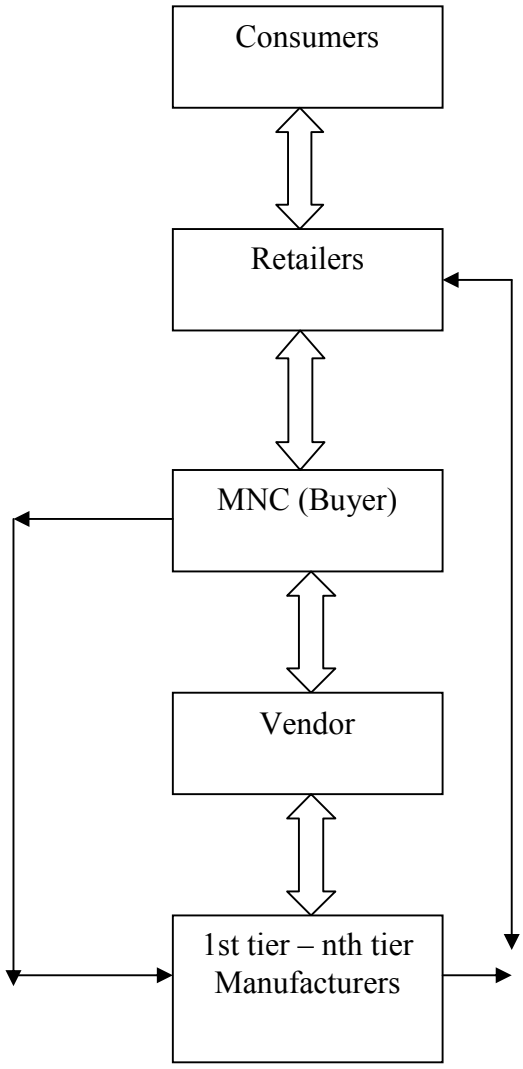
which they need to function. Globalization is one of the most significant factors, which drives the supply chain to be more complex and diverse. Therefore supply chains are longer and more complex and contractors and subcontractors are numerous. Welford (2002) emphasizes that the supply chain relationship is therefore critical in today's globalised world. Referring to figure 1.2, a typical supply chain is made up of a complex chain of actors and includes the following entities:

Retailers are primarily engaged in the distribution and sale of goods to consumers. Retailers include department stores, specialty stores, national chains, discount and cut-price stores, outlets, and mail-order companies. Some retailers who sell their own private labelled products go beyond their traditional role as distributors and become directly involved in the design and sourcing of products from manufacturers and contractors.

Vendors or Middlemen are located locally or regionally and they qualify and inspect foreign manufacturers of products, negotiate with manufacturers, and often monitor production for quality control and compliance with other standards.

1st tier to nth manufacturers are primarily engaged in producing, assemblies, and subassemblies of automobiles from different suppliers. Some manufacturers are contractors or sub-contractors, who generally manufacture parts from materials owned by other firms. 1st tier manufacturers often contract production to many nth subcontractors and some manufacturers are vertically integrated, producing the raw material from which they make automobiles.

Fig 1.3 Actors in a typical supply chain network



The environmental segment consists of the use of natural resources, emissions, waste, hazardous substances, energy use, loss of biodiversity and deforestation, nuclear radiation, ozone depletion and global warming. The linkage between SCM and the environment has only been attracting the attention of academics and industrialists in the last 10 years, in fact a number of researchers have pointed out that the external environmental impacts are much more significant than the internal environmental impacts (Lamming and Hampton, 1996; Noci, 1997; Birret, 1998; Carter and Narasimhan, 1998; Beamon, 1999; Lippmann, 1999; Bacallan, 2000; Bowen et al, 2001; Hagalaar and Van der Vorst, 2002).

The United Nations Environmental Programme (UNEP) also recognises SCM as a valuable environmental management tool (UNEP, 2003). The evolution of supply chain systems has not been linear over time. Various concepts and theories have been formulated to optimize supply chain systems to higher degrees of

performance. The goals of supply chain systems are multidimensional and include cost minimization, increased levels of service, improved communication among partner companies, and increased flexibility in terms of delivery and response (Lancioni et al., 2000).

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request (Chopra and Meindl, 2004). A supply chain is dynamic and involves the constant flow of information, products/services, and funds between different stages. A dynamically configured supply chain has the advantage of delivering more orders in which several objectives are simultaneously satisfied (Emerson and Piramuthu, 2004).For instance, in the case of the Wal-Mart Supply Chain, Wal-Mart provides the product, as well as pricing and availability information, to the customer. The customer transfers funds to Wal-Mart. Wal-Mart conveys point-of-sales data as well as replenishment orders to the warehouse or distributor, who transfers the replenishment order via trucks back to the store. Wal-Mart transfers funds to the distributor after the replenishment. The distributor also provides pricing information and sends delivery schedules to Wal-Mart. Similar information, material, and fund flows take place across the entire supply chain.

SCM is the combination of art and science that goes into improving the way a company finds the components that it needs to make a product/service, manufacture that product/service, and deliver it to customers. SCM and other terms, such as network sourcing, supply pipeline management, value chain management, and value stream management have become subjects of increasing interest in recent years, to academics, consultants, and business management (Saunders, 1998).

Supply chain deals with the control of material, services, information flows, the structural and infrastructural processes relating to the transformation of the materials/information into value added products/services, and the delivery of the finished products/services through appropriate channels to customers and markets so as to maximize customer value and satisfaction (Narasimhan, 2001). It seeks to enhance competitive performance by closely integrating the internal function within the company (i.e. marketing, product design and development, manufacturing) and effectively linking them with the external operations of suppliers, customers, and other channel members.

SCM solutions have been a topic of research since early 1950's. The classical way of managing a supply chain was to observe and analyze the sales, demand and inventory values at the end of a certain pre-defined time, and fill the required gap in it.

During the 1990s, facing challenges from increasingly demanding customers, globalization, and accelerated competition and with the development of information technologies, many manufacturers and service providers collaborated with their suppliers to upgrade traditional supply and materials management functions and integrate them into their corporate strategy. Many wholesalers and retailers integrated their

logistics functions with other functions as well to enhance competitive advantages. Eventually, these efforts evolved into a holistic and strategic approach to materials and logistics management, known as Supply Chain Management (Tan 2002). A supply chain consists of all the stages involved, directly or indirectly, in fulfilling a customer demand. It not only includes the manufacturers and suppliers, but also transporters, warehouses, retailers, and customer themselves (Chopra and Meindl 2001). New and Payne (1995) described SCM as the chain linking each element of the manufacturing and supply process from raw materials to the end users, and treating all firms within the supply chain as a unified virtual business entity. Harwick (1997) pointed out that SCM is a philosophy that extends traditional internal activities by embracing an inter-enterprise scope, bringing trading partners together with the goal of optimization and efficiency. Simchi-Levi et al. (2000) defined SCM as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed in the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements. Successful SCM can provide sustainable competitive advantages to firms by improving product quality, delivery speed, service, etc. at low cost, and thus enhance customers' satisfaction levels. A survey conducted in 2003 by Accenture, INSEAD, and Stanford University showed that the importance of SCM was already realized by most responding firms and it has become more and more important to firms as a competitive differentiator (Mulani 2005).

1.8 State of SCM in Indian Manufacturing Sector

India is being touted as the land of opportunity for logistics providers all over the world. The demand for logistics services has been largely driven by the remarkable growth of the Indian economy. The Indian logistics market, value at around US $14 billion in last decade, is expected to grow at compounded annual growth rate of around 7%.

This growth will continues as European companies continue to set up manufacturing operations in India and large retailers such as shoppers stop, RPG and Big Bazar expand to smaller cities.

Logistics management in India has become complex with about ten million retail outlets to cater to the needs of one billion people. India where corporates are increasingly outsourcing their logistics requirements to specialized operators. Thus market become of private interest to logistics, express and mail companies, with some believing it will eventually rival china in terms of opportunities.

DHL is already in the process of buying its way to market leadership, whilst rival FedEx has stated that, after China, India will be its next frontier. One of the prime reasons for the interest is that India is forecast

to overtake China as the most populous country in the world within fifteen years, which will lead to increased domestic demand for parcels and logistics services.

The recent foreign logistics services provider to climb on the Indian bandwagon was Swift, a subsidiary of Swift Freight LLC of UAE. Rhenus AG, a subsidiary of the $2.4 billion German major Rethmann Group, is also setting up of Shop in India, by tying up with Hyderabad based Seways Shipping Ltd. The joint venture, Seaways Rhenus Logistics Ltd, launched its Indian operations in January 2005.

1.8.1 SCM in relation to Indian Industry

The aim of this section is to estimate the understanding of the key component and motives of the concept of SCM in India. The awareness of the Indian managers on SCM understanding

Different viewpoints of Supply chain management are:

- Concurrent engineering across upstream and downstream in organizations
- Concept of Lean, value engineering, increasing internal efficiency.
- Collaborative planning of logistics
- Managing feed forward control across all the functional departments in both upstream and downstream organizations.
- Sourcing, Vendor Managed Inventory, collaboration.
- Employees on board training, knowledge management, information sharing with vendors
- Information flow upside down across the Supply chain network.
- Customer focus as main agenda balancing supply and demand effectively across the supply chain.

Majority of the executives who are involved in supply chain management view customer focus as very important criteria to be considered in building the effective supply chain.

Critical facet emphasis the definition of SCM by Cox et al (1995) the functions within and outside a company that enable efficient value chain to make products and services with customer focus" to be more adapted in the Indian context.

SCM in India is increasingly viewed as balance and to enhance internal efficiency and focusing on waste reduction through lean concepts.

1.8.2 Motives for SCM adoption

The impulse for SCM choice by the Indian organizations are:

- Cost competitiveness
- Reduction in cycle time
- Inventory management
- Customer focus

Quality enhancement is also identified as important motives for adopting SCM. Cost control has been predominant within the Indian context. Another significant feature has been the transportation cost factor.

The opinion that it's very essential to bring down the costs of external transportation. It is have not recognized as a flat and lean organization structure as one the important perquisite motive for SCM adaptation, which can be perceived as a form of resistance or even reluctance to transform traditional hierarchical structure. Rationalizing the supplier base is also not rated as the important motive; this is in contrast to one of the important prerequisites for successful implementation of SCM However, at the macro level the adoption and use of SCM concepts and practices by Indian organizations can be linked to the fo1lownig facilitating reasons (Saad &Patel, 2004).

Global competition and sweeping changes to economic policies to attract foreign direct and indirect investment. This has been a very important motivator for the multinational enterprises to set tip manufacturing bases such as the automobile sector in collaboration with the Indian organizations. Enhanced development in infrastructure both for transportation and information technology sectors, which play a vital role in the effective functioning of supply chains. Organization's willingness to adopt outsourcing practices (examples like third party logistic companies for transportation and IT services) has made organizations more aware of co-ordinated and importance of' relational improvement with the partners.

Quality of skilled and cost effective work force is perceived as a crucial advantage with the effective implementation of SCM and continuous improvement through learning and innovation. Increasing awareness about the importance of concepts and practices, such as TQM, JIT and SCM, in the development of greater competitive advantage.

1.9 Sustainability in Indian Industry:

It is right time to take a fresh perspective on the status of sustainability in corporate India. Sustainability has many aspects. It should be seen in tandem with different business functions. A marketing director looks at sustainability from a different perspective than a financial director. With this thought sustainability cannot be limited to just a few individuals within an organization, where they look at this subject as only community development or philanthropy. There are companies which have learnt the lessons and are moving forward leaving behind a trail for those who want to be followers and for those who want to take bits from this success and build their own success trail with innovation and leadership.

The sustainability policy works in concert with various other policies which exists evidence from Infosys. (Infosys (2010) Sustainable Tomorrow, Sustainability Report 2009-10.) It follows the philosophy of maximizing value to company's stakeholders; clients, employees, investors, vendor partners and the society, while adhering to company's values. The sustainability agenda of the company is in three areas: social contract working towards equitable society, ensuring resource efficiency by being responsible consumer of energy and natural resources and green innovation by developing sustainable solutions to reduce carbon footprint of their customers.

On the other hand ITC has a sustainability committee in place which reviews, monitors and provides strategic direction to company's sustainability practices towards fulfilling its triple bottom line objectives. This consists of executive as well as non-executive directors of the company. The strategic management of the company rests with the Corporate Management Committee (CMC) comprising full time executive directors and senior management. CMC approves the relevant financial, environmental, occupational health & safety and social policies of ITC. (ITC Sustainability Report 2009-10).

Tata group is an example of how a conglomerate has gone about integrating sustainability initiatives across various group companies. Tata group aims at harmonizing environmental factors by reducing the negative impact of its commercial activities and initiating drives encouraging environment-friendly practices. In one of its many initiatives Tata companies are devising strategies to minimize their carbon footprint. These initiatives started in 2007 with few companies and now being followed by many under its umbrella. Under its Tata Code of Conduct the Group has a clause dedicated to sustainability. All the group companies are signatories to this code *(www.tataquality.com/MPage.aspx?pid.SectionId).*

To ensure that Tata group companies achieved high levels of business excellence the group has institutionalized Tata Business Excellence Model (TBEM). The TBEM provides each company with an outline to help it improve business performance and attain higher levels of efficiency.

The government has also taken a bent towards sustainability by proposing guidelines for corporate social responsibility (CSR) in upcoming Companies Bill 2009. The objective of incorporating CSR in the Companies Bill is to guide Indian corporate on the way of doing business which mainstream sustainability in the decision making process and helping inclusive growth. The guidelines will allow Indian corporate to take voluntary initiatives, too. All of this is the initiative of Ministry of Corporate Affairs which is trying to frame a system of corporate governance in terms of people, planet and profit.

These initiatives by the government, industry bodies and companies are signals of what holds in future. It is in the best interest of Indian corporate to work on ways to make each and every function sustainable. If sustainability has to be integrated with corporate governance it needs to seep into each and every function of the company. Only then can the board and senior management look at issues of sustainability from business point of view, in terms of risks and opportunities.

There are evidences that sustainability issues are being incorporated into strategy, but they are limited to just a few big names. The pace at which economic, social and environmental issues are creeping up, a pace higher is required for companies to start looking at sustainability from the framework of governance. Only then the companies will be able to overcome such issues and emerge as winners.

Every corporate crisis either national or international is a clear hint to the existing gap. It is time for companies to look at the framework which bridges this gap and provide tools which help the board and management to proactively deal with future crises. The interface framework hints on how the board and the senior management through the structure of corporate governance can integrate the issue of sustainability with the overall objective of the firm. This process will require transparency, better information circulation, and disclosure.

The responsibility of overseeing sustainability should not lie only with the board. It should be added to functions of management as well. Functions of the board and the management are well known. However, what is important is to converge sustainability within these functions. It is important that the board and the

management don't view sustainability as philanthropy but as a reason to improve, sustain, innovate, and adapt. Each business should create its own strategy for success and address the risks and opportunities of participating in the sustainable economy. Sustainability is not a separate discipline rather a subject which should be integrated with strategy, which is likely through a framework.

Crises happening at international level also provide an example which can be repeated anywhere, even in India. The British Petroleum oil spill not just distressed the company in terms of human lives lost and financial loss from investor's sentiments and infrastructure. The spill also caused extensive damage to marine and wildlife including several birds, sea turtles, fish, and mammals. The company incurred huge expenditure as a result of cost of the spill response, containment, relief well drilling, grants to Gulf States, claims paid, and federal costs. Later when the investigations were done some astonishing facts came to limelight with British Petroleum taking the onus of the spill, along with Transocean, who owned the oil rig. The facts included negligent behaviour, ignored warnings, and misinterpretation of data. These reasons could have been well avoided with a proactive approach by the company, thus avoiding major disaster and saving the lives, environment, and economy.

Had these companies been a bit more sensitive about the consequences such disasters have, their leadership group level including the Board and senior management would have integrated sustainability with the overall corporate governance. These examples clearly indicate two things. First, opportunities for companies to audit their current operating framework and look for any loopholes which can lead to disaster affecting the human and ecosystem. Second, development of framework integrating triple-bottom-line with corporate governance. The fast paced corporate world has seen many such chapters unfolding. It is important to gain lessons from such examples and move forward with a new approach to success. The new approach requires integration of economic, social and environment issues within corporate governance.

Effective corporate governance requires a proactive, focused state of mind on the part of directors, the CEO and senior management, who all must be committed to business success through maintenance of the highest standards of responsibility and ethics. Even the most thoughtful and well-drafted policies and procedures are destined to fail if directors and management are not committed to enforcing them in practice.

The framework for corporate governance is not only an important component affecting the long-term prosperity of companies; it is also a leading species of large genus namely, National Governance, Human Governance, Societal Governance, Economic Governance and Political Governance. All of this is also a part of sustainability. Sustainability encompasses various issues including, environment, health, safety, corporate social responsibility, philanthropy, community, etc. A sustainable corporation is the one that protects the environment and improve the lives of those with whom it interacts, while creating profits for its shareholders. This definition of sustainable corporation is achievable when the triple-bottom-line (economic, social, environment) is well integrated into the framework of corporate governance. (Verma, and Gupta 2004)

1.10 Need of sustainability in supply chain management

Sustainability, which includes environmental quality and preservation as well as meeting the stress of emissions reductions, is rapidly becoming an important issues for business and also for public policy. It is believed that critical next step from examinations of operations and the environment is the study of sustainability and supply chains (Linton, Klassen and Jayaraman (2007).

A survey conducted by Business Council reported that over 40% of CEO's consider environmental and global warming issues of critical importance (Creyts et al.(2007).3M, the US based global conglomerate which manufactures pressure sensitive tape, reflective materials, video and audio tapes, laser imaging equipment, as well as health- care products, has a programme called Pollution Prevention Pays (3P).This strategy focuses on the prevention of pollution at the source rather than managing and removing it after it has been created. The company's policy is that "anything not in a product is considered a cost". (Esty and Winston 2006).

Everything coming out of a plant is either a product, by product (which can be reused or sold) or waste. Why they ask, should there be any waste? This is a policy that every company needs to start emulating (Penfiled (2008).Companies are grappling with efforts to limit resources, including energy, to create eco friendly products, cut toxic emissions, as well as to help the poor and co-operate with non profit groups (Engardio et al. (2007).

Moreover, there is evidence for concern among businesses, consumers, economic development experts, conservationists and human rights activists alike. The release of carbon dioxide into the atmosphere, through the combustion of fossil fuels (coal, oil and natural gas), has risen 30% in the 200 years since the

industrial revolution (Burruss (2004). The average surface temperature of the earth, expressed as a global average, has increased by about 0.74^0 C over the part hundred years(between 1906 and 2005) with 11 of the 12 warmest years occurring between 1995-2006 (IPCC (2007). The environmental diamenity has damaged fragile ecosystems, resulting in, for example, altered precipitation patterns, species distinction, natural disasters, changing water supplies, and crop yields.

As a remedy, governmental agencies can support sustainability by the provision of environmental standards and regulatory frameworks to conserve resources used for inputs and to monitor quality of life, in an economic environment where industrial competitiveness is negatively affects by the cost to implement such initiatives (Wilkinson, Hill, and Gollan(2001). Several environmental regulations have been geared towards, specifically the electric power industry, which under pins modern society. The power industry is expected to grow by 39% between 2005-2030 due to population growth and other factors. According to the Department of Energy, the cheapest form of electricity generation, coal fired power plants, are expected to meet this growth in demand, accounting for 81% of the incremental load of electric power through 2030, and of which is also responsible for a majority of the electricity generated carbon emissions. Creyts *et* al.(2007). Regulatory mandates lead electric power companies to efficiency improvements though, for example, taxes and /or trade able pollution permit programs. The benefits of such initiatives, shown in a study conducted by Curriea and Neidell(2005) throughout the 1990s in California, which coincides with the 1990 clean air act, found reductions in the level of carbon monoxide saved approximately 1000 infant lives from pollution effects. Lambertini and Mantovani (2007) note the disregard, unrelated to regulatory requirements, of research practitioners to the potential benefits of appropriate competition policy measures and consumer pressures Srivastava (2007). It has been argued that customers and suppliers punish polluters in the market place that violate environmental rules, also called a “reputational penalty” (Klein and Leffler (1981).Klassen and Mc Laughlin(1996)). It is interesting to note, however, that some firms in the public eye have not only met, but exceeded, required environmental mandates Lyon (2003). India is one of the few countries that is willing to address climate change issues in a strategic transparent manner, and is the only country in the world which has a separate national Ministry for Renewable Energy. However, like many other nations, India, too, needs to address several related issues pertaining to water, agriculture and waste, simultaneously.

The Government of India has also implemented a number of policy instruments to accelerate the pursuit of low carbon pathways by businesses. Amongst these are: (a) PAT - Perform, achieve and trade - scheme; (b) REC -Renewable Energy Certificates; (c) Clean energy cess on coal. In such a scenario, disclosing through the CDP platform lets organizations develop appropriate frameworks to not only comply with upcoming

legislations but also leverage the regulations to their competitive advantage. Corporations are influenced by the ecologically conscious market place that, according to a survey sponsored by DuPont Mohawk industries in October 2007, despite the weak economy 65% of consumers are willing to pay an additional 8.3% for products made with renewable resources (Environmental leader (2008).Environmental performance can be seen as a source of reputation, competitive and financial advantage (Miles and Covin (2000), Fabian(2000). A method for companies to achieve voluntary efficiency, through supply chain merger / integration, can possibly, result in synergistic gains.

A firm's success, notably, in terms of financial and environmental practices, has been tied, in part to the strength of its ability to coordinate and integrated activities along the entire supply chain (Spekman, KamauffJr and Myhr (1998), and to effectively implement multi criteria decision making tools to aid in their strategic decisions.

1.11 Need of research

At global level, it is continuously acknowledged that sustainability is the holistic way of doing business. It takes care of three important P's of business, i.e., Profit, People and Planet. After Globalization, India is becoming a favorite destination for global manufacturing. Trained labor at low cost and large resources of India with relative stable political system attracts major manufacturing organization to India. In this connection, it is possible that unrestricted manufacturing activities may create serious threats to people and environment of India. Supply chain is necessary to understand total framework of a company in which it collaborates with its partners to face this competition. Therefore it is necessary to analyze sustainable supply chain management practices in Indian manufacturing industry so that this country remain in a safe and better place to live. The need is also felt as government regulations are also putting pressure to have environmental friendly products and processes. Can this create new business opportunities? This research endeavor to draw an association between the literature on sustainable supply chain management practices and associated benefits in the framework of Indian manufacturing Industries.

1.12 Thesis chapterization

Chapter 1 is emphasized on introduction that comprise of fundamentals such as history, definitions, issues of supply chain management, and Sustainable supply chain management relation to Indian manufacturing

Industry. Unique aspects of supply chain management systems adapted. Also, need for the present research is highlighted.

Chapter 2 presents a detailed review of literature and significant contribution in the area of sustainable supply chain management and Sustainable supply chain management practices. The factors for these measures were identified.

Chapter 3 consists of research methodology employed in this study. This chapter includes detailed narration of steps such as research paradigm, data sample, data analysis; classification characteristics hypotheses are presented to perform the research objectives.

Chapter 4 exemplified the results of the statistical analysis performed to provide empirical support for accomplishment of research objectives. This chapter contains results from descriptive statistics, factor analysis, Discriminant analysis, Inter Item analysis and ANOVA.

Chapter 5 covers the conference of the theoretical and practical implications of the results as well as the researcher's conceptualization about research limitations and future study directions.

Chapter 6 presents the conclusions and findings of the research study. It comprises managerial implications of the findings and the directions for future research.

Appendix-I consists of the measurement instrument for the study structured questionnaire is portrayed. Appendix-II consists of model calculation for internal supply chain benchmarking of selected Indian manufacturing companies.

CHAPTER 2

Literature Review

Literature review is an important part of a research process. It helps in identifying latest research issues in a particular area which benefit in developing research objectives and also in deciding suitable measures and techniques to arrive at the solution. Gall, Borg and Gall (1996) suggests the literature review plays a role in:

- ❖Delimiting the research problem
- ❖Seeking new lines of inquiry
- ❖Avoiding fruitless approaches
- ❖Gaining methodological insights
- ❖Identifying recommendations for further research.

This chapter reviews the relevant literature to derive knowledge for subsequent discussions on the research findings. Specifically, the areas addressed are: sustainable supply chain management, sustainability in manufacturing industry, and dimensions of sustainability, supply chain performance, sustainable supply chain performance, and additional inquiries.

Available internationally referred scholarly journals and publications related to the topic for this review have been considered. Focus is laid on the years 2000 to 2010. The search for major journal publications was carried out on sciencedirect, emerald insight, and Springer link and referred international conferences. Keywords used in the search were sustainability, sustainable supply chain, reverse logistics, sustainable manufacturing, green supply chain management, social sustainability, economic sustainability, and green supplier development. From the search, the most relevant papers in terms of technical content were considered. It was found that total 88 papers pertinent to sustainability, and supply chains have been published from 2000 to 2010.

According to Al-Odeh.,M and Small Wood.,J (2012), ever changing business environment and complexities in regulating an organization's environmental issues have resulted in methodical regulations and helped in improving the customers' awareness. Customer's consciousness put pressure on organizations to adopt sustainable strategies in Supply chain management. Organizations develop

sustainable supply chain management strategies seriously considering the consumers awareness and interest. Organizations also spent more efforts to meet their buyer's specifications. Organizations have also been developing, assessing and monitoring procedures to achieve sustainability in SCM. The emerging technological developments have played a significant role in improving the quality of SSCM practices for implementation.

2.1 List of Journals with year of publication considered for review.

S. No	Name of the Journal	Year of Publication (2000 - 12)												
		2000	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**
1.	International journal of production economics	1						1		3		2		1
2.	Journal of cleaner production	1			2			1	1	5	1	4		
3.	Management research review									1		1		
4.	Ecological economics											1		
5.	Accounting and finance											1		
6.	Journal of operations management								1					
7.	Ecological management & audit		1											
8.	Supply chain management: An international journal								1					
9.	Journal of environment management								1					
10.	Science and engineering ethics						1							
11.	CIRP Journal of manufacturing science and technology											1		
12.	http://mpra.ub.uni-muenchen.de/27721/											1		
13.	Decision support system										1			
14.	Resources, conservational Recycling										1			

Contd ., Table 2.1

S.no	Name of the Journal	Year of Publication (2000-12)												
		2000	01	02	03	04	05	06	07	08	09	10	11	12
15.	Land use policy						1							
16.	Technological forecasting and social change	1												
17.	Industrial marketing management				2									
18.	European journal of operational research									1	1			
19.	Journal of purchasing and supply management									1		1		
20.	WSEAS Transactions on environment and development									1				
21.	Business strategy environment							1						
22.	Ecological management auditing													
23.	California management review		1											
24.	International journal of operations and production management			2					1					
25.	Sustainable development										1			
26.	British Journal of management (1996)													
27.	Transport Research part E: Logistics and transportation review									1				
28.	Journal of business ethics							1			1			
29.	European journal of purchasing and supply management (1997)													

S.no	Name of the Journal	Year of Publication (2000-12)												
		2000	01	02	03	04	05	06	07	08	09	10	11	12
30.	Advanced Engineering Informatics											1		
31.	Corporate social responsibility and environmental management											1		

2.1 Sustainable development

Sustainability concerns the environmental influence on future generations. Sustainability is an endeavor to protect the extensive expression of functioning of a company, its supply chains, and its society. Architecturing a sustainable supply chain compels acute emphasis on long-term strategies; preserving a sustainable supply chain demands emphasizing on operational supremacy and management of jeopardy in the supply chain. In fact, active risk management is a fundamental ingredient of any sustainability maneuver.

The concept of sustainable development serves an outline for the economical usage of resources, productive development of infrastructure, preservation and improvement of quality of life, economic or business development whilst safeguarding the environment. Sustainable development can also be defined as a process of change to bring a new order of development to achieve sustainability. This nuclear term is not only limited to corporal values, economic advancement, material flows and physical environmental progression, but also comprises the public well-being and quality of social existence.

According to Elkington (1997) the three pillars of the triple bottom line concept include economy, social development and environmental quality, in the administration process. Sustainability has been defined as the objective of sustainable development, which is "types of economic and social developments that safeguard and enrich the natural environment and social fairness" (Diesendorf, 2000). Hence concept of sustainable development is being practiced or emerging to build better organizational structure, as well considering all dimensions of sustainability, in operational parlance.

2.2 Sustainable supply chain

The concept of sustainable development is very closely linked with supply chain systems. Supply chains are responsible for transferring raw materials to useful products into the hands of final consumer. Large numbers of intermediate processes are involved such as transportation, manufacturing, distribution etc. All these processes affect the surroundings in more than one ways. Therefore, sustainable supply chains are considered to be an important aspect of business which ensures minimum negative impact of business processes on the surroundings.

Numerous definitions have been proposed for the term sustainable supply chain. Here are a few simplistic and more common definitions for better understanding of the term sustainability in context of supply chains.

According to Business for Social Responsibility (2007) sustainable supply chain is a system of aligned business activities throughout the life cycle of products that creates value to stakeholders, ensures ongoing commercial success, and improves the well-being of people and the environment.

According to Carter and Rogers (2007) Sustainable supply chain refers to an integration of social, environmental, and economic issues in a traditional supply chain.

According to Srivastava (1995) the potential for reducing long term risks in a supply chain is associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management.

According to New Zealand business council for sustainable development (2003) management of raw materials and services from suppliers to manufacturer/service provider to customer and back with improvement of social, economic and environmental impacts are necessary for sustainable supply chains.

NZBCSD (2003) states in general that a supply chain considers the social interactions between a business and its customers and suppliers. The greatest benefits are derived by extending the focus as far as possible upstream towards the raw materials, downstream towards the consumer and then back again as the products and wastes are recycled.

The above perspective explicitly explains the importance of each element of sustainability triple bottom line (TBL). However, to encapsulate SSCM as collaboration of social, environmental and economic issues at the different levels of management an optimistic implication along the traditional supply chain is essential.

2.3 Sustainability in manufacturing

Manufacturing is one of the important driver of economic growth. Role of manufacturing cannot be undermined in any way. Manufacturing is an important part of almost all supply chains. Automobiles, Electronics, Garments are few important sectors where entire supply chain is guided by manufacturing processes. Unaware from the negative results of various manufacturing activities, organizations in manufacturing activities were continuously using natural resources without any consideration, similarly wastes were also discharged without much thought.

Zhu *et al*.(2007) extensively explored the Green supply chain management (GSCM) related latest initiatives of Chinese manufacturers namely power generating,chemical,petroleum,electrical,electronic and automobile industries. Considerable potential reasons for the discrepancy between similar implementation levels and differing performance levels between industrial sectors include the fact that the electrical/electronic major industry has long term international experience. GSCM accepted practices are truly progressive in internal environmental management supported by management, which is a foundation element.

Bemon's (2005) environmental considerations in manufacturing are often viewed as separate from traditional, value added considerations. She answered few of the questions of potential conflicts that arise from ethical decision making in supply chain management and design, engineering ethics governance and application to decisions in supply chain management and design.

Zhu and Sarkis (2006) emphasize that Chinese companies in different industries have been differing from drivers and practices, confirmed that globalization and China's entry into the WTO has helped to promote GSCM practices in manufacturing enterprises. Chinese manufacturers have strong drivers and pressures to implement GSCM, especially for those trying to establish long-term relationships with foreign customers in China such as automobile industry.

Zhu (2008) empirically verified and suggested that both first order and second order models of GSCM practical implementation are reliable and valid among Chinese manufacturers. Manufacturers wishing to substantially improve their GSCM practices need to constantly monitor their implementation.

Zhu and Geng (2010) worked on drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers. Research has been done using Questionnaire and the Sample size of 299 was taken. Practical implementation levels of extended supply chain (ESC) practices among Chinese manufacturers are still in its early stage. At the same time, both drivers and barriers exist for ESC practices among Chinese Manufacturers. Policy implications for the Chinese governments to develop regulations and policies for their Energy saving and emission reduction (ESER) programme development of an effective mechanism to promote ESC practices among manufacturers deserve more attention. Internal barriers are found to hinder ESC practices for ESER goals among manufacturers even with external drivers. How to overcome these internal barriers remains a question to be answered.

Jayal *et al.* (2010) used an optimization technique to investigate the concept of sustainability in manufacturing and overview of recent trends in developing improved sustainability scoring methods for products and processes for sustainable manufacturing process of tool focusing on dry, near dry and cryogenic machining as examples.

Iwata and Okada (2010) examined the environmental performance in relation to financial performance among Japanese manufacturing firms. They have considered two different environmental issues; waste and Green house gas (GHG) emissions, including seven financial performance indices and their effect on utilization. Then observed the influence of market evaluation of corporate management and used the utilization amount of waste and GHG emissions as the proxies of environmental performance on Japanese firm level data. GHG reduction increases ROE, reflects the long run financial performance and no significant effect on ROS short run financial performance is observed.

Conferring to Zhu *et al.*(2010) Japanese manufacturers implement four GSCM practices; green purchasing, customer cooperation with environmental considerations, eco design and investment recovery comparing with Chinese manufacturers. Limitation of the study is that data set is a very small, examination of diffusion mechanism's in comparison of larger and smaller Japanese manufacturers.

Cruz (2009) tendered a theoretically precise framework for modeling, qualitative analysis, and computation of solutions to supply chain networks' sustainability. Executed emission and risk-penalizing weights, were variable and dependent on the value of the emission and risk purpose in the value function associated with each manufacturer as well as with each retailer.

Baskaran *et al*. (2012) used Grey approach for analysis for evaluating Indian textile's supplier's sustainability. The results of this study indicate that the criterion of long working hours plays an important role in evaluating suppliers in both categories (garment manufacturers and ancillary suppliers). In the case of garment manufacturers, they found that pollution and unfair competition were also important criteria. Employing child labor is found to be a critical criterion in the case of ancillary suppliers.

Unnikrishnan and Hegde (2007) worked on environmental training and cleaner production in Indian industry a micro level study proposed that through environmental training and continuous opportunities for information and technology exchange, employees in any organization can work together to generate a positive environmental change for a better tomorrow.

Muduli *et al.* (2012) study focuses on the Indian mining industry as a case study for identifying factors and sub-factors hindering GSCM implementation. A graph theoretic and matrix approach (GTMA) has been used to quantify the adverse impact of these barriers on GSCM implementation.

Gupta and Palsule-desai (2011), review paper and emphasized that SSCM considerations in India has been growing by the concept of Clean Development Mechanism (CDM), a 'flexible mechanism' that allows countries with binding emissions reduction commitments to invest in certain environmental projects in India. While India has been the second largest host country for CDM projects to date, lack of a domestic carbon market may have hindered local innovation in clean technologies and a widespread adoption of sustainable practices.

Kumar, R *et al* (2012) gave an overview sustainability assessment methodologies related to sustainability indices, formulation strategy, scaling, normalization, and weighting and aggregation methodology.

It is conclusive evidence that above literature includes qualitative, quantitative and case study based sustainability issues in manufacturing especially amongst Chinese, Japanese and Indian industries. Chinese

companies practicing the GSCM focus on long term relationship as well as constant monitoring, in contrast to small sample investigated in Japanese market. However, few researchers discussed the relation of financial context but could not be able to cover all the financial variables and environmental performance concerning Japanese manufacturers. Dominant evidence from Chinese manufacturers is available due to the reason of Chinese manufacturers being dominant in manufacturing since a couple of decades. However in Indian context very few significant studies have been found in literature covering sustainable perspective in textile, mining sector. Studies on importance of environmental training for cleaner production, growing concept of CDM in Indian manufacturing industry.

Table 2.2 Significant contributions on sustainability in manufacturing

Author	Findings
Zhu *et al.* (2007)	GSCM practices are truly progressive in internal environmental management supported by management across Chinese manufacturers.
Bemon (2005)	Potential conflicts that arise from ethical decision making in SCM design.
Zhu and Sarkis (2005)	Strong drivers and pressures to implement GSCM among Chinese companies.
Zhu(2008)	Suggested both first order and second order models of GSCM implementation among Chinese manufacturers.
Zhu and Geng (2010)	Extended supply chain practices among Chinese manufacturers are still in early stage.
Jayal *et al.* (2010)	Improved sustainability scoring methods in manufacturing process of tool
Iwata and Okada (2010)	GHG reduction increases ROE among Japanese Manufacturing firms
Zhu *et al.* (2010)	Implementation of GSCM practices among Japanese manufacturers
Cruz (2009)	Executed emission and risk penalizing weights were variable and dependent on the value of emission and risk purpose.
Baskaran *et al*. (2012)	Long working hours plays an important role in evaluating suppliers, Employing child labor a critical criterion
Unnikrishnan and Hegde (2007)	Environmental training and cleaner production to generate a positive environmental change for a better tomorrow.
Muduli *et al.* (2012)	Factors hindering GSCM implementation
Gupta and Palsule-desai (2011)	Growing concept of Clean Development Mechanism (CDM) in Indian industry
Kumar, R *et al* (2012)	Overview of sustainability assessment methodologies

2.4 Sustainable supply chain management and dimensions of sustainability

Literature review has been classified into three dimensions of sustainability

- Economic: compliance, risk and crisis management.
- Environmental: material consumption, energy use, water use, toxics, pollutants and land use.
- External social: labor practice indicators, supplier standards and stakeholder engagement.

2.4.1 Economic aspects in SSCM

According to Min and Galle (2001) adoption of green purchasing is an integral part of purchasing of buying firms concerns safety issues, environmental regulatory compliance, recycling, reusing as cost cutting and economic investment in green purchasing.

Dehghanian and Mansour's (2009) scholarly work on designing sustainable recovery network of end-of-life products using genetic algorithm, Life cycle analysis (LCA) and Analytical Hierarchy Process (AHP) studies the economic and social benefits and negative environmental impacts. Few activities in the recovery network have not been considered. Lesser social issues are considered, and model has not been developed for unknown conditions.

Brain Ilbery and Maye's (2005) case study based work, present interesting findings that businesses are not particularly sustainable, instead driven by a strong economic imperative. They often have to'dip'into various'links' associated with more conventional (commodity-based) food supply chains,revisiting the existing food supply chains, especially dairy products where there is large consumption.

Clift and Wright (2000) used Overall Business Impact Assessment (OBIA) for interpreting the profound implications of companies in the SC among developing economies for reuse and recycling of manufacturing goods. Analysis of both the aggregate performance of complete industrial sectors and the supply chain for mobile telephones shows greatest environmental damage, disproportionate to the economic value generated. Economic value decreases through the supply chain due to the ratio between environmental impacts to added economic value.

Hernandez (2004) directly observed from practical application and simulation of production and process analysis a sustainable perspective of Mexican industries producing resin, bottle manufacturers, soft drink

producers, distribution and plastic and recycling. He evaluated the effect of collecting distance on Global Warming Potential (GWP), and recycling rate, which provided for the understanding of effect of various variables related to economic or environmental impact.

Chaabane *et al.* (2010) developed a design of sustainable supply chains under the emission trading scheme. They used mixed integer programming and Life Cycle Assessment principles as research tools, developed a framework to evaluate the tradeoffs between economic and environmental objectives under various cost and operating strategies in the aluminum industry. They developed model for efficient carbon management strategies and also to help decision-makers to achieve sustainability related broad objectives in a cost-effective manner. Only the economic and environmental dimensions of sustainability are considered in this mathematical model.

As of the discussion, it was consummate that previous studies focused on adoption of green purchasing, sustainable network design models for economic and social benefits, and importance of business as a driver in interpreting economic importance among food supply chains. The other allied areas include Overall Business Impact Assessment (OBIA) for economic analysis of environmental issues in SCM, economic aspects among production and distribution for understanding the effect of variables. Significant studies using mathematical modeling for better decision-making in Emission trading scheme (ETS) considering economic and environmental dimensions in aluminum industry have been done. Interestingly it was found that economic aspects and production variables are key drivers of SC system while examining performance of an organization. **Therefore, the present thesis has considered these variables as parameters to further to evaluate sustainability of a supply chain.**

Table 2.3 Significant contributions on economic aspects in SSCM

Author	Findings
Min and Galle (2001)	Adoption of green purchasing integral part of purchasing
Dehghanian and Mansour (2009)	Economic and social benefits and negative environmental impacts among end of life products.
Brain Ilbery and Maye (2005)	Businesses are driven by strong economic imperatives.
Clift and Wright (2000)	Economic value decreases through SC in developing economies
Hernandez (2004)	Economic, EI effect collecting distance on GWP and recycling rate among Mexican bottle manufacturers.
Chaabane *et al.* (2010)	Efficient carbon management strategies to achieve economic sustainability.

2.4.2 Environmental aspects in SSCM

Neto *et al.* (2009) in their synergetic work on assessing eco-efficiency in logistics networks proposed an algorithm for multi objective linear problem for selecting preferred solution of business and environmental indicators, through most relevant phases for improving eco efficiency in a logistics network, transportation, manufacturing procurement and end of use.

Kovacs' (2008) influential work on corporate environmental responsibility in the supply chain is a cross industry study. The study examines the corporate environmental responsibility beyond corporate boundaries in a supply chain. Further scope of work is investigating cross industrial relationships in supply chains.

Neto *et al.* (2008) worked on designing and evaluating sustainable logistics networks. Tools used are data envelopment analysis (DEA), Multi Objective Programming (MOP). They proposed that companies aiming to decrease Environment Impact (EI) of their network should also look for good trade-offs between environmental impacts and logistics costs. Legislation favoring recycling might not lock out bad environmental solutions.

Walker *et al.* (2008) worked on drivers and barriers to environmental Supply chain management practices using exploratory study. They suggested that organizations were more influenced by external drivers. They explore the differences that exist between public and private sector.

Cruz (2008) worked on dynamics of supply chain networks with corporate social responsibility through integrated environmental decision-making. Mathematical modeling has been used. He considered both static and dynamic supply chain networks with corporate social responsibility through integrated environmental decision-making. He proposed a discrete time algorithm to approximate the continuous time adjustment process.

Georgiadis and Besiou (2008) used system dynamics to understand the long term system behavior under various environmental issues that lead to ecological motivation. Their model can be considered as a methodological tool for conducting the sensitivity analysis on issues such as the firms'compliance to

regulatory measures and green consumerism. Further, study can be done on model development for automobile industry.

Tseng *et al.* (2008) recommended that is explicitness and accumulation of green practices, organizational encouragement, quality of human resources, environmental uncertainty and governmental support exhibit significant influences on the willingness to adopt green innovations for logistics service providers.

Benito and Benito's (2006) identified determinant factors of a company's environmental pro activity viz., company features, stake holder's pressure and external factors should be considered as control variables in explaining and conceptualizing environmental strategies.

Mehalik's (2000) case study of a textile fabric design focused on waste disposal, credibility and financial problems. Findings of this research are that firms engaging in sustainable design and identifying their network contingency's collaborative allies for responsiveness as well as technology sharing.

Walley and Stubbs (1999) used context-process-control (C-P-C) framework to depict a particular Small Medium Enterprise (SME) greening success story considering network design. Significant aspects of environmental tactics in the greening process is an idea of linking greening initiatives to quality systems, which is apparent in case considered.

Florida and Davison (2001) examined the new & innovative approach to managing business goals and environmental performance, adoption of environment management system(EMS), motivation behind adoption and effectiveness after usage in managing environmental costs, key stakeholder groups, information sharing and interaction with stake holder groups.

Michelsen (2007) based their case study on the production of a chair using Pareto's analysis. Portfolio matrices is used to analyze the supply markets marginal effects on environmental performance. Importance of suppliers is analysed using Overall Business Impact Assessment (OBIA) to compare the ratio between environmental impact and eco efficiency.

Ahsen (2009) addressed environment management in a supply chain of automotive industry using empirical analysis. He proposed that environmental criteria have become a crucial part in a process of supplier evaluation and selection and insisted suppliers to implement Environmental Management systems (EMS).

Rao (2002) determined the extension of the greening supply chain in South-East Asia. He argued that greening suppliers would significantly enhance their own environmental performance leading to competitiveness, partnering and mentoring approach of greening suppliers appear to be the right answer for bringing about environmental sustainability.

Simpson *et al*. (2007) explored the impact of relationship between customers and suppliers in customers' environmental performance perspective concerning Australian automotive industry. Proposed that Customers consider the application of any programme of a green supply chain in a hierarchical manner. Non strategic suppliers, (particularly those that provide more commodities & goods) follow basic level of compliance such as ISO 14001, which is one of the order qualifiers.

Vermeulen and Seuring (2009) analyzed major challenges of climate change, energy provision and creating wealth for an increasing world population.

De Brito and vandeer Laan (2008) worked on integrating environmental issues with operations and used a behavioral theory and abductive reasoning to explain the prevailing lack of integration of sustainability as a whole in supply chain management research. Integration of sustainability is well documented in their work.

Sarkis (2001) studied manufacturing organization's environmentally sustainability issues. Organizations need to take on global perspective, not departmental, not even one project a time while evaluating environmental concerns. The outcome is that manufacturing strategy is influenced by evolution of organizational structures, designs, virtual enterprises and dynamic network, which influence the environment consciousness.

Lamming and Hampson's (1996) critical analysis of relevant consumer attitudes, legislation and concepts in environmental management linked with SCM is suggestive of the fact that environmental pressures may be expected to increase in the future and an effective means of dealing should be linked with purchasing function.

Carter *et al*. (2000) proposed that purchasing function can create value and significantly affect the environmental actions of a firm and its upstream supply chain. Research gap is the effect of environmental purchasing on a firm's performance.

Tsoulfas and Pappis (2006) proposed for sharing of responsibilities for environmental effects, and accountability of industries for cleanup costs of pollution and damage to health of humans and the ecosystem. They say that business should have bottom line incentives for sustainable development adoption.

Hines and Johns (2001) closely examined the environmental supply chain management and tool's effect on environmental change in suppliers.

Sarkis (2003) explored the pertinence of a dynamic non linear multi attribute decision model, defined as an analytical network process, for decision making within a green supply chain, that the model is suggestive of an inter organizational implementation of decision framework. It has to incorporate the perceptions of a number of stakeholders.

Sundarakani *et al*. (2010) suggested an analytical model which illustrated and found that carbon emissions across stages in a SC constitute a significant threat. They suggested that further considerable work can be extended on a global scale by taking the cost of carbon emissions into account, considering turbulent mixing on a multi-echelon supply chain, and the Organizational pressures in the model at each stage of the supply chain.

Pan and Ballot (2010) used mathematical modeling, computed CO_2 emissions for two transport modes,i.e road and rail. Supply network pooling proposed by them is an efficient approach to reducing CO_2 emissions.

Kainuma and Tawara (2006) worked on a multiple attribute utility theory approach to lean and green supply chain management. Proposed that Impact of demand information sharing and lead time information sharing in evaluation of lean and green supply chain. The results obtained from research is a case of only one decision maker, further research for other decision makers from the view point of management and consumers may also be thought.

Maria *et al*. (2009) proposed a bi mixed integer linear model. Life cycle assessment are used as research tools for minimization of the total SC costs and environmental impact.

Lindhqvist and Nawrocka (2009) through an interview based formal group technique, and survey, suggested that cooperation between the purchasing and environmental functions within a company is frequently not sufficiently achieved in implementation of ISO14001. ISO14001 has a facilitating role in the environmental activities between a customer and a supplier. Research gaps are that only ISO14001 certified companies are considered for the study as the consistency in implementation or practicing guidelines may change yearly.

Conclusions emerging from the preceding discussions on the environmental issues related to SCM include observations on improvement of eco-efficiency in logistics network, corporate environmental responsibility in supply chain, optimization of environmental impact on design and evaluation of sustainable logistics network. Thus they infer that environmental aspects also impact SSCM.

Organizations influenced by external drivers, algorithms based model for decision-making in a supply chain network a CSR perspective, system dynamics model used for sensitivity analysis for understanding the ecological motivation covering compliance and regulatory issues also point out in the similar direction and motivate those aspects to be taken as key ingredient to be an integrated part of the study.

In addition, studies on factors influencing green innovations and determination of factors in conceptualizing environmental strategies were also observed.

Use of OBIA for understanding the supply markets and marginal effects on environmental performance and importance of supplier evaluation for implementation of EMS among SC of automobile industry is also witnessed. It is interesting to note that in Australian context customers consider green Supply chain in a hierarchical manner.

Few studies insisted that there is an alarming need for sustainability, and SSCM governance. Contrary to this, few researchers such as Tsoulfas and Pappis (2006), Kainuma and Tawara (2006), argue that integration of sustainability in SCM research is well documented. Manufacturing organizations which are environmentally sustainable have organizational structure, design, virtual enterprises and dynamic network.

Rise in environmental pressures in future should be linked with purchasing function. Apparently lack of it seems that there is a lack of studies on environmental purchasing and a firm's performance. For sustainable development adoption, business should have bottom line incentives. Frame work suggested in the studied

literature has not considered the business and environmental relationship explicitly, factors for decision-making in a green supply chain and extension of work on analytical models of carbon emissions in multi echelon supply chain.

Impact of demand, information sharing and lead time, has been playing a vital role in evaluating lean green supply chain. Mathematical models have been developed for SC cost optimization. Cooperation between purchasing and environmental functions has been observed in ISO 14001 companies of Thailand which again provides a direction.

Table 2.4 Significant contributions on Environmental aspects in SSCM

Author(s)	Findings
Neto *et al.*(2009)	Selecting preferred solution of Business and environmental indicators in logistics network – eco efficiency perspective.
Kovacs'(2008)	Environmental responsibility downstream in the supply chain was clearly assigned to a focal company; environmental demand had no effect on supplier criticality.
Neto *et al.* (2008)	Companies aim to decrease EI of their SC network, tradeoffs should be present between environmental impact and logistics costs.
Walker *et al.* (2008)	Organization influenced by external drivers.
Cruz (2008)	Discrete algorithm to approximate continuous time adjustment process for static and dynamic supply chain networks with CSR.
Georgiadis and Besiou(2008)	Firm's compliance to regulatory measures and green consumerism.
Tseng *et al.* (2008)	Explicitness and accumulation of green practices.
Benito and Benito's(2008)	Control variables consideration in conceptualizing environmental strategies.
Mehalik's(2008)	Collaborative allies for responsiveness, technology sharing in network's contingency
Walley Stubbs (1999)	Greening initiatives to quality systems.
Florida and Davison (2001)	Adoption of Environment management systems (EMS) for effectiveness in managing environmental costs.
Michelsen (2007)	Supply markets marginal effects on environmental performance.
Ahsen (2007)	Environmental criteria crucial part in process of supplier evaluation.
Rao (2002)	Greening suppliers significantly enhance environmental performance.
Simpson *et al*. (2007)	Customers perception in Green supply chain programmes have hierarchical approach in Australian automotive industry.
Vermeulen and Seuring (2009)	Climate change, energy provision
De Brito and Vandeer Laan (2008)	Lack of Integration in sustainability.

Contd., Table 2.4 Significant contributions on Environmental aspects in SSCM

Author(s)	Findings
Sarkis (2001)	Manufacturing strategy is influenced by evolution of organizational structures.
Lamming and Hampson's (1996)	Purchasing function should be linked with environmental pressures.
Carter *et al.* (2000)	Purchasing function create value and affect environmental actions.
Tsoulfas and Pappis (2006)	Business should have bottom line incentives for SD
Hines and Johns(2001)	Environmental supply chain management change in suppliers.
Sarkis (2003)	Interorganizational implementation for better decision framework in green supply chain.
Sundarkani et al. (2010)	Carbon emissions across stages of SC a significant threat.
Pan Ballot (2010)	Supply network pooling is an efficient approach to reduce CO_2.
Kainuma and Tawara (2006)	Impact of Demand information sharing and lead time information sharing in evaluating Green supply chains.
Maria *et al.* (2009)	Minimization of total SC costs.
Lindhqvist and Nawrocka (2009)	Cooperation should be present between purchasing and environmental functions.

2.4.3 Social issues in SSCM

Salam (2009) using nomological validity contributed in purchasing related social responsibility, extending the method of application previously suggested by Carter and Jennings to an Asian environment and proposed that individual values and people oriented organizational culture are the most powerful aspects of cultures.

Ansett (2007) examined the Corporate Social Responsibility (CSR) concerning GAP Inc., an apparel retailer for development of effective labor standards, assurance programmes, stakeholder engagement strategies enhancing the Gap Inc., insights into innovation with company's CSR framework.

Kopling *et al.* (2007) proposed an approach to integrate social and environmental standards into supply chain policy and supply management with reference to Volkswagen AG Germany. Environmental and social standard systems and their potentials for integration in the business process of company were analyzed. Normative requirements, supply process, monitoring and Supplier developments are the four levels which help in eliminating damages and social problems in the supply chains of a company.

Lopez *et al*. (2007) investigated among European firms the relation between CSR and certain accounting indicators and observed significant difference in performance, which is negative when sustainability practices are applied in the first year, and there is no budget provisions for new assets, along with lack of long-term view in new policy making.

Seuring and Muller (2008) exclusively did literature review using 191 papers and suggested two distinct strategies. Those are supplier management for risks and performance and supply chain management of sustainable products demand. Thus contributing in defining the life cycle based standards. In addition, external triggers are put forward, which are placed on focal companies by controlling agencies, customers and stake holders.

Maloni and Brown (2006) proposed a framework which details on unique CSR applications in food supply chain, including animal welfare, biotechnology, environment, fair trade, health and safety and labor and human rights.

Ciliberti *et al*. (2010) using case study approach examined how a code of conduct (i.e. SA8000) can help to address the principal-agent problem, for SMEs, between chain directors and partners in supply chains to investigate how to increase the awareness of the customers, as part of the public, and make them willing to reward socially responsible companies as well as identifying instruments to re-distribute supply chain profits in line with their overall contribution.

Reniers *et al*. (2010) proposed for creating sustainable chemical industrial parks an empirical research with a sample size of 375, and identified the collaboration drivers and the partner features in chemical companies which are essential for enhancing collaboration initiatives, as well as the possible disadvantages of collaboration arrangements.

Foerstl *et al*. (2010**)** based on multiple case studies, and their work explored how leading purchasing and supply management (PSM) functions identify, assess, and treat supplier sustainability risks in a supplier management process of chemical industry. Research gap's are associated with derivation of sustainable supplier management (SSM) decisions from the supplier sustainability risk assessment process for PSM professionals.

Wognum *et al*. (2010) did empirical research work. Their findings are related to identification of current technical and organizational solutions. Information provision mainly regards the single isolated business actor. Further work can be done on transparency approaches for sustainability in environmental dimensions of sustainability traceability as an approach.

Leire and Mont (2010) developed a model of a socially responsible purchasing process based on empirical & secondary data and proposed vital phases like internal policies, setting purchasing criteria considering social issues, applications of assurance practices, managing supplier relations, building internal capacity to be considered in implementation of the model.

Ciliberti (2010) analyzed the CSR reports published by European Union (EU) in order to investigate how CSR issues are implemented and controlled along SC. Companies focus only on first-tier suppliers in educating them for ethical and environmental considerations, and few companies did not describe in detail how they deal with CSR issues in SCM.

Schmidt and Schwegler (2008) proposed the concept of cumulative eco-intensity and a decision-making aid to a company seeking to fulfil it's ecological sustainability. Further preliminary work is to be done on uniform regulations for balancing and calculating the indicators.

Maxwell and Vorst (2003) did intensive work on developing sustainable products and services. Approach used is concept development a method for effective sustainable product and/or service development (SPSD) in industry and research, which provides a framework for implementing through an entire life cycle of a product and/or service in U.K. Industry.

Ciliberti *et al.* (2008) used multiple case studies and examined the practices and difficulties, respectively, adopted and faced by SMEs to transfer socially responsible behaviors to the partners in their supply chains(SCs). They concluded that different management tools can be effectively and simultaneously adopted by SME managers to get suppliers more involved in CSR. Further scope of work can be an extension for analyzing selected companies assuming different criteria, e.g., using informal systems to transfer CSR issues to suppliers and monitor their practices.

Castka and Balzarova (2008) did an empirical research and determined a set of propositions about diffusion of ISO 26000 and hence socially responsible practices among business organizations. Propositions are made in relation to SR orientation of organizations/ networks, differences in regulatory systems, and the role of governments and national environments. Scope of empirical research is related to the diffusion of ISO 26000 from different perspectives which can be investigated together or separately. Apart from studying the international diffusion, researchers may as well look at national patterns.

Hutchins and Sutherland (2008) used mathematical modeling to review metrics, indicators, and frameworks of social impacts and initiatives relative to their ability to evaluate the social sustainability of supply chains. Findings are that there is a relationship between business decision-making and social sustainability. Research gap is related to the study on operationalisation indicators of corporate social sustainability in decision making related to supplier selection or supply chains.

Debrito *et al.* (2008) in an interview and questionnaire based worked on conflicts of the different dimensions of sustainability and leverage the internal and external organizations in the European supply chain. Further research on development of a framework for negotiation skills, have to be developed to set up and manage a SC where public authorities, private companies and nonprofit organization may co exists.

According to Carr and Smeltzer (1997) strategic purchasing has positive relation with status of the purchasing function viz., purchasing knowledge, skills, willingness to take risks, and resources.

Smeltzer and Carr (2003) proposed reasons for using reverse auctions and the risks involved in reverse auctions, conditions under which auctions are made.

According to Carr and Kaynak (2007) traditional communication methods, information sharing within a firm, and supplier development are significant factors for improving a buyer's performance.

Stefan *et al.* (2011) reveals that social dimension of sustainability is neglected both in conceptual research and in corporate practice concerning corporate risk management as well as the implementation of standards. Win-win situation between the dimensions of sustainability are more accentuated than trade-offs while the inter relations between the dimensions of sustainability need further research.

Hence from above social aspect related arguments of SSCM, it is corroborates the purchasing related social sustainability which comprises of individual values, people oriented organizational culture in Asian environment, insights into innovation with company's CSR framework, critical analysis of environmental and social standard system and their potential integration in the business process. On the distinct view especially among European firms, there is a relation between CSR and certain accounting indicators, which manifests the performance. Frequently recited work of (Seuring and Muller, 2008) for a markedly better understanding along with the literature of SSCM advocates work on distinct strategies like supplier management risks and performance.

Fundamental concept of SSCM studies are not only limited to automobile, electronic industries but also extends to few studies within the framework on application of CSR across the food supply chains. Investigations in addition revealed that among SME's there is an increasing awareness of customers to redistribute SC profits, also further work is to be explored for analysis of companies using informal systems to transfer CSR issues to suppliers and monitor their practices.

Empirical studies comprehensively outline indicates the enhancing collaboration initiatives for building the sustainable chemical industrial parks and purchasing and supply management (PSM) function's assessment of a supply management process of chemical industry. Propositions on socially responsible practices among business organization's networks, regulatory systems, role of governments and national environment in relation to diffusion of ISO 26000 are also instrumental in providing research directions.

Further work should be explored in the areas of transparency approach for sustainability. Managing supplier relations, building internal capacity has been validated using the model of a socially responsible purchasing process. Detailed investigation on implementation and control of CSR issues along SC using CSR reports of EU also is suggestive of few aspects vital to the proposed study,

At last from the Carr's (1997) significant studies it can be abridged that there is a positive relation between status of purchasing function and strategic purchasing, reasons for reverse auctions and traditional communication methods for significant improvement in buyer's performance.

Table 2.5 Significant Contribution on Social issues in SSCM

Author (s)	Findings
Salam (2009)	Individual values and people oriented organizational culture are most powerful aspects in PSR for Asian environment.
Ansett (2007)	CSR in apparel retailer effective social sustainability indicators.
Kopling et al (2007)	Supply process, monitoring and supplier developments help in eliminating damages and social problems in SC's of a company.
Lopez et al. (2007)	Significant difference in performance and negative when sustainability practices are applied in first year.
Seuring and Muller (2007)	Two distinct strategies: supplier management for risks and performance; and supply chain management of sustainable products demand.
Maloni and Brown (2006)	Framework for unique CSR in food supply chain.
Ciliberti *et al.* (2010)	Code of conduct in SME's for rewards as socially responsible companies.
Reniers *et al.* (2010)	Collaboration drivers and partner features in chemical companies for enhancing collaboration initiatives for sustainable chemical industrial parks.
Foerstl *et al* .(2010)	Supply management functions in treating supplier sustainability risks in a supplier management process in chemical industry.
Wognum *et al.* (2010)	Information provision regards single isolated business actor.
Leire and Mont (2010)	Internal policies, setting purchasing criteria, social issues, assurance prac tices, supplier relation are vital phases for socially responsible purchasing.
Ciliberti *et al.* (2010)	Companies focus only on first – tier suppliers in implementing CSR issues in SCM.
Schmidt and Schwegler (2008)	Companies seek to fulfill ecological sustainability as a decision making aid.
Maxwell and Vorst (2008)	Framework for developing sustainable products and services.
Ciliberti *et al.* (2008)	Different management tools can be effectively and simultaneously adopted by SME managers to get suppliers more involved in CSR.
Castka and Balzarova (2008)	Differences in regulatory systems, role of governments and natural environments in Social responsible practices in organizations.
Hutchins and Sutherland (2008)	Strong relationship between business decision making and social sustainability.
Debrito *et al.* (2008)	Leveraging internal and external organizations in European supply chain.
Carr and Smeltzer (1997)	Strategic purchasing has positive relation with status of the purchasing function.
Smeltzer and Carr (2003)	Primary steps to be followed in strategic sourcing.
Carr and Kayank's(2007)	Significant factors for improving buyers performance.

2.5 Supply chain performance

Definitions of Performance Measurement: The literature concerning performance measurement (PM) has changed over the past few decades (Ghalayini & Noble, 1996). The definitions of performance measurement have also changed in different perspectives (Kennerley & Neely, 2002; Beamon, & Ware, 1998; Ghalayini & Noble, 1996; Parker, 2000; Schermerhorn & Chappell, 2000; Neely *et al.* 1994; Kaplan, 1990; Gunasekaran, Brunel & Tirtiroglu, 2001). Different authors view performance measurement differently. The systematic perspective, for example, a traditional performance measurement system begun in the late 1880s and went through the 1980s, that focused on financial measures such as return on investment, liquidity ratios (Ghalayini *et al,* 1996; Schermerhorn & Chappell, 2000).However, modern performance measurement system started in the late 1980s as a result of changes, which focused on non-financial measures such as time, quality, flexibility (Kennerley *et al*. 2002; Gunasekaran *et al*. 2001; Parker, 2000; Kaplan, 1990).

Neely (1995) points out that the definition of performance measurement remains a broad topic and rarely defined. However, the authors define performance measurement as follows:

- Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action (Neely, Mills, Platts, Gregory, Richards, 1994).
- A performance measurement can be defined as metric used to quantify the efficiency and/or effectiveness of an action. (Kaplan, 1990; Gunasekaran *et al.* 2001)
- A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions (Neely, 1994)
- Performance measurement is a process of assessing and evaluating on effectively and efficiently utilizing people, resources, and technology of an organisation. (Schermerhorn & Chappell, 2000).

The authors define the words of effectiveness and efficiency in different aspects and contexts, for example, when they are used in marketing area, effectiveness refers to the extent to which customer requirements are met, while efficiency is a measure of how economically the firm's resources are utilized when providing a given level of customer satisfaction (Neely, Gregory, Platts, 1995). In management area, effectiveness is an output measure of task or goal accomplishment, and efficiency is a measure of the resource cost associated with goal accomplishment. (Schermerhorn & Chappell, 2000). Consequently from distinct definitions and contemplations it manifests that performance measurement is being exercised for competitive advantage as well as to make organizations run impressively or efficiently.

2.5.1 Classification of performance measures

To regain a competitive edge, companies not only have been shifting shifted their strategic priorities from low-cost production to quality, flexibility and short lead time, as non-financial measures (Bower & Hout, 1988; Rushton & Oxley, 1989; Stewart, 1995;Toni *et al*. 1994; Graham *et al*. 1994; Fisher, 1997; Harrington,L 1996; Kennerley *et al.* 2002; Gunasekaran *et al.* 2001; Parker, 2000; Kaplan, 1990; Wild, 1995), but also implemented new technologies and philosophies of production (Gelders, *et al.* 1994; Wild, 1995; Levy, 1997; Maskell, 1991), and total quality management (Juran, & Gyrna, 1980; Feigenaaum, 1991; Berger & Pyzdek, 1992; Beamon & Ware, 1998).

Performance measurements have generally been classified at strategic, tactical and operational levels (Gunasekaran *et al*. 2001). Table: 2.5 show different performance metrics corresponding to different levels and further putting them as financial metric or non financial metric. Thus, it gives a framework for the performance evaluation of a supply chain. (Gunasekaran *et al*. 2001) state that metrics would be used in performance measurement influences the decisions to be made at different levels.

The issue is to determine the suitability of a performance measurement system for measuring performance in a firm or an organization. It is hard to exactly point out as many companies have realized the importance of both financial and non-financial performance measures (Stewart, 1995; Kaplan & Norton, 1992; (Gunasekaran *et al.* 2001). Each performance measurement system and its dimensions may be appropriate under specific circumstances and functional role. Traditional performance measures should not compete with more non-traditional measures, rather it should complement them by providing knowledge about complex phenomena within their context. Further, they would also facilitate continuous improvement and process control (Beamon & Ware, 1998).

However, companies always fail to adopt financial and non financial performance measures in a balanced framework (Gunasekaran *et al.* 2001). Maskell (1991) points out that for a balanced approach, companies should bear in mind that, while financial performance measurements are important for strategic decisions and external reporting, day-to-day control of manufacturing and distribution operations are better handled with non-financial measures. He also suggests that companies should carefully consider and decide on using a few good metrics.

Table: 2.6 A framework for the performance evaluation of a supply chain

Level	Performance Metric	Finance	Non-Finance
Strategic	Total cash flow time		♦
	Rate of return on Investment	●	
	Flexibility to meet particular customer needs		♦
	Delivery lead time		♦
	Total cycle time		♦
	Level and degree of buyer supplier partnership	●	♦
	Customer query time		♦
Tactical	Extent of co-operation to improve quality		♦
	Total transportation cost	●	
	Truthfulness of demand predictability/forecasting methods		♦
	Product development cycle time		♦
Operation	Manufacturing cost	●	
	Capacity utilization		♦
	Information carrying cost	●	
	Inventory carrying cost	●	

(Source : Adopted from Gunasekaran et al.2001) [*Note: ● Finance; ♦ Non- Finance;]*

Hence from the above discussion, detailed classification of performance measure into financial and non financial directly concerning with distinctive levels of management has been developed. However, companies failed to adopt a particular structure for the performance measurement.

2.5.2 Supply chain performance measure

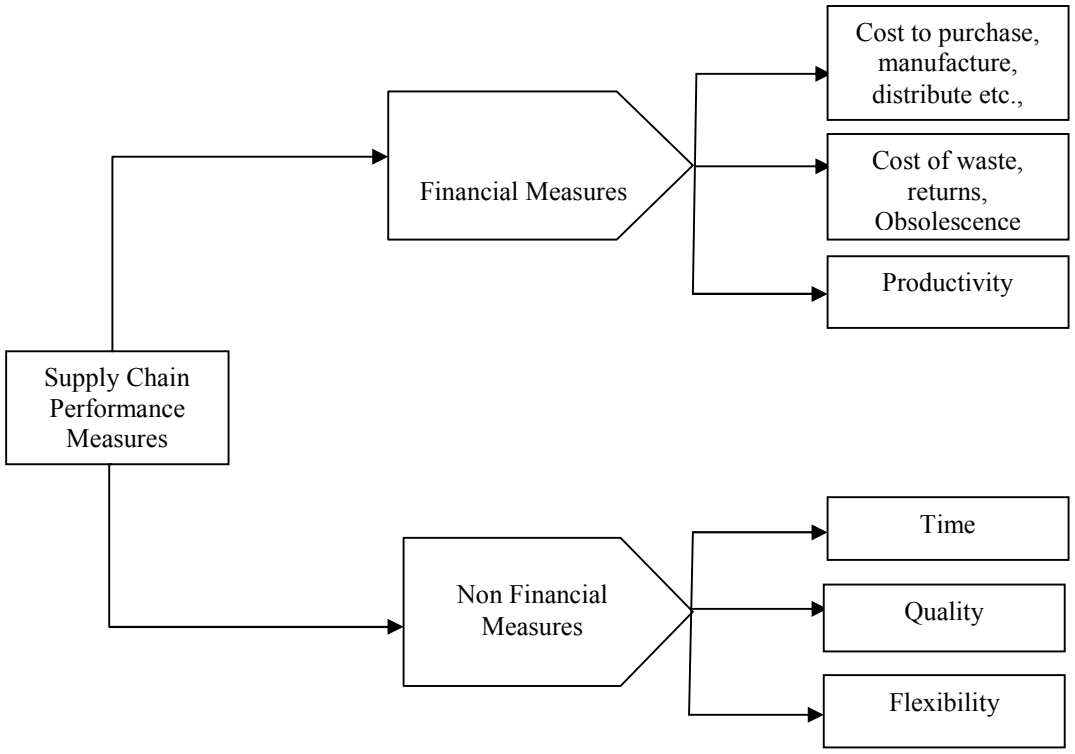
Performance measurement is very important as a strategic tool and also provides means to achieve the objectives required, fulfilling a firm's mission statement. Many firms have been observed to evaluate performance, basically based on cost and efficiency (Skinner, 1971). Therefore, traditional performance measures have been principally based on management accounting systems and financial measures (Alaa and James,1996).This has resulted in most measures focusing on financial data such as return on investment, return on sales, price variances, sales per employee, productivity and profit per unit production, etc.

As a result of globalization and competition the organizations have started adopting innovative business

practices and performance improvement initiatives such as TQM, JIT and SCM. The conventional cost-based measures are found to be inadequate as they fail to incorporate the basic principles of continuous improvement and intangible aspects of performance. Therefore, firms can't manage properly if they can't measure the intangible and non-financial performance also.

And hence, performance measurement incorporating non-financial measures has been a topic of great interest throughout most of the 1990s. Toni and Tonchia (2001) conceptually classified the performances of the operations into two broad categories of 'Cost performances' (financial measures) and 'Non-Cost performances, (non-financial measures) which have further divisions as shown in

Figure: 2.1. Classification of performance measures (Toni and Tonchia, 2001)



2.5.3 Non-financial performance measures

Non-financial performances include measures related to time, flexibility and quality. It is an important move towards a multi criteria approach, which can correspond to the need of holistic and strategic approach. Non-monetary units of measures generally measure the non-cost performances. As far as they influence the economic and financial performances (net income and profitability), the link with them cannot be calculated in a precise manner as for the cost performances. For example, an average delivery time which is five days

shorter or a product of better quality (which consumes 4 per cent less of 5 days) surely has a positive impact on the economic and financial performances, but such an impact cannot be quantified in terms of increment in net income and/or profitability. As discussed earlier, non-cost measures are divided into three categories, namely quality, time and flexibility related measures.

2.5.4 Time related measures

Time element has strategic importance in business and hence 'time' has to be used as a strategic metric in performance measurement (Stack *et al.* 1990). These authors argue that measuring, controlling and compressing time shall improve quality, reduce costs, improve responsiveness to customer orders, enhance delivery, increase productivity, increase market share and increase profits. Time is not a lagging metric, and it is always beneficial to reduce time. Supporting this view, Krupka (1992) argues that 'time' is a more important metric than cost and quality since it can be used to drive improvements in both. Earlier, Azzone *et al.* (1991), suggested that time measure has to be applied in research and development, operations, sales and marketing as well.

2.5.5 Flexibility related measures

Flexibility (to measure the ability to deal with the dynamic nature of the business) is a performance apart, since it is an ability to change something (for example, the production volume or mix) in relation to all the three performances of cost, time and quality (Toni and Tonchia, 1998). Being flexible refers to make available the products and services to meet the individual demands of the customers. This has been made possible by the technological developments such as flexible manufacturing systems, group technology, computer integrated manufacturing and also ICT systems development. Various kinds of flexibility include volume flexibility, product mix flexibility, product modification flexibility, process modification flexibility, and expansion flexibility.

Gunasekaran *et al.* (2001) outlined six sets of performance metrics. The emphasis is also on the importance of measuring the non-financial aspects and the non-quantifiable and intangible aspects of performance. These parameters and metrics include the measures at strategic, operational and tactical levels, and this metrics are aligned to the four basic links that constitute the supply chain: plan, source, make and deliver. The measure sets incorporate measures for the issues related to supplier's relations.

The financial performance of a supply chain can be evaluated by looking into the following items.

(Bagchi *et al*. 1998):

- Cost of raw material
- Revenue from goods sold
- Activity-based costs such as material handling, manufacturing, assembling, etc
- Inventory holding costs
- Transportation costs
- Cost of expired perishable goods
- Penalties for incorrectly filled or late orders delivered to customers
- Credits for incorrectly filled or late deliveries from suppliers
- Cost of goods returned by customers
- Credits for goods returned to suppliers

Companies must not only view SCM for improving efficiency but also a way to bring about an increase in sales, boost competitive advantage increase share holder's value (Vlasimsky, 2003). The first universal performance measures those were used in supply chain performance measurement are generated by Pittglio, Rabin, Todd and Mcgrath, widely known as the PRTM (Stewart, 1995). The PRTMs concept of supply chain benchmarking has been extended to be the supply chain operations reference (SCOR) model by the supply chain council (Stewart,1997).

Chan and Qi (2002,2003a,b) and Chan *et al*. (2003) proposed an innovative performance measurement system(PMS) for Supply chains which include a conceptual performance model, and a performance measurement and aggregation method. The model can quantify the relative importance of both SC processes and measures with respect to SC strategies. Liljenberg (1996) finds that better allocation lowers supply chain costs by 0% to 3.9%. Chen (1998), finds that supply chain costs are lowered up to 9%, and on an average by 1.8%. Aviv and Federgruen(1998), report benefits of 0% to 5%. Raghunatahan (2003), reported on the study by Lee *et al.*(2000), that benefits can be negligible if the supplier knows the parameters of the retailer's (Accounts receivable) process. Economists disagree with the use of accounting data to measure firm performance because it ignores opportunity costs and the time value of money (Chen and Lee 1995). (Shah and Singh 2001), proposed the benchmarking as an internal supply chain performance for a paint industry, however few parameters like Days payable outstanding, and Days sales outstanding have not been considered in their study.

Table 2.7: Performance measure for supply chain management

Supply chain Process	Performance measure
Plan	Order entry method (Gunasekaran *et al.* 2004) Order lead-time (Christopher, 1992) Customer order path
Source	Supplier selection Buyer-supplier relationship
Manufacturing	Product cost, quality, speed of delivery, delivery reliability, flexibility (Slack *et al.* 1995; Mapes *et al.* 1997;) Range of product and services (Mapes *et al.* 1997) Capacity utilization (Slack *et al.* 1995) Effectiveness of scheduling techniques (Little *et al.* 1995)
Delivery	Delivery performance (Stewart, 1995) Number of faultless notes invoiced; flexibility of delivery systems to meet particular customer needs (Novich, 1990) Total distribution cost (Thomas and Griffin, 1996)
Customer	Product development cycle time; machine/toolset up time; economies of scope (Christopher, 1992) Number of inventory turns; customer query time Post transaction measures of customer service
Overall chain	Total supply chain costs (Cavinato, 1992) Total cash flow time ROI Total cost of inventory (Stewart, 1995; Christopher, 1992; Slack *et al*.1995; Lee and Billington, 1992; Levy, 1997) Information processing cost (Stewart, 1995)

2.6 Sustainable supply chain management performance evaluation

Vachon and Klassen (2008) based their work on plant level survey. Findings are influenced by collaboration in each direction and empirically assessed for multiple objective and perceptual measures of manufacturing performance for the package and printing industry. Research gaps are to find the potential link between environmental activities in the supply chain and internal quality management practices.

Vachon and Mao's (2008), survey based study findings are that supply chain strength has a strong correlation with GDP per capita positive relationship between supply chain strength and environmental performance.

Research gaps are: linking of corporate environmental management measured at the country level could be benchmarked to country risk ratings and foreign direct investments.

Jean (2008) Simulation based work, and major findings are dynamic efficiency of emission standards using co evolution of technology, user requirements and market structure. Research gaps are: Model considered a generic industry without emphasizing differences and regularities that exist in the sectors. Better specifications would lead to a clear understanding of the diversity among sectors and would allow the study of the co evolutionary processes underlying their dynamics in order to explain sectoral differences on environmental performance.

Bai, Sarkis and Wei (2010) : Research tool used is the technique for order preference by similarity to ideal solution (TOPSIS). Findings are rough set methodology is flexible enough to be applied as a selection tool, performance measurement evaluation and a development programme evaluation to Green supply chain management.

Erol *et al*. (2010) used multi criteria decision making for a framework of a sustainable supply chain measurement to evaluate the sustainability performance of a supply chain using fuzzy multi attribute utility theory (FMAUT)/fuzzy entropy.

Artiach *et al*. (2010) investigated factors and their role in corporate sustainability performance concerning US firms investing in sustainability principles considering the Dow Jones Sustainability world index and observed higher levels of growth and higher return on equity than conventional firms.

Matos and Hall (2007) based on case study, interview work on integrating sustainable development in supply chain considered firm level economic performance. Findings are that rugged landscape is the most appropriate approach to search for high performance when dealing with sustainable development. They suggested the framework for identifying parameters and uncertainties, searching for interdependence and adapting through cross functional walks.

Cerin and Dobers (2001) properly investigated the structure and transparency of the Dow Jones Sustainability Group Index (DJSGI) compared with Dow Jones Global Index (DJGI) and proposed that DJSGI focuses more on technology sector than the general DJGI and hence illustrated the transparency of DJSGI.

Svensonn (2007) suggests that first order supply chains of brand new clothing go beyond the traditional point of consumption, n-order supply chains should be considered in business practices from the point of origin in the first-order supply chains in order to enhance corporate efforts of SSCM.

Fine performance measurement is a successful tool in controlling and benchmarking among business processes. Thus from the above literature on SSCM performance suggests the need and importance of analysis of the potential link between environmental activities in the supply chain and internal quality management practices. They also described that there is a positive relation between supply chain strength and environmental performance.

Studies are also indicative of efficiency of emission using co evolution of technology, rough set as a methodology for performance measurement evaluation of GSCM. Application of fuzzy multi attribute utility theory for sustainable supply performance of a supply chain is also observed.

Table 2.8 Significant Contributions on SSCM performance evaluation

Author	Findings
Vachon and Klassen (2008)	Colloboration
Vachon and Mao's(2008)	Relationship between supply chain strength and environmental performance
Jean (2008)	Dynamic efficiency of emission standards
Bai,Sarkis and Wei(2008)	Roughset methodology to evaluate performance measurement in GSCM
Erol *et al.*(2010)	MCDM for evaluation of SSCM performance
Artiach *et al.*(2010)	Corporate sustainability performance among US firms
Matos and Hall(2007)	Rugged Landscape is most appropriate approach to search for High performance in SD
Cerin and Dobers (2001)	DJSGI focuses more on technology sector than the general DJGI
Sevensonn (2007)	n-order supply chains should be considered in business practices to enhance corporate efforts of SSCM

In recent literature, a fair amount of attention has been given to environmental considerations and the importance of sustainable development, and this has resulted in life-cycle thinking which has gained support over the more traditional view of seeking efficiencies in individual activities along the supply chain.

The concept of life-cycle management is involved with managing the impact of a product or service, and the resources used to produce it, on the environment at each stage of the product's life-cycle. Life-cycle

assessment is formally defined by International organization for standardization (ISO 1997) as "a compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life-cycle". It has been widely accepted within the environmental research community as a good basis for comparing alternative materials, components, and services. (see Committee on Material Flows Accounting of Natural Resources (CMFANR), 2004,57-58).Previous studies are also suggested that Life Cycle Assessment (LCA), Environmental Management System (EMS) as prosperous research tools for evaluation of product life cycle concerning a supply chain for achieving the sustainability.

Papers that are related to SSCM were also found since these papers are focusing on allied areas, especially production and consumption (Harry 2008), strategic decisions (Hugo and Pistikopoulos 2005), were also considered for direction and analysis.

Harry (2008) presented model that investigated supply chain from the consumption perspective providing insights into the contributions of regions and sectors in the production related in Dutch consumption. Outcome of the research is detailed picture consisting of region sector combinations with high contributions to the pressure of total Dutch consumption or specific supply chains. For complete sustainability analysis social and economic aspects to be considered. Developed Multi regional input output model (MRIO) used to determine for which final demand the production in a certain region-sector combination is intended.

Hugo and Pistikopoulos (2005) proposed a methodology utilizing mixed integer modeling techniques to address strategic decisions involving the selection, allocation and capacity expansion of processing technologies and assignment of transportation links required to satisfy the demand in the markets.

2.7 Research gaps - evident and emerged

Few important points can be drawn from the review of supply chain performance benchmarking problems:

- The most important gap in performance measurement related literature is that Supply chain is not viewed as a single entity. Major difficulty in evaluating the performance arises when there are multiple inputs and multiple outputs to the system and there are complex relationships between the inputs and outputs as there is a lot of uncertainty in tradeoffs.

- Past work failed to address the collaborative relationships involving joint decision making. Mathematical models are insufficient.
- Supply Chain Operations Reference model (SCOR) needs a more dynamic platform to address the integration and synchronization when it involves collaboration in joint decision making in a supply chain. (Wang *et al.* 2008.)
- Another research gap in Supply chain performance is consideration of financial data to find the presence of linkage between Supply chain, operational performance and financial performance (Nathalie *et al.* 2008).
- Qualitative metrics and nonfinancial measures of innovativeness and customer satisfaction should also be addressed. Design of Performance measurement systems considering HRM, modern manufacturing practices, including JIT, TQM & BPR should be navigated. Investigation of factors influencing the success or failure in implementing measurement systems for supply chain should be addressed.
- Another research gap is how to integrate a Performance measurement system with HRM & Modern Manufacturing practices such as TQM, BPR, JIT or new IT tools. The business environment is always dynamic but the existing measurement system for measuring supply chain performance is static. Hence, the frequency in measurement of supply chain performance should be evaluated.
- Evident research gaps are there proposed model & application of a case study is scarce. From past literature, theoretical framework is addressed in integration of a supply chain. Supply chain benchmarking using mathematical models and tools to be used are to be investigated. The suitability of the tools in addressing the supply chain benchmarking in an integrated perspective needs to be explored. (Wang *et al.* 2008.)

Papers reviewed in this chapter give details of different dimensions of SSCM. Some of the papers explore different aspects of SSCM. These various aspects can be summarized as follows:

- Environmental performance in SCM
- Financial performance linked with SCM
- Eco efficiency
- Corporate social responsibility
- Carbon emissions
- Suppliers and purchasing partnerships

Researchers used different tools for analysis in their work such as frame work development, simulation, mathematical modeling, case study and empirical analysis. Most of the papers reviewed have followed modeling, empirical study, and case study as research design.
However the following gaps were identified in current literature review:

- Zhu's developed scale has been validated only between Chinese manufacturers and not considered internal barriers in his study.
- Models developed have not addressed social issues, as well as have taken only few activities in recovery network and have not delivered better results for uncertainty.
- Modeling of carbon emissions did not address all the dimensions of sustainability. There is a scarcity of models for an insight into improving the eco efficiency covering all the activity's distribution, transportation, and procurement.
- There shall be a need of integration of sustainability and governance in SCM. Particularly absence of analysis in business opportunity developments concerning the environmental burden is intriguing.
- Studies and solutions related to operationalisation indicators of corporate social sustainability in decision making related to supplier selection or supply chains did not produce desired results.
- There is a need for further study to find the potential link between environmental activities in the supply chain and internal quality management practices.
- Linking corporate environmental management measured at the country level using benchmarking to country risk ratings and foreign direct investments is also desirable and foreseen.
- Modeling for generic industry do not prominently include differences and regularities that exist in the sectors.

Therefore, the need for the current study emerges for significant contribution to the body of knowledge and to the literature of SSCM. A large gap as is evident from the discussion of literature review is found. So, it became imperative that concerned sustainability issues, Supply chain performance as well as cost variables, environment, economic, business opportunity development and carbon emissions in case of Indian manufacturing companies must be analyzed through an empirical study discussed explicitly in the succeeding chapters of this thesis.

CHAPTER 3

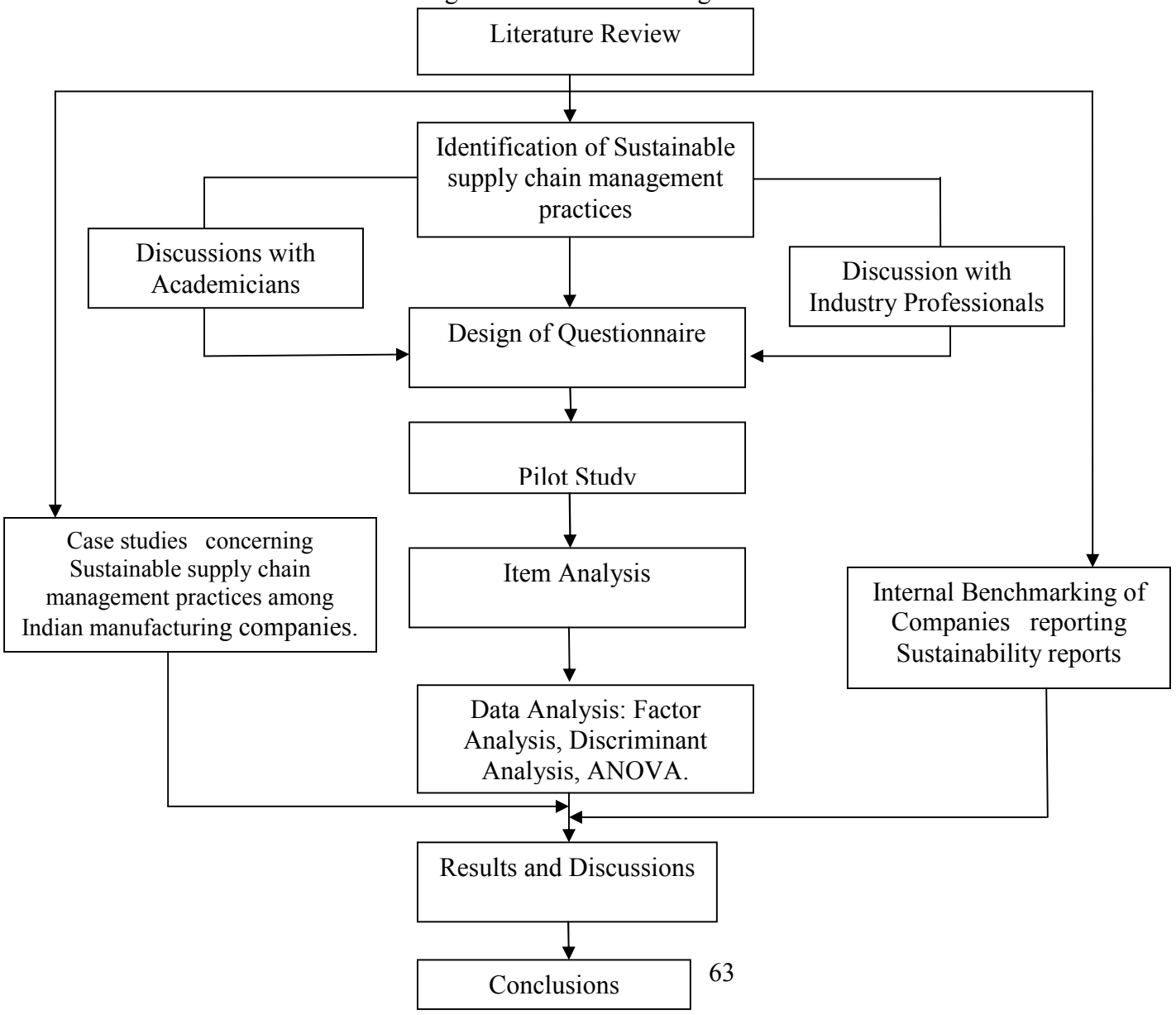
Research Methodology

Review of related literature, correlatively yet sequentially was elaborated upon in chapter 2 where in research gaps were identified. It was recognized that this research had justifiable reasons for an analysis of sustainable supply chain management practices in Indian manufacturing industries.

This chapter discusses the research objectives, hypotheses framed, questionnaire design, list of items considered for testing of hypotheses framed, population considered for this study, mode of data collection, reliability, followed by validity and tools used to execute the research objectives.

Figure 3.1 presents flow diagram of research design used in this thesis.

Figure: 3.1 Research Design



3.1 Research objectives

Following objectives were proposed for current study:

1. To study the awareness and importance given to sustainability in manufacturing companies.
2. To study the influencing factors and reasons to implement the concept of sustainability in manufacturing companies.
3. To study the SCM performance of companies following sustainability.
4. To identify some of the best practices in the supply chain of Indian manufacturing companies with sustainability perspective.

3.2 Hypotheses design

After extensive literature review, following hypotheses were framed with relevance to the objectives identified.

Hypothesis1: There is a significant relation between supply chain performance and publication of sustainability reports.

H 1(a): There is a positive relation between manufacturing cost and sustainability.

H 1(b): There is a positive relation between distribution cost and sustainability.

H 1 (c): There is a positive relation between supplier selection and sustainability.

Hypothesis 2: There is a significant relation between SCM sustainability and environmental impact.

Hypothesis 3: There is a significant relation between environment and economic sustainability in manufacturing companies.

Hypothesis 4: There is a significant relation between environmental and social sustainability in manufacturing companies.

Hypothesis 5: There is a significant relationship between sustainability and business application opportunity development.

H 5(a): There is a positive relation between sustainability and emission trading scheme (ETS).

H 5(b): There is a positive relation between sustainability and cleaner production.

Hypothesis 6: There is a significant relationship between environment concerned and sustainability.
H 6(a): There is a positive relation between reduction of carbon emissions and sustainability.
H 6(b): There is a positive relation between transportation in supply chain network and sustainability.

Research methodology adopted to accomplish this work is related to empirical approach as well as case study approach concerning the established research objectives. In addition to this, convenience sampling has been adopted for data collection, because of the reason that there is a little difference in population and sample of this study, the fact being organizations which are reporting on sustainability are only covered hence justifying descriptive research design chosen for the study

3.3 Questionnaire design

Data was collected using a questionnaire consisting of 95 items. Questionnaire was initially prepared after in depth discussions with professionals, academicians and practioners of SSCM. The questions were designed to address following areas:

a. Profile of the company
b. General understanding about the organization's supply chain policy, sustainability issues
c. Sustainability issues in relation to supply chain performance were classified concerning supply chain operation reference model (SCOR) i.e plan, source, make deliver and return
d. Environmental impacts
e. Social sustainability
f. Business opportunity development due to sustainability issues

Items considered for hypotheses testing were considered from the sustainability reports of the Indian company's viz., ACC, JSW, Jubilant Organsys, Mahindra, Kansai Nerolac paints limited, Tata Motors, Tata Chemicals, Dr Reddy's laboratories Ltd. In this study, the supply chain operations reference (SCOR) model, a process oriented model, is adopted. The SCOR model is one of the first models that have holistically framed the supply chain processes from an operational process perspective. It was developed by Supply Chain Council together with Pittiglio Rabin Todd & McGrath (PRTM) and AMR research in the late 1990's and focuses on the operational aspects of supply chain management. The SCOR model includes all customer interactions (order entry through invoice payment), all physical transactions (including equipment, suppliers, spare parts, bulk products, software, and etc.), and all market interactions (from demand forecast to order fulfillment).

Supply chain planning processes information from suppliers, customers, and internal operations, and then synchronize the operations of supply chain associates to satisfy the ultimate customer desires (Supply Chain Council, 2000).

The "Plan" process in the SCOR model incorporates forecasting supply chain demands and collaborating with different players in a supply chain.

The "Source" process in the SCOR model refers to purchasing, which has been studied extensively in literature. Sourcing is vital for a manufacturing firm, because a manufacturing firm usually invests more than half of its revenue on purchasing. The extant literature shows that sourcing has a huge impact on business performance, including both financial performance and operation performance (Watts *et al.* 1992, Gadde and Hakansson, 1994, Narasimhan and Das, 2001).

The "Make" process in the SCOR model refers to production. The traditional operation's management literature has extensively explored good production practices and has studied the relationship between production process and business performance. The production process has evolved from mass production in early 1900s to lean production in the past twenty years (Womack *et al.* 1990). The relationship between lean production practices and business performance has been tested and found to be favorable (Flynn *et al.* 1995, Powell, 1995, Mac Duffie *et al.* 1996, Flynn et al., 1999, Cua *et al.* 2001).

Delivery process, according to the SCOR model logic starts from order inquiry processing and ends with invoicing. It includes processes such as process inquiry, enter orders, consolidate orders, route shipment, select carriers, pick products from warehouse, transport products, and so on. The extant literature and anecdotal evidence have shown that a good delivery system has a big impact on a firm's business performance. According to Johnson and Davis (1998), poor order processing system costs Hewlett Packard a million dollars a day. The cross docking technique used by Wal-Mart, which uses its warehouse as a switching station rather than a stocking place, has reduced both inventory carrying cost and docking spaces (Stalk *et al.* 1992). Gurin (2000) described how Ford partnered with the UPS logistics group to develop and implement an Internet-based delivery process, which significantly improved Ford's delivery performance. La Londe *et al.* (1993) suggested that it was beneficial to push inventories back from retailers to manufacturer.

The "Return" process is part of the reverse logistics system. The return process is defined as the recycling, material's substitution, reuse of materials, waste disposal and refurbishing, repair, and remanufacturing. The return process is added to the SCOR 5.0 version. The return process has a significant influence on business performance for several reasons. First, it is expensive to process returned products. Langnau (2001) estimated that the average cost per product return will be $30-$35 in the next few years. The reported cost to process returned products was about $40 billion in total. The logistics infrastructure required for product return is different from the traditional "forward" logistics environments (Fleischmann et al., 2001). As an example, O'Heir (1998) described how Toshiba boosts their services by reducing the product return cycle. The notebook product can get an express service guarantee of the 8-hour repair cycle with a 40-hour product return cycle.

List of items considered for testing various hypotheses as addressed in questionnaire are :

Sustainability indicators used in publication of sustainability report:

- Patient care
- Education
- Livelihood
- Community care
- Disaster relief
- Human rights
- Product responsibility
- Vocational training
- Product stewardship

Social sustainability indicators:

- Social accountability
- Safety and health issues of employees
- Safety and health issues of surrounding community
- Safety and health issues of laborers and transporters
- New products, new processes, green technology
- Cleaner development mechanism and carbon trading

Classification of different items under make, deliver, source, return have been considered from the work of Gunasekaran et *al.* (2004)

Plan

- Information carrying cost
- Over head cost

- Intangible cost
- Total supply chain response time
- Total supply chain cycle time
- Order lead time
- Customer response time
- Total cash flow time
- Cash – cash cycle time
- Order entry methods
- Order flexibility

Source:

- Supplier cost saving initiatives
- Supplier booking in procedures
- Purchase order cycle time
- Efficiency of purchase order cycle time
- Buyer – supplier partnership level
- Supplier rejection rate
- Mutual trust
- Satisfaction with knowledge transfer
- Satisfaction with supplier relationship
- Supplier assistance in solving technical problems
- Timely available of accurate information
- Supplier ability to respond to quality problems.

Make:

- Manufacturing cost
- Work in process
- Inventory cost
- Inventory turnover ratio
- Inventory days of supply
- Economic order quantity
- Warehouse costs
- Disposal costs
- Planned process cycle time
- Manufacturing lead time
- Production flexibility
- Volume Flexibility

Deliver:

- Total logistics costs
- Distribution costs
- Delivery costs
- Transportation costs
- Delivery efficiency
- Delivery lead time
- Delivery reliability
- Quality of delivery goods
- Quality of delivery documentation
- Frequency of delivery
- Delivery flexibility
- Transport flexibility

Return:

- Warranty/returns processing costs
- Customer response time
- Level of customer perceived value of product
- Customer complaints
- Rate of complaint

Sustainability environmental perspective:

- The level of gaseous emissions from organization negatively effects the environment.
- Organization's liquid waste discharge affects the ground water level.
- Solid wastes from organization have negative effects on the environment.
- Using environment friendly transportation system costs additionally.
- Organization practices the concept of landfill for solid waste management.
- Perception about the scarcity of raw material resources is used by your organization for next ten years.
- Usage of products manufactured by organizations have negative impact on the environment.
- Packaging material which is being used by organizations has negative impact on the environment.
- The production process in organization affects employees.
- The activities in supply chain affects the people around organization.

Items under sustainability i.e use of raw materials, landfill for solid waste management, gaseous emissions have been considered from the work of James *et al* (1997).

Few other items like recycling (Vachon and Mao, 2008), Cleaner development mechanism (Reddy and Balachandra ,2006) were addressed in the questionnaire.

Business opportunity developments:

- New products
- New processes

Carbon emissions:

- Green technology
- Cleaner development mechanism
- Carbon trading

3.3 Sample

The sample size for each group was decided by considering factors like; the requirements of analysis, sample sizes adopted in previous studies and qualitative factors. Targeted respondents of the research were drawn from functional areas like supply chain, manufacturing, distribution working in manufacturing industries. It is assumed that their job or designation enables them to have a good working knowledge about their own organization. They are most earmarked personnel to answer questions related to sustainability and SCM issues.

3.4 Sample size and data Collection

Data was collected using convenience sampling. Knowledge and functional area experience of top and middle-level management employees were chosen in this study for filling in the questionnaire. Vishakhapatnam, Hyderabad is chosen to collect data because of the presence of manufacturing companies those were to be included in the study, as confidence level of the sample considered is an accepted analogy of the population.

The data was also collected from the manufacturing companies located in cities like Raipur, Vijayawada, Chennai, Ahmedabad, Haridwar, Indore, Mumbai and Bangalore.

Indian manufacturing company's communities were chosen, and the concerned employees are requested to participate in this study by personal interaction where a questionnaire was sent (Appendix-1).The need and purpose of the research study were explained in the questionnaire. The responses were collected on five-point Likert Scale. The data was collected from respondents in three months i.e. from August 2011 to October 2011.A total of 250 questionnaires were sent out to top and middle-level managers and senior engineers related to supply chain management in the manufacturing companies. Pilot testing was done using first 50 responses two kinds of mailings (email and personal) and subsequent follow-ups were done. Forty six usable responses were collected by validate the scale personal interactions; twenty four responses were collected through e-mail and web links from the respondents where personal meeting was impossible. Significant role in usage of a social-networking website like the face book were also used to administer the questionnaire for data collection process by leaving a link that had been designed using google spreadsheet.

Table : 3.1 Summary of mode of data collection

Number of questionnaire sent	Number of usable responses	Mode of collection			
		Google spreadsheet web link	Email	Personal	Response rate (%)
250	101	31	24	46	40.4

Thirty one responses were collected through an online questionnaire designed using google spreadsheet 101 usable responses returned. Ninety Six manufacturing firms participated in the study with response rate of 40.4 %. The sample size for each group was decided by considering factors like; the requirements of analysis, sample sizes adopted in previous studies and qualitative factors. Targeted respondents of the research were drawn from functional areas like Supply chain, manufacturing, distribution working in manufacturing industries. It is assumed that their job or designation enables them to have a good working knowledge about their own organization. They are most earmarked personnel to answer questions related to sustainability, SCM, issues.

Nominal and interval scales were used to get the responses from the targeted samples. The nominal scale/categorical scale were used to capture the demographics of the respondents. The interval scale shall be used for measurement of items deployed in this study.

Thriteen companies operating in India were considered and publishing their sustainability report from last three years consecutively. As the underlying essence of this research is exclusively concerned about the analysis of sustainable supply chain management in Indian manufacturing companies, the companies doing business manufacturing as main activity and their geographical location in India across different states was considered. Balance sheet of these companies were obtained from PROWESS, a database developed by Center for Monitoring Indian Economy (CMIE). Due to confidentiality Companies are named as Company A, Company B, Company C, Company D, Company E, Company F, Company G, Company H, Company I, Company J, Company K, Company L, Company M.

Company A is India's foremost manufacturer of cement and concrete. Company's operations are spread throughout the country with 17 modern cement factories, more than 40 Ready mix concrete plants, 21 sales offices, and several zonal offices. It has a workforce of about 9,000 persons and a countrywide distribution network of over 9,000 dealers.

Since inception in 1936, the company has been a trendsetter and important benchmark for the cement industry in many areas of cement and concrete technology. Company has a unique track record of innovative research, product development and specialized consultancy services. The company's various manufacturing units are backed by a central technology support services centre - the only one of its kind in the Indian cement industry.

Company B is one of the leading cement manufacturing companies in India was founded by Narotam Sekhsaria in 1983 with a partner, Suresh Neotia. Sekhsaria's business acumen and leadership skills put the company on a fast track to growth. The Company commenced cement production in 1986. The global cement major Holcim acquired management control in 2006.Holcim today holds little over 50% equity in this company. Its current cement capacity is about 27.25 million tonnes. The Company has five integrated cement manufacturing plants and eight cement grinding units across the country. Its environment protection measures are on par with the finest in the country. It is one of the most profitable and innovative cement companies in India. It is the first Indian cement manufacturers to build a captive port with three terminals along the country's western coastline to facilitate timely, cost effective and environmentally cleaner shipments of bulk cement to its customers.

Company C a flagship company of the Aditya Birla Group, ranks among India's largest private sector companies, with a consolidated net revenue of Rs.216 billion and consolidated net profit Rs.22.8 billion (FY 2011).

Starting as a textiles manufacturer in 1948, today company's businesses comprise viscose staple fibre (VSF), cement, chemicals and textiles. Its core businesses are VSF and cement, which contribute to over 90 per cent of its revenues and operating profits. It is the world's largest producer of VSF, commanding a 21 per cent global market share, with an aggregate capacity of 333,975 tpa has a global market share of 10 per cent. It is also the second largest producer of caustic soda (which is used in the production of VSF) in India.

Company D is India's largest Fast Moving Consumer Goods Company with a heritage of over 75 years in India and touches the lives of two out of three Indians. According to company, it works to create a better future every day and helps people feel good, look good and get more out of life with brands and services that are good for them and good for others. With over 35 brands spanning 20 distinct categories such as soaps, detergents, shampoos, skin care, toothpastes, deodorants, cosmetics, tea, coffee, packaged foods, ice cream, and water purifiers, the Company is a part of the everyday life of millions of consumers across India. The Company has over 16,000 employees and has an annual turnover of around Rs. 21,736 crores (financial year 2011 - 2012). One of the world's leading suppliers of fast moving consumer goods with strong local roots in more than 100 countries across the globe with annual sales of about €46.5 billion in 2011.

Company E was incorporated on August 24, 1910 In recognition of the Company's multi-business portfolio encompassing a wide range of businesses - Fast Moving Consumer Goods comprising Foods, Personal Care, Cigarettes and Cigars, Branded Apparel, Education and Stationery Products, Incense Sticks and Safety Matches, Hotels, Paperboards & Specialty Papers, Packaging,Agri-Business and Information Technology.

Company F founded in 1945 as a steel trading company entered automotive manufacturing in 1947 to bring the iconic Willys Jeep onto Indian roads. Over the years, they have diversified into many new businesses in order to better meet the needs of our customers. They follow a unique business model of creating empowered companies that enjoy the best of entrepreneurial independence and Group-wide synergies. This principle has led their growth into a US $15.9 billion multinational group with more than

155,000 employees in over 100 countries across the globe. Their operations span 18 key industries that form the foundation of every modern economy: aerospace, aftermarket, agribusiness, automotive, components, construction equipment, consulting services, defense, energy, farm equipment, finance and insurance, industrial equipment, information technology, leisure and hospitality, logistics, real estate, retail, and two wheelers.

Company G has been a cherished name in millions of households across the length and breadth of India. The company manufactures a diversified range of products for every surface. It is the second largest coating company in India and market leader in Industrial Coatings. It's Industrial Coatings it has a wide range of products in the Automotive, Powder, General Industrial and High performance Coatings space. It is a subsidiary of Japan based Kansai Paint Company Limited, which is one of the top ten coating companies in the world.

Company H is India's largest automobile company, with consolidated revenues of INR 1,65,654 crores (USD 32.5 billion) in 2011-12. It is the leader in commercial vehicles in each segment, and among the top three in passenger vehicles with winning products in the compact, midsize car and utility vehicle segments. It is the world's fourth largest truck and bus manufacturer. It's over 55,000 employees are guided by the vision to be "best in the manner in which we operate, best in the products we deliver, and best in our value system and ethics." Established in 1945, Its presence indeed cuts across the length and breadth of India. Over 7.5 million vehicles ply on Indian roads, since the first rolled out in 1954. The company's manufacturing base in India is spread across Jamshedpur (Jharkhand), Pune (Maharashtra), Lucknow (Uttar Pradesh), Pantnagar (Uttarakhand), Sanand (Gujarat) and Dharwad (Karnataka).

Company I established in 1907, is among the top ten global steel companies with an annual crude steel capacity of over 28 million tonnes per annum (mtpa). It is now one of the world's most geographically-diversified steel producers, with operations in 26 countries and a commercial presence in over 50 countries. With a turnover of US$ 26.13 billion in FY 2011- 2012, it has over 81,000 employees across five continents and is a Fortune 500 company. Its vision is to be the world's steel industry benchmark through the excellence of its people, its innovative approach and overall conduct. Underpinning this vision is a performance culture committed to aspiration targets, safety and social responsibility, continuous

improvement, openness and transparency. It has larger production facilities include those in India, the UK, the Netherlands, Thailand, Singapore, China and Australia.

Company J is a subsidiary of Suzuki Motor Corporation, Japan. Company has been the leader of the Indian car market for over two and a half decades. The company has two manufacturing facilities located at Gurgaon and Manesar, south of New Delhi, India. Both the facilities have a combined capability to produce over a 1.5 million (1,500,000) vehicles annually. The company plans to expand its manufacturing capacity to 1.75 million by 2013. The Company offers 15 brands and over 150 variants ranging from people's car to the latest Life Utility Vehicle, It has became the first company in India to introduce factory fitted CNG vehicles. In terms of number of cars produced and sold, the Company is the largest subsidiary of Suzuki Motor Corporation. Cumulatively, the Company has produced over 10 million vehicles since the roll out of its first vehicle on 14th December, 1983. This is the only Indian Company to have crossed the 10 million sales mark since its inception. In 2011-12, the company sold over 1.13 million vehicles including 1,27,379 units of exports. The Company employs over 9000 people (as on 31st March, 2012).

Company K is the Corporation that has multi product industrial profile and manufacturers of Drip and Sprinkler Irrigation Systems and Components; PVC, Polyethylene (HDPE, MDPE) & Polypropylene Piping Systems; Plastic Sheets (PVC & PC sheets); Agro Processed Products includes Dehydrated Onions and Vegetables; Processed Fruits (Purees, Concentrates & Juices); Tissue Culture, Hybrid & Grafted Plants; Greenhouses, Poly and Shade Houses; Bio-fertilizers; Green Energy includes Solar Photovoltaic (Solar lighting and appliances, Solar pumping systems), Solar water heating systems and Bio-Energy sources. They render consultancy for complete or partial project planning and implementation e.g. Watershed or Wasteland and / or Crop Selection and Rotation.

Company L is one of the fastest growing business conglomerates with a strong presence in the core economic sector, which led enterprise has grown from a steel rolling mill in 1982 to a multi business conglomerate worth US $10 billion within a short span of time.
As part of the US $ 16.5 billion company Group has diversified interests in Steel, Energy, Minerals and Mining, Aluminium, Infrastructure and Logistics, Cement and Information Technology. On its road to growth and expansion, the Group is also conscious about its responsibility towards environment and social development. Eco-efficiency is a matter of principle. Preventive measures for damage to the environment are taken into account at the planning stage of production and growth.

3.5 Internal benchmarking for sustainable supply chain performance

For achieving the third research objective a framework as following is developed for supply chain performance using internal benchmarking as a tool. Main aim is for interpreting and expressing the internal supply chain performance measure, internal benchmarking of selected organizations with quantitative as well as qualitative perspective. The financial metrics and linkage with supply chain performance measures for selected organizations. The main aim is to suggest an appended methodology for calculating performance measures and their qualitative interpretation, constancy of conducting internal supply chain benchmarking in financial perspective concerning the organizations publishing the sustainability reports.

Figure no.3.2: A Methodology for Internal Benchmarking (Shah and Nitin, 2001)

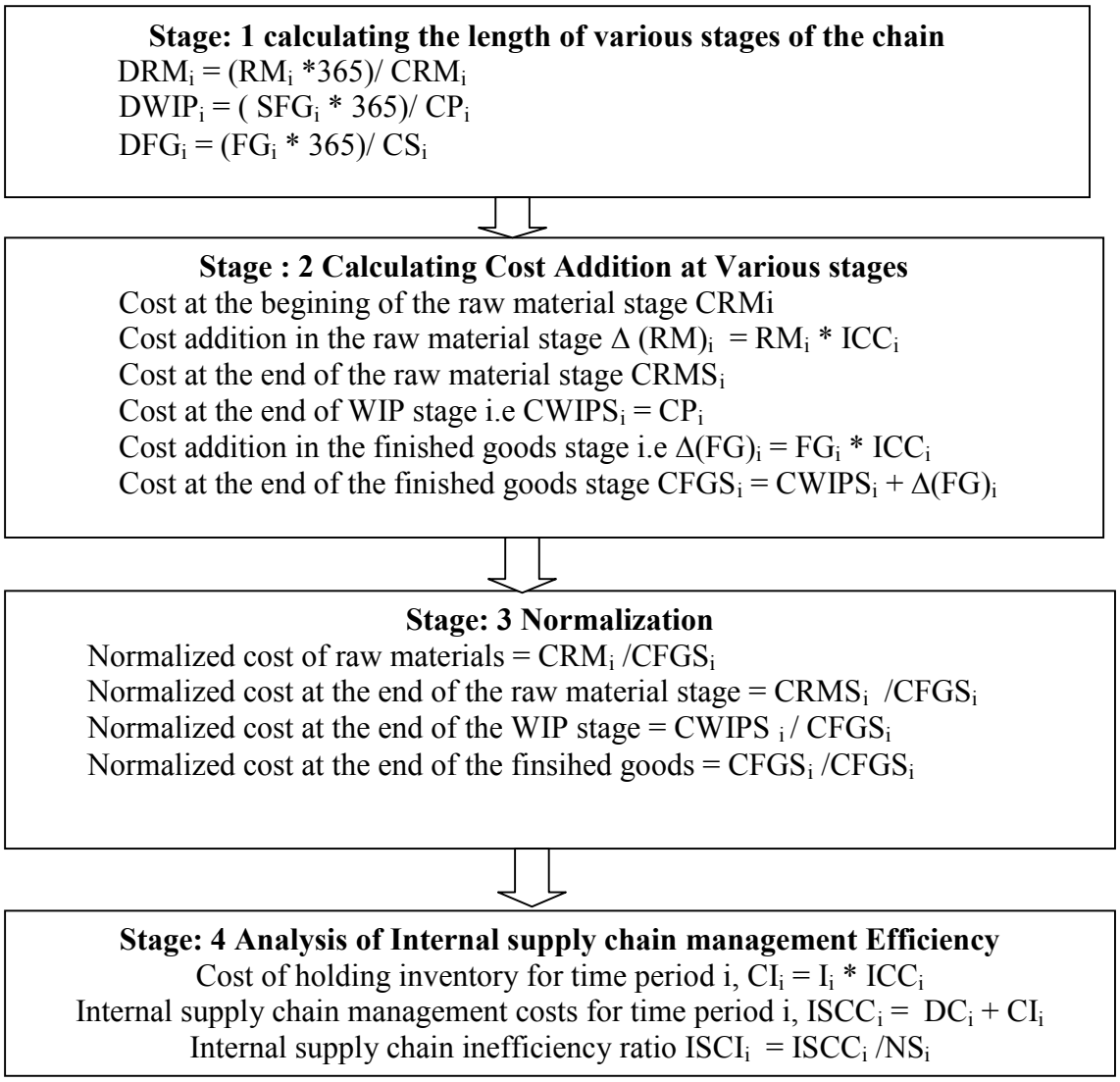


Table no: 3.2 List of parameters considered and obtained from the financial statements is as presented in

Terms	Expressed as
Cost of raw materials	CRM_i
Cost of distribution	DC_i
Cost of production	CP_i
Cost of sales	CS_i
Net Sales	NS_i
Inventories (Inclusive of raw materials,Semi finished goods and finished goods)	I_i
Raw materials inventory	RM_i
Semi finished goods inventory	SFG_i
Finished goods inventory	FG_i
Accounts receivables	AR_i
Accounts payable	AP_i

(Shah and Nitin 2001),proposed methodology on benchmarking internal supply chain performance for a paint industry however few parameters like days payable outstanding, days sales outstanding have not been considered in their study which have been considered in present study by appending the stage 5 to the methodology covering analysis of internal supply chain working capital productivity, (C-2-C cycle) $ISWC_i = I_i + AR_i – AP_{i,}$; internal supply chain working capital productivity $ISWCP_i = NS_i / ISWC_i$; days payables outstanding = $(AP_i / AR_i)*365$; days sales outstanding= $(AR_i$ / Annual Revenues)*365.

3.6 Best Practices in Supply Chain - Sustainability Perspective

For achieving the fourth research objective i.e to identify some of the best practices in the supply chain of Indian manufacturing companies with sustainability perspective. Few case studies/case lets of Mahindra & Mahindra, GMR, Nestle India, Nokia and Saint Gobain glass India Ltd, Tata motors, Hero motocop Ltd., Hindustan Unilever limited, Tata Motors, Tata chemicals have been selected as a reference base to discuss the empirical results with reference to the said objectives.

After carrying out pilot studies, structure questionnaire was designed to address the particular groups. Groups (Manufacturing industry) were considered as per centre for monitoring Indian
economy.

Classification is made into fourteen types viz., engineering, automobiles, petroleum, fertilizers, power, electronics, pharmaceuticals,steel,cement,consumer,textiles,agrobased, chemical and others.

3.7 Reliability

The reliability of the constructs is initially assessed using coefficient alpha (Cronbach, 1951) and item–total correlation analysis. The typical approach for reliability assessment is in terms of Cronbach's alpha coefficient (Cronbach, 1951) which ranges from 0 to 1, has the desirable property of being a lower bound of reliability (Lord and Novick, 1968) and is a commonly used index for evaluating the reliability of strategy measures (Venkatraman and Grant, 1986). An alternate conceptualization of reliability is that it represents the proportion of measure variance attributable to the underlying trait. Following Werts *et al.* (1974) the reliability can be calculated as Alpha= Trait Variance/ (Trait Variance+ Error Variance).

When alpha is greater than 50%, it implies that the variance captured by the trait is more than that by error components (Bagozzi, 1981). An alpha in excess of 0.50 indicates that at least 50% of the variance in measurement is captured by the trait variance. An alpha value of 0.70 and above is considered to be the

criterion for demonstrating internal consistency of established scale (Nunnally, 1988). In the case of exploratory research, an alpha value of 0.60 or above is considered significant (Hair *et al.* 1998).

The Cronbach's alpha of constructs discussed in this study for supply chain management policy 0.896, for plan, source, make, deliver, and return 0.95, for environmental impacts 0.859, for social sustainability & business opportunity development 0.896, and alpha values for SCM policy, plan, source, make, deliver, return; environmental impacts, social and sustainability business opportunity developments are 0.8,0.9,0.8 and 0.8 respectively. From these values, it can be concluded that the construct considered for this study demonstrated internal consistency, and further analysis can be done.

3.7.1 Content Validity

Content validity of an instrument refers to the degree to which it provides an adequate depiction of the conceptual domain that it is designed to cover (Hair *et al.* 1998). If the items representing the various constructs of an instrument are substantiated by a comprehensive review of the relevant literature, content validity can be ensured (Bohrnstedt, 1983). The five strategic items adopted from a SCOR model i.e plan, make, source, deliver, return, (Gunasekaran *et al.* 2002) are identified from the literature. Hence, the selection of the constructs is absolutely justified concerning the existing literature in Supply chain management ensuring the content validity of the instrument. The establishment of content validity shows logic, good intuitive and high perseverance on the part of the instrument designer (Kaplan and Sacuzzo, 1993)

3.7.2 Face Validity

In face validity, one looks at the measure and sees whether on its face, it seems a good translation of the construct under study. Face validity is the subjective assessment of the correspondence between the individual items and the concept through rating by expert judges (Hair *et al.*1998).

3.8 Tools Used For Analysis

The following analyses have been carried out to meet the objectives.

Discriminant Analysis: Discriminant analysis is a technique for analyzing data when the dependent variable is categorical, and the independent items are interval in nature. It examines whether significant differences exist among the groups in terms of independent variable or not. It determines which of the

independent items contribute to most of the inter-group differences. It has been used to determine how the SCM performance of companies publishing the sustainability reports and companies that are not publishing their sustainability reports. It was also used to determine the levels of awareness of Sustainability issues being practices in the organizations considered for this study based on dependent items like; gender, qualification, occupation, etc.

Factor Analysis: Factor analysis is a general name denoting a class of procedures primarily used for data reduction and summarization. It is an interdependence technique in that an entire set of interdependent relationships is examined. In this research, it has been used to group the various sustainability practicing issues across the supply chain management

Hypothesis Testing of Proportions: Hypothesis testing begins with an assumption, called a hypothesis, which we make about a population parameter. Then we collect sample data, produce sample statistics, and use this information to decide how likely it is that our hypothesized population parameter is correct.

The next chapter deals with analysis of data presentation, results based on hypotheses used and statistical tools applied.

CHAPTER 4
Data Collection and Analysis

This chapter presents data collected and primary analysis for present study. The organization of the chapter is as follows:

i. Survey respondents
ii. Demographic presentation
iii. Descriptive statistics
iv. Results of Inter - Item – analysis
v. Analysis of Hypotheses
vi. Internal supply chain benchmarking

4.1 Survey Respondents

The selection of respondents is considered very important for obtaining sufficient and good quality of data in a survey based research. The respondents in different manufacturing industries are expected to have appropriate knowledge on the subject areas of the survey. It was desired that respondents must have experience in Sustainable Supply Chain Management (SSCM) practices, as well as possess general understanding of supply chain management policy and supply chain performance measure in their respective companies as well as the generally accepted benchmark in industry. For minimizing response bias and generalizing the results of the study, it was also desirable to have a sample that could represent different geographic areas, industries and firm sizes.

The targeted respondents of the study were supply chain professionals and senior corporate executives. It is expected that their job function enable them to have a working knowledge about their own organization as well as the partner organizations in their supply chains. They are the most appropriate personnel to answer questions related to sustainability, SCM practices. Responses are finally collected from 101 top and middle-level managers, engineers working in various manufacturing industries in India. Their participation is confirmed only by receiving the completely filled-in questionnaire.

4.2 Demographic presentation

4.2.1 Types of companies covered in survey

Table 4.1 shows that 29% of responses were collected from engineering companies, 7% from automobiles, 5% from petroleum, 2% from fertilizers, 9% from power, 4% from electronics, 5% from pharmaceutical, 7% from steel, 3% from cement, 5% from consumer, 2% from textile, 5 % from agro base, 10 % from chemical, 10% from others including paper & pulp, and mining.

Table 4.1 Types of Industries participated in this survey

Types of Industries	Percentage of Responses
Engineering	29
Automobiles	7
Petroleum	5
Fertilizer	2
Power	9
Electronics	4
Pharmaceutical	5
Steel	7
Cement	3
Consumer	5
Textile	2
Agro-Based	5
Chemical	7
Others	10

Table 4.2 shows the types of companies on the basis of ownership structure that participated in this research. It can be seen that about 7% of the companies are public limited. 67% of the responding companies fall under the category of private limited. 24 % of the responding companies are government undertaking companies.

Table 4.2 Types of companies(based on ownership) participated in this survey

Type of company	Number of respondents (in percentage)
Private Limited	64
Government undertaking	23
Public Limited	7
Others	6

Table 4.3 presents the age of respondent companies in years 23% companies are more than 50 years old. 8% companies were in slab of 41years to 50 years age, 10% in slab of 31years to 40 years age, 11% in slab of 21 to 30 years age, 9% in slab of 5 to 10 years age, 10% under age of less than five years have been participated in this study. It can be seen that companies falling in the range of 11 to 20, greater than 50 have major contribution of the sample, which is justifiable and company's age has been considered as one of the yardstick in choosing or justification of the sample size considered in this study.

Table 4.3 Company's age in years

In Years	Number of respondents (In Percentage)
Less than 5 Years	10
5 to 10 years	9
11 to 20	29
21 to 30	11
31to 40	10
41 to 50	8
Greater than 50	23

Table 4.4 presents hierarchical position of responding employee in his/her company. Only top level and middle level executives were considered for survey. Lower level executives were not involved in the survey. Because sustainability issues in the supply chain generally dealt among the two levels of management i.e top and middle. Out of total respondents 24% were top level and 76% were middle level executives. It has been found that most of the employees having the background of engineering in production, distribution who are responsible for SSCM issues in their companies supply chain network.

Table 4.4 Hierarchical positions of respondents participated in the survey

Hierarchical Position	Respondents In Percentage
Top Level Management	24
Middle Level Management	76

Among the respondent's company profile, it has been observed that out of 96 companies 40 (42%) companies are either MNC or foreign company having an equity stake of 50% or more. Due to the globalization and foreign direct investments into the manufacturing sector majority of developed countries

have initiated establishing their company's presence in India, which implies in imparting the significant role in enhancing the sustainable supply chain management practices.

Company's size is presented in terms of a number of employees in the company, as shown in table 4.5. 47% of the responding companies belong to the category of large-size organizations having employee strength more than 1000 employees. The second group is of companies having employees less than 99 23% and 100 - 499 of 25%. Remaining (5%) are of companies having employees range of 500-999 employees.

Table 4.5 Participating companies in terms of employee size

Employee size range	Number of Respondent (In percentage)
1 to 99	23
100-499	25
500-999	5
Greater than 1000	47

From table 4.6 it can be interpreted that 78% of the companies are evaluating the environmental performance followed by green labeling 62%. Green label is an environmental certification logo awarded to specific products, which have the less detrimental impact on the environment in comparison with other products serving the same function. Environmental labeling is being promoted in a number of states to encourage cleaner production and raise awareness among consumers of the environmental implications of consumption patterns. Indian government has prepared "Ecomark" criteria for 14 product category's soap and detergents, paper, paints, plastics, lubricating oil, aerosols, food items, packaging materials, wood substitutes, textiles, cosmetics, electrical and electronic goods, food additives, and batteries. 61% of companies do practice of waste recycling and 39.8 % of companies do practice energy efficiency program implementation been considered as vital sustainable practices being practised by responding companies.

Table 4.6 Sustainable practices observed by the participated companies in the survey

Few Sustainable practices observed by the Participating companies in the survey.	Yes (%)	No (%)
Evaluation environmental performance	78.12	21.87
Practice of waste recycling	61.45	38.54
Green labeling	62.50	37.50
Energy efficiency program implementation	39.58	22.90

Table 4.7 Criteria used for environmental performance by the respondents company

Criteria Used for evaluation of Environmental Performance of Vendors	In Percentage
The status of ISO 14001 implementation	21
Corporate philosophy and environmental policy	24
Organisation Structure for Environmental management planning	24
EIA for their products and materials	22
Environmental education and disclosure of information	4
Reduction of chemical substance	5

Table 4.7 tells about the criterion being practiced by the respondents.78.12% of the companies evaluating the environmental performance among these companies sub criterion i.e 24% of companies use organization structure for environmental management planning and 24 % of companies use corporate philosophy and environmental policy chosen as the top priorities observed among the six choices given in the questionnaire. Followed by environmental impact assessment for their products and materials 22% of the respondents are using the criteria for environmental performance consequently 21% of the respondents are using the status of ISO 14001 implementation as criteria in evaluating the environmental performance.

Table 4.8 Programs attended by the respondents

Type of Program	In Percentage
Training Program	31
Workshop	21
Conference	12
Seminar	14
None of the Above	22

In order to interpret the awareness level about the sustainability concepts in respondents companies table 4.8 shows that 31 % of the respondents have attended training program on sustainability or environmental issues in supply chain management followed by 21% of respondents attended the workshop, and 14% and 12% of the respondents attended the seminar and conference respectively. Overall 76% of the respondents have attended any one of five choices given in the questionnaire which reflects the responses given by respondents have good knowledge about the SSCM issues that are being practiced in their manufacturing companies.

Table 4.9 Ensurance of environmental compliance by the respondents company

Type of Environmental compliance	Number of Respondent companies
ISO 14001	43
CDP	10
ISO 26001	8
ISO 5001	9
Any Others	22
Not applicable	8

From the table 4.9 respondents company ensurance of environmental compliances are being used by the companies for order winners or order qualifiers as well as due to government regulations ensurance of environmental compliance have been made manadatory. In this current study respondent's company i.e 60% of them have stated others as environmental compliance, 43 % of the companies are following the ISO 14000 series followed by 9 % of the companies following ISO 5001(Energy management). 10 %,8% of the companies are following Carbon disclosure project and ISO 26001(Social responsibility) each respectively. However the compliances that are being practised by the companies will change for every year due to the revisions or auditing of the compliances.

4.3. Descriptive statistics

Table 4.10, 4.11,4.12, 4.13, and 4.14 represent the responses on SCM policy, SCOR model, environmental impacts,social sustainability performance indicators and business opportunity and development in manufacturing companies of India considered in this research.

Table 4.10: Descriptive statistics of SCM policy

Items	1	2	3	4	5	Mean	S.D
Customer satisfaction	1	4	8	42	46	4.27	0.847
Low waste	2	6	24	35	34	3.92	0.997
Capacity utilization	1	4	23	53	20	3.86	0.813
Reliability	1	6	28	41	25	3.82	0.910
Cost cutting	0	8	27	43	23	3.80	0.883
Asset turnover	1	3	34	41	22	3.79	0.852
Responsiveness	0	8	25	49	19	3.78	0.844
Supply chain surplus(Profitability)	2	12	23	34	30	3.77	1.067
Customization	0	7	36	33	25	3.75	0.910
Distribution channel strategy	1	4	39	42	15	3.65	0.818
Low inventory	4	10	29	37	21	3.60	1.050
Flexibility	1	11	29	48	12	3.58	0.875
Information sharing	3	16	25	38	19	3.53	1.064
Lead time reduction	0	17	30	40	14	3.50	0.934
Strive for sustainable partnership integration	4	18	29	29	21	3.45	1.127
SCM Leverage	2	17	32	34	16	3.45	1.015

From the table 4.10 it can be interpreted that among the sixteen items used in the survey instrument, majority of the respondents preferred customer satisfaction as top priority in their company's supply chain policy followed by low waste and capacity utilization. Reliability has also been chosen one of the priority in the supply chain policy of the respondent companies.

Table 4.11 (a): Descriptive statistics of SCOR model

Item	1	2	3	4	5	Mean	SD
Quality of delivery goods	2	2	10	40	47	4.27	0.871
Quality of deliverey documentation	2	4	10	53	32	4.08	0.868
Manufacturing cost	0	3	13	59	26	4.07	0.711
Customer complaints	2	4	20	36	39	4.05	0.963
Timely available of accurate information	0	1	22	53	25	4.01	0.714
Supplier ability to respond to quality problems	1	3	15	57	25	4.01	0.781
Delivery reliability	2	2	21	49	27	3.96	0.859
Mutual Trust	0	5	18	55	23	3.95	0.779
Customer response time	1	6	19	49	26	3.95	0.833
Transport costs	3	2	17	56	23	3.93	0.863
Distribution costs	1	3	21	53	23	3.93	0.803
Satisfaction with supplier relationship	2	2	26	43	28	3.92	0.891
Satisfaction with Knowledge Transfer	1	4	19	56	21	3.91	0.801
Inventory turnover ratio		3	27	47	24	3.91	0.789
Inventory cost	0	6	19	53	22	3.91	0.805
Rate of complaints	4	3	24	38	32	3.9	1.015
Buyer-supplier partnership level	1	3	23	52	22	3.9	0.806
Total Logistics costs	1	6	19	52	23	3.89	0.859
Supplier cost saving initiatives	1	1	26	53	20	3.89	0.76
Supplier assistance in solving technical problems	1	5	24	45	26	3.89	0.882
Total cash flow time	1	5	20	53	22	3.88	0.875
Inventory days of supply	1	2	26	51	21	3.88	0.791
Delivery costs	1	3	21	58	18	3.88	0.765
Production flexibility	0	4	25	52	20	3.87	0.77
Efficiency of purchase order cycle time	0	5	24	51	21	3.87	0.796
Manufacturing Lead time	0	4	25	53	19	3.86	0.762
Level of customer perceived value of product	0	4	29	45	23	3.86	0.813
Work in Process	0	9	15	59	18	3.85	0.817

Table 4.11 (b): Descriptive statistics of SCOR model contd.,

Item	1	2	3	4	5	Mean	SD
Economic order quantity	0	3	27	53	18	3.85	0.74
Cash-cash cycle time	1	7	21	50	22	3.84	0.88
Delivery efficiency	4	2	26	45	24	3.82	0.953
Order Lead Time	0	8	27	42	24	3.81	0.891
Suppliers booking in procedures	1	4	27	51	18	3.8	0.813
Purchase order cycle time	2	4	22	57	16	3.8	0.825
Warranty/returns processing costs	2	5	27	45	22	3.79	0.909
Planned Process cycle time	1	7	22	56	15	3.76	0.826
Order Flexibility	0	8	25	51	17	3.76	0.826
Frequency of delivery	2	5	33	36	25	3.76	0.95
Transport flexibility	2	7	23	51	18	3.75	0.899
Over head cost	0	7	23	59	12	3.75	0.754
Volume flexibility	1	6	19	52	23	3.72	0.763
Total supply chain cycle time	1	17	19	36	28	3.72	1.078
Delivery lead time	3	7	28	42	21	3.7	0.975
Warehouse costs	3	3	26	59	10	3.69	0.809
Information carrying cost	0	8	29	50	14	3.69	0.809
Delivery flexibility	1	7	30	47	16	3.69	0.857
Order entry methods	1	6	31	49	14	3.68	0.824
Total supply chain response time	0	19	19	45	18	3.61	0.99
Supplier Rejection Rate	1	11	35	36	18	3.58	0.941

From the table 4.11(a) & (b) it can be interpreted that among fifty one items used in the survey instrument for SCOR model, it has been observed that majority of the respondents chosen quality of delivery of goods, quality of delivery documentation, manufacturing cost, customer complaints, timely availability of accurate information followed by supplier ability to respond to quality problems, delivery reliability.

Here cost means production and distribution of product at low cost. Meaning of quality is to manufacture products with high quality or performance standards. Flexibility is related to react to changes in production, changes in product mix, modifications in design, fluctuations in materials, and ability to change in sequence quickly. Delivery means responding quickly to customer orders.

Out of Cost, quality, flexibility, delivery speed are key order winners or order qualifiers for any organizations, in this work survey findings tell that majority of the companies are quality conscious in delivering their products or services, considering cost also as a major driver in running their business

organizations. The generic manufacturing capabilities/priorities often mentioned in significant contribution such as Hayes and Wheelwright(1984), Hill (1987), Gerwin (1993), have been cost, quality, dependability, flexibility, and innovation. Hill (1987) introduced the concept of order winners and order qualifiers and differentiated between them. Order qualifiers are those criteria that a company must meet for a customer even to consider it as a potential supplier. Order winners are those criteria that could win the order. To provide qualifiers companies need only to be as good as competitors, but to provide order winners they need to be better than their competitors.

Table 4.12: Descriptive statistics of environmental impacts

ITEM	1	2	3	4	5	Mean	S.D
Your perception about the scarcity of raw material resources being used by your organization for next ten years	7	14	33	38	9	3.28	1.040
Your organization's liquid waste discharge affects the ground water level	22	33	14	28	4	2.59	1.218
Your organization practices the concept of landfill for solid waste management	11	18	38	25	9	3.03	1.109
Using Environmental friendly transportation system costs additionally	7	8	21	50	14	3.56	1.057
Usage of Products manufactured by your organization have negative impact on the environment	27	37	15	14	8	2.40	1.242
The production process in your organization affects employees	21	35	21	15	9	2.56	1.228
The level of gaseous emissions from your organization negatively effects the environment	20	29	22	22	8	2.69	1.239
The activities in your supply chain affects the people around your organization	22	35	19	18	7	2.53	1.213
Solid waste from your organization have negative effects on the environment	11	18	38	25	9	2.64	1.230
Packaging material which is being used by your organization has negative impact on the environment	24	34	24	15	4	2.42	1.125

From table 4.12 among the ten items in the questionnaire majority of the respondents agreed with first top priority that their company would be effected scarcity of raw material resources being used by their

organization for next ten years. Secondly respondents also agreed that their Company's liquid waste discharge affects the ground water level. Thirdly as remedial measure of protecting the environment organization's are practicing the concept of landfill for solid waste management.

Table 4.13: Descriptive statistics of social sustainability performance indicators & business opportunity and development.

ITEM	1	2	3	4	5	Mean	S.D
Vocational Training	0	7	17	50	27	3.96	0.848
Social Accountability	1	3	26	47	24	3.89	0.835
Safety and health issues of labourers and transporters	1	1	8	49	42	4.29	0.739
Safety and health issues of employees	0	0	8	44	49	4.41	0.635
Safety and health issues of surrounding community	0	2	21	39	39	4.12	0.875
Product stewardship	1	9	33	36	22	3.68	0.948
Product responsibility	1	3	13	51	33	4.11	0.811
Patient care	2	7	8	55	29	4.01	0.911
New Products	0	6	25	44	26	3.89	0.859
New Processes	0	3	30	42	26	3.90	0.819
Livelihood	2	5	24	43	27	3.87	0.934
Human rights	2	6	13	47	33	4.02	0.938
Green Technology	0	2	11	57	31	4.04	0.774
Education	1	5	16	46	33	4.04	0.882
Disaster Relief	3	4	16	48	30	3.97	0.943
Community care	3	5	20	38	35	3.96	1.009
Cleaner Development Mechanism	0	2	11	57	31	4.16	0.689
Carbon Trading	3	4	20	39	35	3.98	0.990

From table 4.13 among the eighteen items in the questionnaire majority of the respondents agreed with top priority as safety and health issues of laborers and transporters if any company's want to become sustainable the first step is to reframe the company's identity, by providing conducive environment to employees company can be projected as identity among the other companies which is a favorable perception by aspiring employees in society. Secondly social accountability, companies thrive to be socially acceptable should follow social accountability measures like safety measures in and around the

company keeping in mind about future generations in a three dimensional approach i.e people, planet and profit.

4.4 Results of Inter-Item Analysis

It is important to disregard the non-response bias (Lessler and Kalsbeek, 1992). This research avail oneself of multiple contacts with the respondents and followed (Dillman,2000) to magnify response rate. After the responses are acquired, the responses of those who act up early are analogized with those who returned belated to determine if there is any statistical variance (Lessler and Kalsbeek, 1992). The large-scale responses are split into two groups. Thirty-eight responses were returned after August second week, while sixty three responses were returned before October second week. From table no: 4.14 the survey items are chosen and ANOVA test are performed on each item (n_1 =38,n_2= 63) samples for means are performed on each item name. Since no significance level is smaller than 0.05, the F-tests show that there are no statistically significant differences among the early respondents and late respondents. The data analysis proceeds into the next section.

Table 4.14: Comparing early to late respondents

S.No.	Items considered from the scale	Early, Mean (n_1 =38)	Late Mean (n_2=63)	F-Value	Significance
1.	Supply chain management policy	3.706	3.761	0.464	0.500
2.	Plan, Source, Make, Deliver, Return	3.853	3.872	0.345	0.558
3.	Environmental Impacts	2.832	2.703	0.525	0.477
4.	Social Sustainability & Business opportunity Development	4.030	3.973	0.745	0.393

4.5 Analysis of Hypotheses

Tests of Analysis of Variance (ANOVA): Analysis of Variance is a technique for analyzing data when the dependent variables are interval and the independent variables are categorical in nature. A test of ANOVA (the F value) has been used to examine the differences in the levels of different criteria used in testing hypotheses.

Hypothesis 1 There is a significant relation between supply chain performance and publication of sustainability report.

Table 4.15 Testing result of Hypothesis -1

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	0.321	1	0.321257	
Within groups	1.460	68	0.021471	0.0028
Total	**1.781**	**69**		

Hypothesis 1 (a) There is a positive relation between manufacturing cost and sustainability.

Table 4.16 Testing result of Hypothesis -1(a)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	6.118	1	6.118	2.12
Within groups	1.541	20	0.077	
Total	**7.6597**	**21**		

Hypothesis 1(b) There is a positive relation between distribution cost and sustainability.

Table 4.17 Testing result of Hypothesis -1(b)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	6.824	1	6.824	1.63
Within groups	1.664	20	0.083	
Total	**8.489**	**21**		

Hypothesis 1(c) There is a positive relation between supplier selection and sustainability.

Table 4.18 Testing result of Hypothesis -1(c)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	6.694	1	6.694	8.44
Within groups	1.506	20	0.075	
Total	**8.201**	**21**		

Hypothesis: 2 The positive impact on the environment by the companies practicing the supply chain management (SCM) sustainability is significantly larger than the companies that are not practicing SCM sustainability.

Summary of canonical discriminant functions for different items in the questionnaire

Table 4.19 Supply Chain Management Policy

Eigen values				
Function	Eigen value	% of Variance	Cumulative %	Canonical Correlation
1	.248	100.00	100.00	.446
Wilks' Lambda				
Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.801	20.188	16	.212

The significance level is estimated based on a Chi-square of 20.188 with 16 degrees of freedom as given in Table 4.4.4. This is significant beyond the .05 level. The Eigen-value associated with this function is 24.8 and it accounts for 100% of explained variance. The canonical correlation associated with this function is 0.446. The square of this correlation is 0.19, which indicates 19% of variance in the dependent variables. In other words, all the independent variables explain 19 % discrimination in dependent variables.

Wilks' lambda performs, in the multivariate setting, with a combination of dependent variables, the same role as the F-test performs in one-way analysis of variance. Wilks' lambda is a direct measure of the proportion of variance in the combination of dependent variables that is unaccounted for by the independent variable (the grouping variable or factor).If a large proportion of the variance is accounted for by the independent variable then it suggests that there is an effect from the grouping variable and that the groups(in this case the companies practicing the supply chain management (SCM) sustainability and companies that are not practicing SCM sustainability)have different mean values.

Wilks' lambda statistic can be transformed (mathematically adjusted) to a statistic which has approximately an F distribution. This makes it easier to calculate the P-value. (Everitt and Dunn (1991).

Wilks' lambda indicates the significance of the discriminant function. Table 4.19 indicates a highly significant function ($p < .000$) and provides the proportion of total variability not explained, i.e. it is the converse of the squared canonical correlation. So we have 80.1% unexplained.

Table 4.20 Plan, Source, Make Deliver, Return

Eigen values				
Function	Eigen value	% of Variance	Cumulative %	Canonical Correlation
1	.979	100.00	100.00	.703
Wilks' Lambda				
Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.505	47.783	52	.640

Table 4.21 Social Sustainability & Business Opportunity Development

Eigen values				
Function	Eigen value	% of Variance	Cumulative %	Canonical Correlation
1	.239	100.00	100.00	.439
Wilks' Lambda				
Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.807	18.670	18	.412

From the above summaries of canonical discriminant functions reported it is observed that the Chi-square value, degrees of freedom and significance level in all the cases which is acceptable. The two subgroups i.e. Companies publishing the sustainability report and companies not publishing their sustainability report discriminate each other. Hence the Hypothesis 2 is also accepted.

Hypothesis: 3 There is a significant relationship between environment and economic sustainability in manufacturing companies.

Table 4.22 Testing Result of Hypothesis -3

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	6.761	1	6.761	3.81
Within groups	1.534	21	0.073	
Total	**8.295**	**22**		

Hypothesis: 4 There is a significant relationship between environmental and social sustainability in manufacturing companies.

Table 4.23 Testing Result of Hypothesis - 4

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	8.892	1	8.892	
Within groups	1.764	21	0.084	1.18
Total	**10.656**	**22**		

Hypothesis: 5 There is a significant relationship between sustainability and business application opportunity development.

Table 4.24 Testing Result of Hypothesis – 5

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	4.987	1	4.987	1.31
Within groups	1.413	13	0.108	
Total	**6.300**	**14**		

Hyp 5(a) : There is a positive relation between sustainability and emission trading scheme (ETS).

Table 4.25 Testing Result of Hypothesis –5(a)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	1.392	1	1.329	0.015
Within groups	1.364	9	0.151	
Total	**2.576**	**10**		

Hyp 5(b): There is a positive relation between sustainability and cleaner production.

Table 4.26 Testing Result of Hypothesis –5(b)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	7.825	1	7.825	1.46
Within groups	1.598	16	0.099	
Total	**9.423**	**17**		

Hypothesis: 6 There is a significant relationship between environment concern and sustainability.

Table 4.27 Testing Result of Hypothesis – 6

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	5.688	1	5.688	1.77
Within groups	1.708	13	0.131	
Total	**7.396**	**14**		

Hyp 6(a): There is a positive relation between reduction of carbon emissions and sustainability.

Table 4.28 Testing Result of Hypothesis – 6(a)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	3.831	1	3.831	0.00018
Within groups	1.381	11	0.125	
Total	**5.212**	**12**		

Hyp 6(b): There is a positive relation between transportation in supply chain network and sustainability.

Table 4.29 Testing Result of Hypothesis – 6(b)

ANOVA Single factor				
Source of variation	Sum of squares	df	Mean Square	Significance
Between groups	6.700	1	6.700	3.96
Within groups	1.644	19	0.086	
Total	**8.344**	**20**		

4.6 Summary of Hypotheses Testing

Table 4.30 Using ANOVA for Hypotheses Testing

S.No		Significance level	Accepted or Rejected
1.	Hypothesis 1	1.04^	Accepted
2.	Hypothesis 1(a)	2.12^	Accepted
3.	Hypothesis 1(b)	1.63^	Accepted
4.	Hypothesis1(c)	8.44^	Accepted
5.	Hypothesis 3	3.81^	Accepted
6.	Hypothesis 4	1.18^	Accepted
7.	Hypothesis 5	1.31^	Accepted
8.	Hypothesis 5(a)	0.015^	Accepted
9.	Hypothesis 5(b)	1.46^	Accepted
10.	Hypothesis 6	1.77	Accepted
11.	Hypothesis 6(a)	0.00018*	Rejected
12.	Hypothesis 6(b)	3.96^	Accepted
P^>0.05; P<0.05; significant at 95% confidence level.*			

4.7 Discussion on internal benchmarking for sustainable supply chain performance

In accomplishing the third research objective to study the SCM performance of reporting sustainability, a methodology has been appended with (figure 3.1 Refer chapter 3) analysis of Internal supply chain working capital (C-2-C cycle) ISWCi = Ii + ARi – APi; Internal supply chain working capital productivity ISWCPi = NSi / ISWCi; Days Payables Outstanding = (APi / ARi)*365;Days Sales Outstanding = (ARi / Annual Revenues)*365.

For analysis, and results the discussion among the thirteen companies considered have been grouped on the basis of their manufacturing activity i.e six groups. First Group automobile manufacturing companies comprising company A, Company B, Company C, Second group Cement manufacturing companies comprising Company D, Company E, Company F and Company G, third group single Engineering company i.e Company H, fourth group fast moving consumer goods (FMCG) manufacturing companies comprising of Company I and Company J; fifth group paint manufacturing company i.e Company K and Sixth group steel manufacturing companies comprising of Company L and Company M.

Table 4.31 Length of raw material stage (In days)

Group		2006	2007	2008	2009	2010	Percentage Change
Automobile	COMPANY A	175	151	149	124	124	29.14
	COMPANY B	69	76	92	86	64	2.86
	COMPANY C	72	70	54	93	66	3.43
Cement	COMPANY D	326	313	398	297	296	17.14
	COMPANY E	223	221	186	144	144	45.14
	COMPANY F	46	44	35	99	55	-5.14
	COMPANY G	44	38	34	28	32	6.86
Engineering	COMPANY H	193	190	273	259	117	43.43
FMCG	COMPANY I	614	631	518	736	453	92.00
	COMPANY J	1574	1656	1991	1619	1585	-6.29
Paint	COMPANY K	33	28	25	20	24	5.14
Steel	COMPANY L	10	9	8	9	9	0.57
	COMPANY M	44	38	34	28	32	6.86

For DRM the following observations have been found from the analysis and above table 4.31 The raw material inventory in the Automobile Group (A,B and C),Company A has shown sudden decrease for two years and uniform decrease in last two years of the period. Company B also exhibited fall and rise alternatively in the period. Company C has shown uniform decrease for two years and rise and then again decrease. Company A has shown a significant time in holding the length of raw material.

Cement group among Company (D, E, F and G) Company G has shown significant figure in holding the length of raw material. Engineering group Company H has a uniform fall and rise Among the FMCG group Company's (I and J) Company I has shown stable fall and rise. Among Steel Group Company's (L and M) Company L has shown uniform decrease.

Thus from the above interpretation among the sustainability reporting companies considered for this study concerning the length of raw material, Company I can be chosen as sustainable internal benchmarking tool because it has exhibited favorable conditions with DRM perspective for measuring the SSCM performance because of percentage of change in length of raw material stage in days from 2006 to 2010 to 92% However the other companies may follow the inventory and procurement policy depending on the dynamic market situations which may not be applicable to all kind of companies.

Table: 4.32 Days work in process (In days)

Group		2006	2007	2008	2009	2010	Percentage Change
Automobile	COMPANY A	0	14	16	20	13	-7.43
	COMPANY B	4	4	4	3	3	0.57
	COMPANY C	1	1	1	1	0	0.57
Cement	COMPANY D	171	127	110	106	112	33.71
	COMPANY E	45	44	75	114	88	-24.57
	COMPANY F	3	3	3	9	2	0.57
	COMPANY G	29	29	25	26	14	8.57
Engineering	COMPANY H	0	0	0	0	0	0.00
FMCG	COMPANY I	10	11	10	53	63	-30.29
	COMPANY J	10	13	16	18	16	-3.43
Paint	COMPANY K	7	5	4	4	4	1.71
Steel	COMPANY L	1	1	1	1	3	-1.14
	COMPANY M	3	1	1	3	2	0.57

To analyze days work in process (DWIP), it is evident from the table 4.32 that under automobile group company A has show increasing trend from year 2007 to year 2009. Company B and Company C has shown a consistency. Company D has shown reduction of 33% in DWIP while Company G has shown reduction of 8.57% in DWIP. Company D, has exhibited uniform fall days work in process which is healthy sign of maintaining WIP. Company E, F and G shown fall and rise. Engineering Company no days work in process. Among the FMCG group company's I, and J observed rise and fall. Paint Company K shown uniform decrease. Among the Steel group company's L and M Company L has shown linear trend. Company M observed uniform for two years and rise consecutive years. The longer the WIP stage the company attempts to delay in product differentiation to the last stage of the production process. In context of days of work in process inventory it was found that two companies D, G exhibited good trend i.e. decrease in days of work in process inventory for the time period of study considered ,which would reflect decrease in Inventory holding cost and explicit effect on the total cost of inventory. Where company D as significant change has been found can be chosen for internal benchmarking practice for SSCM performance.

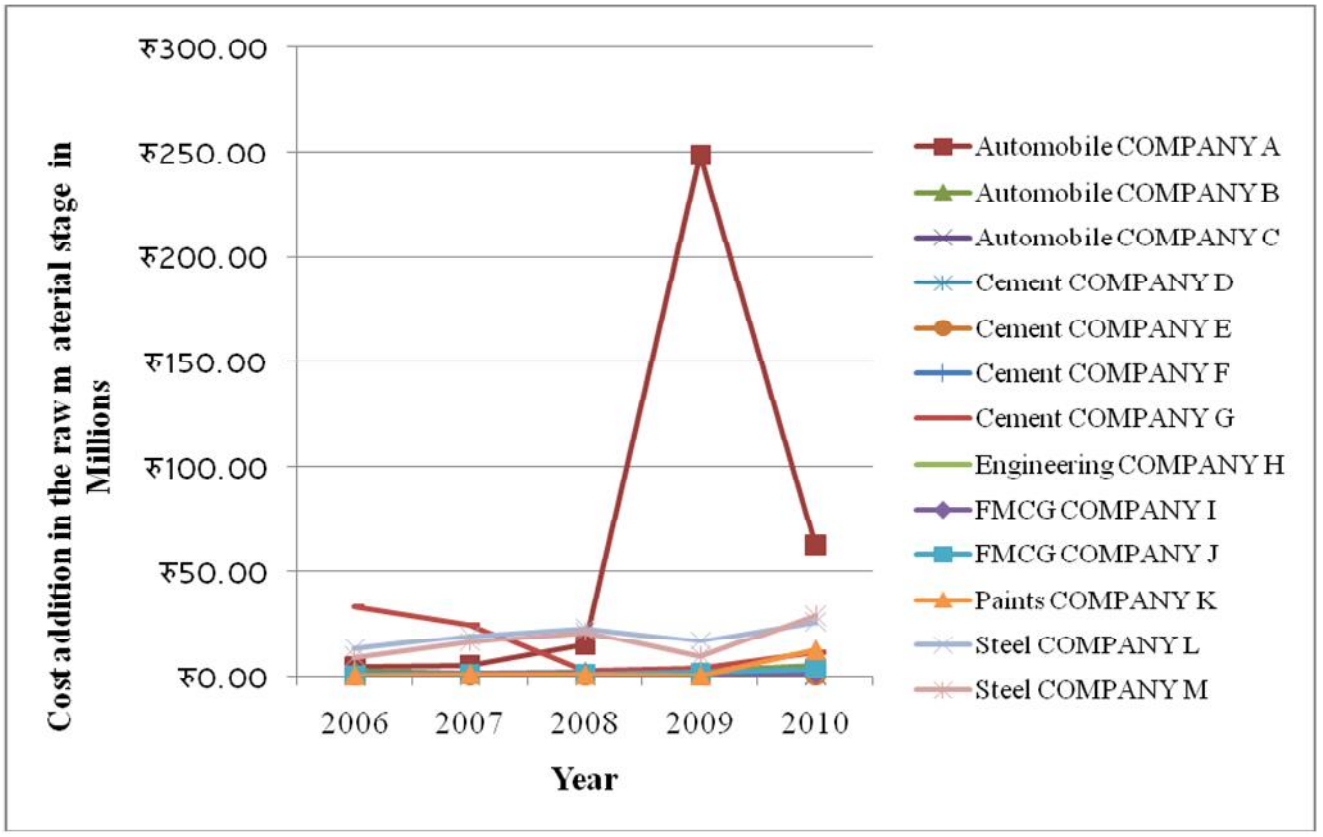
Table: 4.33 Days finished goods (In days)

Group		2006	2007	2008	2009	2010	Percentage Change
Automobiles	COMPANY A	179	143	163	103	87	52.57
	COMPANY B	222	209	103	228	96	72.00
	COMPANY C	23	21	17	22	16	4.00
Cement	COMPANY D	47	34	40	39	40	4.00
	COMPANY E	24	25	31	42	26	-1.14
	COMPANY F	7	5	8	8	3	2.29
	COMPANY G	27	31	43	37	44	-9.71
Engineering	COMPANY H	13	4	9	2	3	5.71
FMCG	COMPANY I	160	176	145	239	202	-24.00
	COMPANY J	174	207	188	278	171	1.71
Paints	COMPANY K	24	25	24	19	21	1.71
Steel	COMPANY L	10	13	15	9	11	-0.57
	COMPANY M	15	17	18	18	9	3.43

For DFG the following observations has been found from the above table 4.33 the following observations has been found from the analysis among the automobile group Company's (A, B and C) Company B has shown the consistent decrease to 72.00 % in DFG which is favorable. And the condition is the less number of days the company holding the finished goods inventory which has direct relation with the sales generated in which it effects the revenue generated and profits earned in short period of time.

Among the cement group company's (D,E,F and G) no regular pattern has been observed. However, company D has shown favorable condition up to some extent. In the Engineering i.e Company H has shown fall and rise and then again fall in DFG. Among the FMCG Group Company I and J Company I have exhibited favorable condition. Paint Company K has shown consistent for three years and later fall and rise. Among Steel Company's L & M Company M have exhibited favorable condition.

Graph 4.1 Cost additions in the raw material stage



Graph 4.1 presents cost additions in the raw material stage. The cost addition is due to inventory carrying at raw material stage. The cost addition is directly proportional to the number of days raw materials are kept in inventory. Among automobile group, company A cost addition in the raw material stage increased four years continuously. Company B shows consistency, company C has exhibited lower values as compared to Company A and Company B. Among cement group, Company D increased for five years, Company E increased for four years except one year i.e in 2009 the figures for Company F for first two years decreased, in third year increase and in fourth and fifth year decrease. Company G decrease for three years and last two years increased in this group. Company E exhibited low cost addition in raw material stage in engineering group company H cost addition increased for three years and decreased for last two years. Among FMCG Group, Company I cost addition increased for three years and in last two years fall and rise. Company J increased year by year. However, company J exhibited low cost addition among two companies. In paints group Company K rise for two years decreased in next two years and again increase

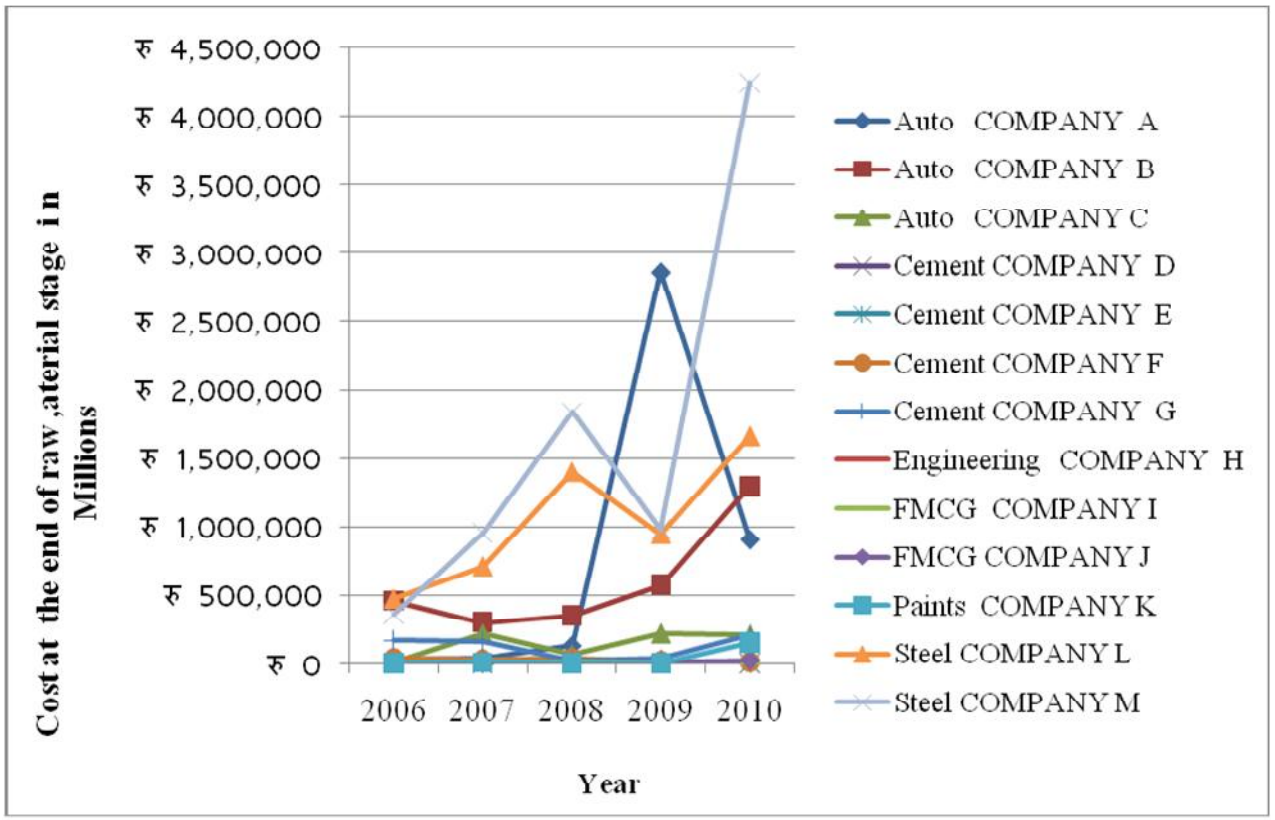
in last year. In steel group increased for three years and last two years fall and rise of the cost addition. However, company M has exhibited low cost addition among the steel group. It has been observed from the graph that all companies do not follow any particular uniform trend. It can be concluded that cost addition in the raw material cannot be predicted as market conditions are stochastic. But this parameter has significant effect in calculating all the other parameters in the methodology considered in this present work as well as it cannot be considered as a single yard stick in internal supply chain benchmarking. It is also necessary to keep cost addition in raw material stage as low as possible by focusing on VMI, low cost procurement, inventory strategies.

Table 4.34 Profiles of different raw material stages for the companies

Group		**Length of Raw material Stage**	**Length of WIP stage**	**Length of Finished Goods Stage**	**Total Length**
Automobile	COMPANY A	124	13	87	224
	COMPANY B	66	3	96	165
	COMPANY C	64	0	16	80
Cement	COMPANY D	296	112	40	448
	COMPANYE	144	88	26	258
	COMPANY F	55	2	3	60
	COMPANY G	32	14	44	90
Engineering	COMPANY H	117	0	3	120
FMCG	COMPANY I	453	63	202	718
	COMPANY J	1585	16	171	1772
Paints	COMPAN-Y K	24	4	21	49
Steel	COMPANY L	9	3	11	23
	COMPANY M	32	2	9	43

Total length of the stages is the sum of days of raw material stage, days of work in process inventory and days of finished goods inventory. Among the automobile group (A,B&C) C has minimum total length of the stages. Among the cement group (D,E,F&G) F , in FMCG company I company L under steel group have minimum total length of the stages which can be choose for sustainable internal benchmarking tool, from the perspective of the total length of the stages. However for calculating the cost profile of the said companies the most recent year of the study (i.e 2010) has been considered.

Graph 4.2 Cost at the end of the raw material stage



From the above graph (4.2) the Cost at the end of the raw material stage ($CRMS_i$) for automobile group of companies A,B and C for company A's cost at the end of the raw material stage increased for two years and decrease for one year and again increased in last two years. Company B decreased for three years and increased in last two years, Company C's cost increased in first two years decrease in the third year and increase in fourth year.

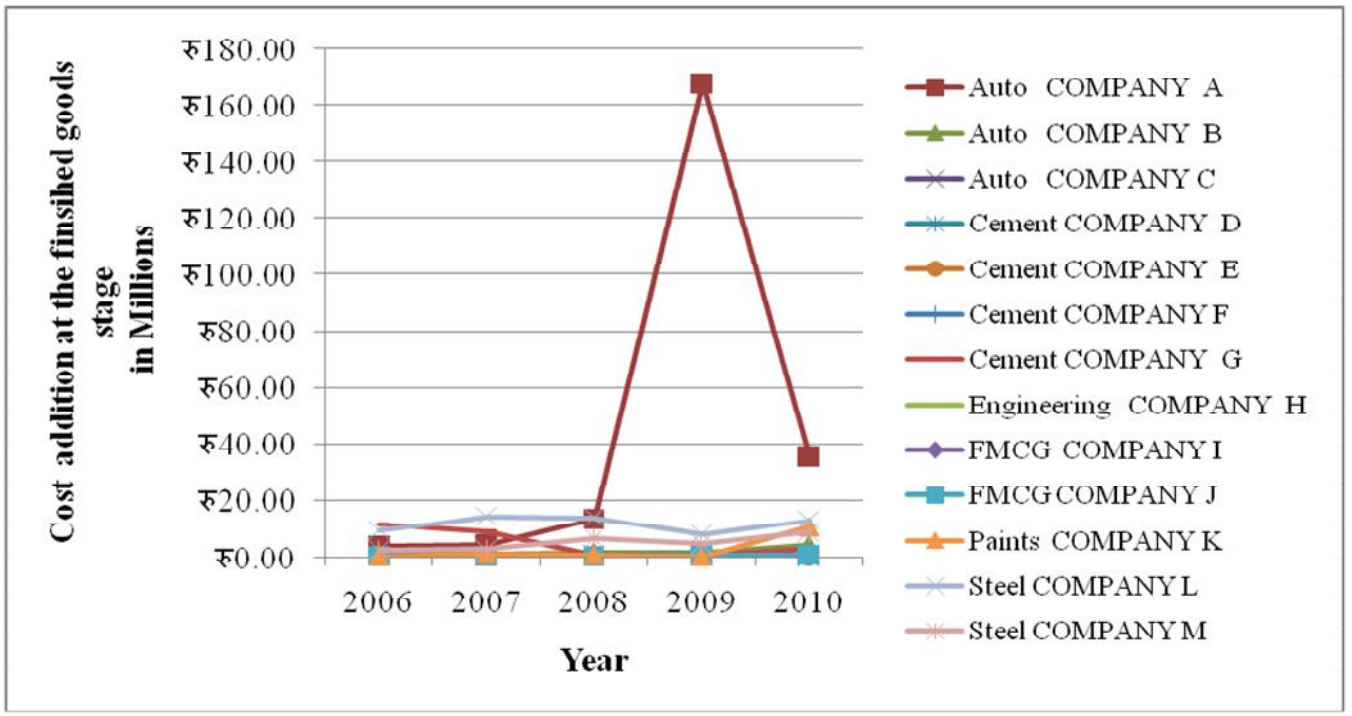
Among the cement group of companies D, E, F and G cost at the end of the raw material stage for company D's increased for three years and fall and rise. For company E's increased for four years and decrease in last year. For company F's decreases for two years and rise and fall. For company G decreased for three years and increased in last two years.

Among the engineering group $CRMS_i$ for company H fall and rise pattern, Among the FMCG group of company's I,J, K. $CRMS_i$ Company I increased for three years and decreased in last two years. For company J consistently increased from first to last year. In paint group i.e. Company K increased for three years fall and rise.

Among the steel group Company L and Company M $CRMS_i$ increased for first three years and then it fluctuated. Also there is not enough inventory to meet market demands to ensure customer satisfaction.

Therefore inventory control policies should be redesigned such that correct levels of supplies at order and reorder points be maintained, because these levels reflect the critical day to day operation of organizations and to sustain the high levels of customer satisfaction. So maintaining the cost at the end of the raw material stage is the critical issue in supply chain management and it depends on the process orientation and market conditions. If high number of customer orders are promised the $CRMS_i$ should be high and vice versa.

Graph 4.3 Cost addition in the finished goods stage



From the graph 4.4 among the automobile group of companies A, B and C Company A's cost addition finished goods stage Δ (FG) I increased for four years and then decrease in last year. Company B consecutively rise and fall for five years. Company C's Δ (FG) fluctuated.

Among the Cement group of companies D,E,F and G Company D fall for two years and rise in last three years. Company E's Δ (FG) increased consistently for five years. Company F's Δ (FG) fall and rise consecutively. Company G's Δ (FG) falls for three years and rise in fourth and fifth year. In engineering group Company H's Δ (FG) increased for three years decreased in fourth year and again increased in fifth year. Among the FMCG group, Company I's (FG) increased for three years and from fourth year decreased. Company J's Δ (FG) two years increased, third year decreased from fourth year increased. In paint group Company K rise in second year fall for another two years and rise.

Among the Steel group Company L and M, company L rise for two years and fall in third and fourth year and rise in fifth year, company M rise for three years and fall in fourth and fifth year.

It is desirable for a company to keep the cost addition to a minimum low is found in Company E's Δ (FG). This infact can be used as internal benchmarking practice for SSCM tool for the cost addition in the finished goods stage Δ (FG) i for time period considered for this study. If the cost addition increase in the finished goods stage then the inventory carrying cost will increase which will result increase in the total cost.

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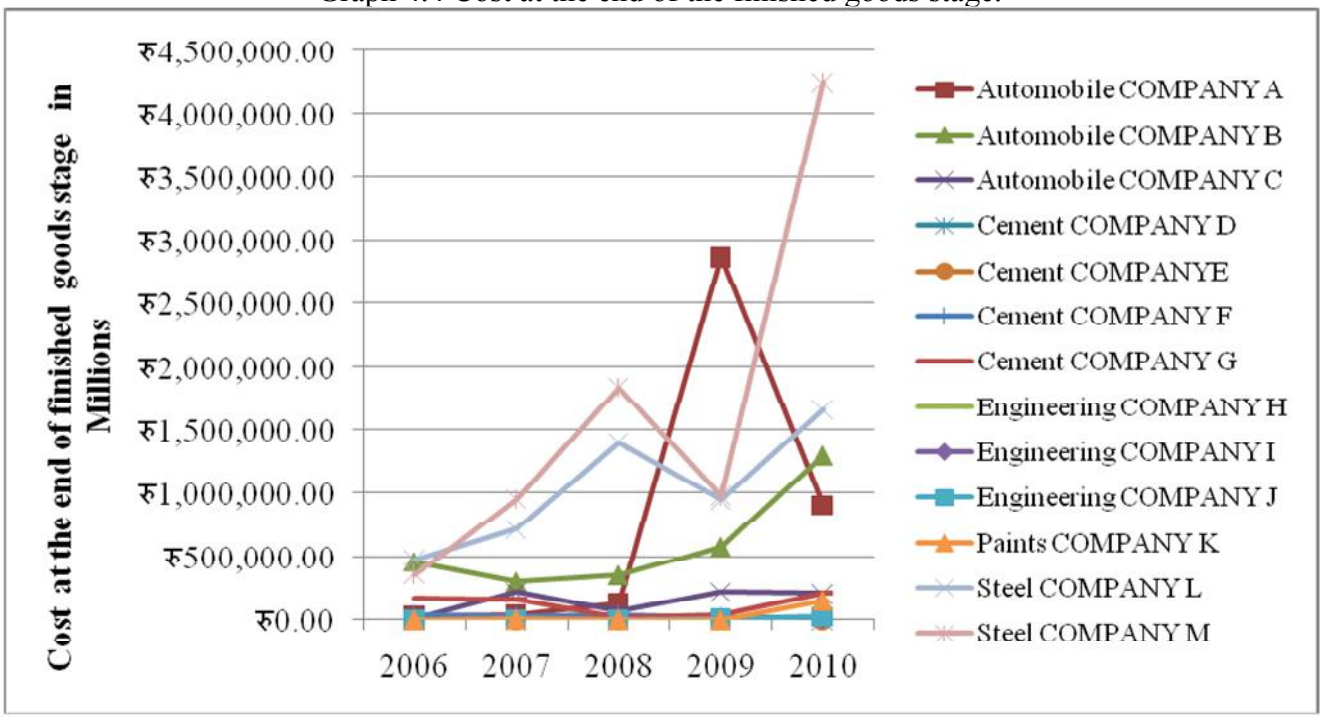
Graph 4.4 Cost at the end of the finished goods stage.



From the graph (4.4) among the automobile group of companies A,B and C Cost at the end of finished goods stage (CFGSi). Company A's CFGSi fall and rise in last three years, company B's, Company C's CFGSi fluctuates. Among Cement group D, E and F, Company D's CFGSi rise consecutively for three years and than falls, Company E's CFGSi rises for five years, Company F and Company G have fluctuations. In engineering Company H rises and fall. Among FMCG group, Company H,I and J Company I's CFGSi rise in first two years and fall next four years, Company J's rise for first three years and fall in last two years. In paints company K's CFGSi rises in first two years fall and rise in last three years. Among steel companies L and M company L and Company L rise and fall pattern consecutively in five years.

CFGSi the pattern observed in graphs is not so favorable to choose any company for sustainable internal benchmarking tool as the fluctuation in demand of dynamic market varies depending upon the type of product the company manufactures. A change in pattern has been observed after the third year in all the parameters considered during period of study of five years ie.2006-2010.This is due to the recession in the market, where the cost of labor and raw material has some explicit relationship with the above said parameters.

Table 4.35 Normalized costs of raw material

Group		**2006**	**2007**	**2008**	**2009**	**2010**
Automobile	COMPANY A	0.00172	0.00176	0.00064	0.00007	0.00041
	COMPANY B	0.10472	0.13888	0.08336	0.11766	0.05696
	COMPANY C	0.49428	0.18284	0.28003	0.50964	0.48145
Cement	COMPANY D	0.04966	0.05517	0.04197	0.04762	0.04293
	COMPANYE	0.14466	0.10038	0.12403	0.11274	0.09470
	COMPANY F	0.04180	0.10925	0.06234	0.14236	0.24950
	COMPANY G	0.00045	0.00074	0.00991	0.01031	0.00635
Engineering	COMPANY H	0.05061	0.02686	0.02648	0.03821	0.02627
FMCG	COMPANY I	0.01405	0.00704	0.01044	0.00854	0.01099
	COMPANY J	0.02491	0.02330	0.02700	0.01067	0.00963
Paints	COMPANY K	0.02410	0.00729	0.01151	0.10912	0.00115
Steel	COMPANY L	0.00376	0.00259	0.00432	0.00693	0.00490
	COMPANY M	0.01730	0.02192	0.01331	0.02158	0.01638
	MIN	0.00045	0.00074	0.00064	0.00007	0.00041
	MAX	0.49428	0.18284	0.28003	0.50964	0.48145
	MEAN	0.07477	0.05216	0.05349	0.08734	0.07705

Company G, under Cement group has exhibited low normailized cost of raw materials compared to other companies for five years consecutively.

Table 4.36 Normalized cost at end of Raw material stage

Group		2006	2007	2008	2009	2010
Automobile	COMPANY A	1.00000	1.00000	1.00000	1.00000	1.00000
	COMPANY B	1.00000	1.00000	1.00000	1.00000	1.00000
	COMPANY C	0.99999	1.00000	1.00000	1.00000	1.00000
Cement	COMPANY D	0.99995	0.99995	0.99997	0.99996	0.99998
	COMPANYE	0.99972	0.99989	0.99988	0.99991	0.99993
	COMPANY F	1.00000	1.00000	1.00000	1.00000	1.00000
	COMPANY G	1.00000	1.00000	1.00000	1.00000	1.00000
Engineering	COMPANY H	1.00000	1.00000	1.00000	1.00000	1.00000
FMCG	COMPANY I	1.00000	1.00000	1.00000	1.00000	1.00000
	COMPANY J	1.00000	1.00000	1.00000	1.00000	1.00000
Paints	COMPANY K	1.00000	1.00000	1.00000	1.00000	1.00000
Steel	COMPANY L	1.00000	1.00000	1.00000	1.00000	1.00000
	COMPANY M	1.00000	1.00000	1.00000	1.00000	1.00000
	MIN	0.99972	0.99989	0.99988	0.99991	0.99993
	MAX	1.00000	1.00000	1.00000	1.00000	1.00000
	MEAN	0.99997	0.99999	0.99999	0.99999	0.99999

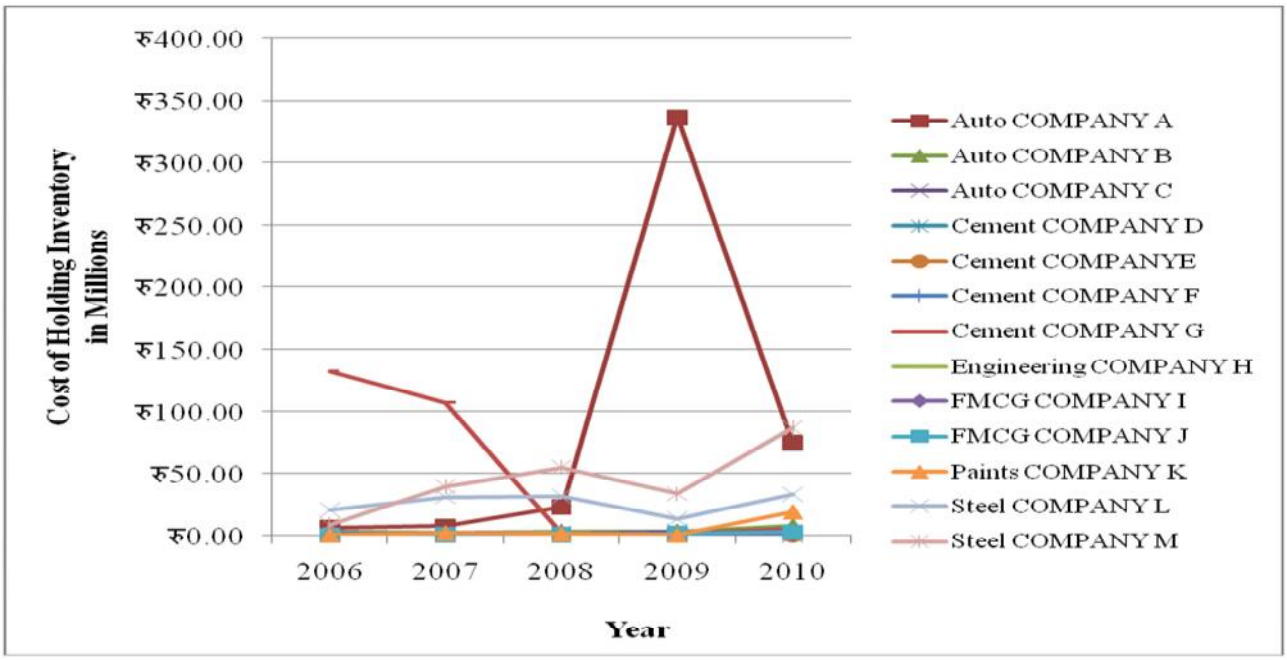
From the table 4.36 Company E have demonstrated low normalized costs at the end of raw material stage for five years.

Table 4.37 Normalized cost at the end of WIP stage

Group		2006	2007	2008	2009
Automobile	COMPANY A	0.00000	0.00000	0.00000	0.00000
	COMPANY B	0.00000	0.00000	0.00000	0.00000
	COMPANY C	0.00002	0.00000	0.00000	0.00000
Cement	COMPANY D	0.00026	0.00028	0.00019	0.00022
	COMPANYE	0.00138	0.00054	0.00048	0.00029
	COMPANY F	0.00000	0.00000	0.00000	0.00000
	COMPANY G	0.00000	0.00000	0.00000	0.00000
Engineering	COMPANY H	0.00000	0.00000	0.00000	0.00000
FMCG	COMPANY I	0.00000	0.00000	0.00000	0.00000
	COMPANY J	0.00000	0.00000	0.00000	0.00000
Paints	COMPANY K	0.00000	0.00000	0.00000	0.00002
Steel	COMPANY L	0.00000	0.00000	0.00000	0.00000
	COMPANY M	0.00000	0.00000	0.00000	0.00000
	MIN	0.00000	0.00000	0.00000	0.00000
	MAX	0.00138	0.00054	0.00048	0.00029
	MEAN	0.00013	0.00006	0.00005	0.00004

From the above table 4.7 company A,B,F,G,H,I,J,K,L and M has exhibited low normalized cost at the end of the WIP stage for five years, It can be concluded that normalization factor helps in making cost profile for the companies for a particular period of time.

Graph 4.5 Cost of holding inventory for time period



From the graph 4.5 it has been observed for automobile group of companies A,B and C. that Company A's cost of holding inventory fluctuated, Company B's, Company C's cost of holding inventory also fluctuated. Among the Cement group, Company D, E, F and G Company D's, Company E's cost of holding inventory rise for five years. Company F's cost of holding inventory decreased for two years and rise in last three years. Company G's cost of holding inventory fall and rise consecutively. In the engineering Company H's cost of holding inventory fluctuates. Among the FMCG group, company I and company J, Company I's cost of holding inventory rise for three years and fall in last two years,

Company J's cost of holding inventory rises in all five years. In paints Company K's cost of holding inventory falls for three years and rises in last two years. Among the steel group Company L and company M Company L rise and fall consecutively over five years, Company M fall for three years and rise in last two years. It can be concluded, that if cost of holding inventory is high the company may be anticipating more demand from market. It is because, either the market demand is poor or marketing strategy is poor in both of which have an implicit relation. In choosing this parameter as internal supply chain benchmarking tool the company which exhibits consistency in holding the inventories should be chosen i.e is Company D,E,J satisfies the criteria.

Table 4.38 Internal supply chain inefficiency ratio

Group		**2006**	**2007**	**2008**	**2009**	**2010**
Auto	COMPANY A	530.118	553.985	1535.11	16187	2868.84
	COMPANY B	58.571	97.787	103.083	32.2845	62.8541
	COMPANY C	7.6002	8.0516	7.43499	3.59162	4.40048
Cement	COMPANY D	14.3994	12.6684	16.3946	16.6911	21.816
	COMPANYE	3.51776	6.76524	7.21764	13.2031	12.9684
	COMPANY F	21.8242	9.63667	15.2784	8.9297	9.83109
	COMPANY G	373.391	622.542	761.031	432.259	569.147
Engineering	COMPANY H	1145.63	745.144	58.9614	60.7569	189.06
FMCG	COMPANY I	47.7051	89.9429	68.4362	74.8012	52.2902
	COMPANY J	23.0901	26.6967	27.6164	54.7901	82.7419
Paints	COMPANY K	33.7438	98.3378	65.9845	6.19799	739.366
Steel	COMPANY L	1.49236	24.4558	6.08464	11.3796	5.45325
	COMPANY M	0.04026	0.03627	0.03306	0.0281	0.02215
	MIN	0.04026	0.03627	0.03306	0.0281	0.02215
	MAX	1145.63	745.144	1535.11	16187	2868.84
	MEAN	173.933	176.619	205.589	1300.15	355.292

The firms that have the lowest internal supply chain management inefficiency ratio are selected as the best in terms of performance. From the above table 4.38 among automobile group, company C has exhibited the lowest ratio. Among cement group, company D among FMCG company J, among steel company M has exhibited the lowest ratio. Following the integrated logistics strategy, there by achieving the cost efficiency and optimization in the internal supply chain process. Company M can be treated as sustainable internal benchmarking tool in terms of internal supply chain inefficiency ratio, however other factors like market niche and competitive focus should also be considered as parameter in internal supply chain benchmarking for sustainable supply chain management performance process.

Table 4.39 Internal supply chain working capital

Group		**2006**	**2007**	**2008**	**2009**	**2010**
Auto	COMPANY A	15276.5	16939.8	21635.9	25760.1	30120.8
	COMPANY B	-8480.4	-6704.7	-1151.3	-4976.6	13514.6
	COMPANY C	7517	-280	-6936	2793	-3679
Cement	COMPANY D	7830.02	8190.88	10139.4	11095.2	9814.66
	COMPANY E	5857.1	5724.84	8151.79	13282.8	9176.52
	COMPANY F	4438.5	5272.1	12008	23286.6	5985.4
	COMPANY G	78090.9	93788.8	140490	183186	198360
Engineering	COMPANY H	2788.3	4275.2	7791	9668.5	11231.3
FMCG	COMPANY I	19647.8	21658	25470.2	32052.7	28381.9
	COMPANY J	30509.3	38695.4	51703.9	54653.9	52668.4
Paints	COMPANY K	2032.8	2321.7	1700.3	989.8	1443.8
Steel	COMPANY L	-4316.4	-2786.1	-6941.3	5418.6	-12085
	COMPANY M	17293.7	6418.1	5196.4	11490	14723.6

A classical example of restaurant business one should consider in interpreting the negative working capital. As customers pay in right time as products delivered and sold to customer instantaneously there is no problem in raising cash. However negative working capital is positive sign for sometimes because some companies can generate the cash so quickly. Researchers argue that a negative working capital is symbol of managerial efficiency in a business with low inventory and accounts receivables it is a sign that whether company into catastrophe by interpreting the numbers of company's accounts payable to the total inventory on the balance sheet.

From table 4.39 among automobile group, (A,B&C) Company B, Company C have exhibited the negative working capital so company C can be chosen for internal benchmarking tool for sustainable supply chain

management performance in internal supply chain working capital productivity. No significant negative working capital has been observed among the group of cement, engineering, FMCG & Paint considered in this study. Sourcing strategies should be linked with specific business units (Narasimhan and carter 1988). In the development of supplier using process oriented approach (Hartley and Jones 1997), firms should focus on defining the objectives for improving the transaction process with their suppliers and distributors.

Table 4.40 Days payable outstanding (In days)

Group		**2006**	**2007**	**2008**	**2009**	**2010**
Automobile	COMPANY A	80	76	83	61	70
	COMPANY B	1221	1159	834	738	513
	COMPANY C	426	640	1119	499	784
Cement	COMPANY D	117	146	124	113	153
	COMPANY E	73	94	100	70	117
	COMPANY F	553	487	299	64	223
	COMPANY G	28	40	26	19	44
Engineering	COMPANY H	267	258	215	191	198
FMCG	COMPANY I	101	116	131	143	153
	COMPANY J	132	127	76	104	138
Paints	COMPANY K	310	276	370	483	517
Steel	COMPANY L	2128	1874	2580	1333	3963
	COMPANY M	141	526	976	845	808
	MAX	2128	1874	2580	1333	3963
	MIN	28	40	26	19	44
	Mean	429	448	533	359	591

Effective cash management (firm's holds cash for long time) results from days payable outstanding ratio has an upward trend which is portrayed in the existing literature on financial theory. Accounting practioners argues that cash flow difficulties are due to an upward trend in day's payable outstanding (DPO). A question arises whether DPO is a comfort sign or a alert sign. If more cash in hand the higher the DPO. Company has to maintain a trade-off between preserving cash and keeping suppliers satisfied. Here from the above table 4.10 it has been observed among automobile group (A,B&C) Company C, among cement group (D,E,F&G) Company D FMCG group, company I among steel Company M has shown upward trend which indicates favorable condition, for internal benchmarking tool for SSCM performance in days payable outstanding perspective.

Table 4.41 Days sales outstanding (In days)

Group		2006	2007	2008	2009	2010
Automobile	COMPANY A	311	319	378	440	396
	COMPANY B	18	17	21	32	35
	COMPANY C	18	20	14	25	15
Cement	COMPANY D	144	143	182	185	141
	COMPANYE	111	109	154	220	144
	COMPANY F	28	33	37	34	18
	COMPANY G	579	471	599	663	641
Engineering	COMPANY H	135	145	145	150	143
FMCG	COMPANY I	233	214	150	214	195
	COMPANY J	143	144	233	185	156
Paints	COMPANY K	47	51	50	48	45
Steel	COMPANY L	11	11	9	15	6
	COMPANY M	66	32	17	16	17
	Min	11	11	9	15	6
	Max	579	471	599	663	641
	Mean	133	123	143	160	140

Days sales outstanding (DSO) represents the average length of time that a firm must wait after making a credit sale before receiving cash , that is its average collection period, DSO can also be evaluated by comparing it with the terms on which the company sells its goods. Whenever these trends of rise in DSO are observed from past data and credit policy has not been reviewed. Company has to redesign the credit policy in collecting the account receivables as general practice in collection of account receivables should be less than 32 days.

From above table 4.11 it has been observed among automobile group company B, has shown consistency among cement group (D,E,F&G), F has shown consistency, among steel Company's L and M, L has shown consistency in DSO which can be chosen as internal benchmarking tool for SSCM performance in DSO perspective where as company G under Cement group has high DSO days compared to other companies, in which credit policy should be changed.

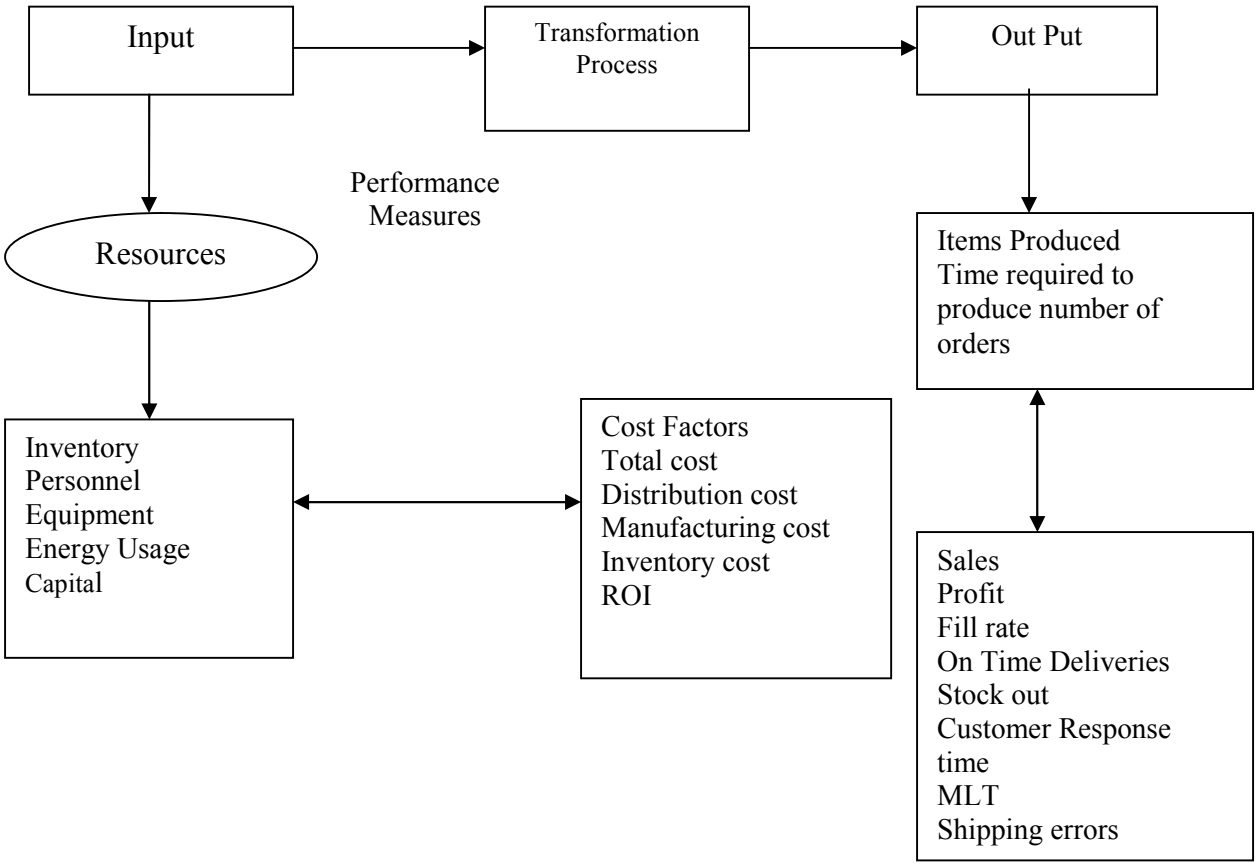


Figure 4.1 A framework for Supply chain performance measurement system.

From the above framework cost factors like total cost, capital, distribution cost, inventory cost , sales and profit have been considered to calculate the different parameters adopted in the methodology used for internal supply chain benchmarking this has an effect at different levels of performance measurement system like resources, linked with inputs and transformation process, outputs.

However there is a lot of scope for future research by considering some other factors from the above framework like OTD, fill rates, number of orders, items produced, personnel, equipment, and energy usage in different directions for calculating the supply chain performance measure.

4.4 Financial linkage with SCM performance measures

An organizations value can be enhanced in four different ways increasing revenue, reducing operating cost, reducing working capital and increasing asset efficiency. But long term growth requires revenue enhancement and need for managers focus on all four ways to increase value (Lambert et al, 2005). Some of the important strategies to be adopted for maximizing the wealth organization are operating, investment

and financial strategies where operating strategies improves economic efficiency by lowering operating costs or through improvements in the efficient utilization of resources thus leading to improved profitability.

Many researchers have proposed sets of measures used to evaluate supply chain performance (Gunasekaran,Patel and McCaughey(2004),Banker,Chang,Janakiraman and Konstans(2004), Otto and Kotzab(2003), Gunasekaran and Tirtiroglu(2001),Beamon(1999).

David Walters (1999) has identified the implications of shareholder value planning for logistics decisions and the belief that the share holders' return is important has always been an implicit objective manifested through financial objectives. Sridharan *et al*. (2005) have concluded that the supply chain implementation issues can have major impact on the value of firms.

From the above discussion conclusion is that factors effecting or influencing success to implement measurement systems for supply chains in financial perspective considering the data from financial statements has been investigated. A key performance indicator for supply chain, financial flows have a significant role in internal benchmarking.

By using the suggested methodology for internal benchmarking of sustainable supply chain performance measures it has been found that the frequency of conducting the internal bench marking of supply chain performance is at least for every three years with reference to the companies considered, however the quantitative analysis of data cannot be considered in making managerial decision making as many factors effect underground reality.

With reference to the organizations considered under this study as financial perspective day's payables outstanding, day's sales outstanding which are a metrics under sourcing, pricing respectively, which are the two key logistics drivers plays a significant role in internal supply chain decision making framework.

CHAPTER 5

Results and Discussion

This chapter presents advanced results derived from primary data which is presented in chapter 4. Further, detailed discussions to understand managerial and theoretical implications are also presented in this chapter. At First measurement validation is presented, measurement validation results are derived using the following statistical implications derived from Factor analysis, Discriminant analysis. For accomplishing the fourth research objective i.e. is some of the best practices in the supply chain of Indian manufacturing companies with sustainability perspective are also presented in this chapter.

- Unidimesnionality of the constructs
- Factor Loadings
- Reliability
- Corrected Item total correlation
- Kaiser- Meyer - Olkin test
- Bartlett's Test

5.1 Unidimesnionality of the constructs

The validity and reliability of the constructs of the questionnaire could be assessed by analyzing unidimensionality of each construct. Principal component analysis facilitates to analyze unidimensionality, which demonstrates that all items of a single construct measure the same thing. In the principal component analysis, Eigen value 'greater than one' criteria is applied to test unidimensionality in which number of Eigen values greater than one are equal to number of factors (Netemeyer and Bearden, 2003). The rationale is each construct must have only one Eigen value of its value more than one, which enables all variables to have as much variance on the same construct. The principal component analysis of this study proved that these constructs are unidimensional as each construct has only one Eigen value of its value more than one. The Eigen value, percentage of variance explained by all variables on each construct, and their factor loadings are shown in Table 5.1, Table 5.2, Table 5.3, Table 5.4, Table 5.5, and Table 5.6.

Table 5.1 Unidimensionality of the Sustainable supply chain management practices: Supply chain policy

Construct	Items	Eigen Value	% of Variance	Factor Loading
Customization	Low waste	6.393	39.958	0.79
	Cost cutting			0.38
	Responsiveness			0.38
	Customer satisfaction			0.76
Flexibility	Capacity utilization	1.540	9.628	0.75
	Asset turnover			0.55
Sustainable partnership integration	SCM Leverage	1.146	7.165	0.69
	Information sharing			0.68
	Reliability			0.90
Supply chain surplus (profitability)	Distribution channel strategy	1.020	6.375	0.81
	Low inventory			0.49

From above table 5.1 customization (low waste, cost cutting,responsiveness,customer satisfaction) construct has the eigen value is 6.393 which should be more than 1 and percentage of variance is 39.958 which should be not less than 35% for first construct.

For all the constructs i.e flexibility (Capacity utilization,asset turnover),sustainable partnership integration(SCM leverage,information sharing,reliability) supply chain surplus(distribution channel strategy,low inventory) have eigen value more than one. From the above table 5.1.1 unidimensionality of Sustainable supply chain management practices: Supply chain policy has been established.

Table 5.2 (a) Unidimensionality of Supply chain performance with sustainability

Construct	Items	Eigen Value	% of Variance	Factor Loading
Distribution Management	Quality of delivery goods	17.913	34.448	0.78
	Delivery efficiency			0.71
	Transport costs			0.69
	Delivery reliability			0.68
	Quality of deliverey documentation			0.61
	Delivery lead time			0.60
	Satisfaction with Knowledge Transfer			0.52
	Planned Process cycle time			0.52
	Satisfaction with supplier relationship			0.51
	Order entry methods			0.38
Customer Relationship Management	Customer Complaints	3.344	6.431	0.82
	Rate of Complaints			0.82
	Warranty/returns processing costs			0.69
	Level of Customer perceived value of product			0.51
	Purchase order cycle time			0.42
	Order Lead time			0.34

Table 5.2(b) Unidimensionality of Supply chain performance with sustainability

Construct	Items	Eigen Value	% of Variance	Factor Loading
Supplier Relationship management	Supplier assistance in solving technical problems	2.610	5.018	0.82
	Supplier ability to respond to quality problems			0.72
	Timely available of accurate information			0.56
	Mutual Trust			0.79
Manufacturing strategy	Manufacturing cost	2.326	4.474	0.74
	Work in Process			0.65
	Production flexibility			0.60
	Manufacturing Lead time			0.50
	Buyer-supplier partnership level			0.42
Logistics Drivers	Transport flexibility	2.181	4.194	0.71
	Frequency of delivery			0.68
	Delivery flexibility			0.56
	Total supply chain cycle time			0.50
	Total supply chain response time			0.46

Table 5.2(c) Unidimensionality of supply chain performance with sustainability

Construct	Items	Eigen Value	% of Variance	Factor Loading
Costing	Information carrying cost	2.058	3.958	.74
	Intangible cost			.69
	Over head cost			.65
Cash	Cash-cash cycle time	1.722	3.312	.83
	Total cash flow time			.79
	Customer response time			.69
Purchasing operations	Suppliers booking in procedures	1.686	3.242	.82
	Supplier cost saving initiatives			.57
	Efficiency of purchase order cycle time			.57
	Order Flexibility			.42
Delivery costs	Distribution costs	1.464	2.816	.82
	Total Logistics costs			.82
	Delivery costs			.62
Storage	Warehouse costs	1.338	2.573	.72
	Disposal costs			.72
Batch sizing	Supplier Rejection Rate	1.181	2.271	.62
	Economic order quantity			.53
	Volume flexibility			.50
Inventory management	Inventory turnover ratio	1.077	2.70	.72
	Inventory days of supply			.61
	Inventory cost			.53

Unidimensionality of supply chain performance with sustainability: distribution Management with 10 items,customer relationship management with 6 items, supplier relationship management with 4 items, manufacturing strategy with 5 items,logistics drivers with 5 items,costing with 3 items, cash management with 3 items, purchasing operations with 4 items,delivery costs with 3 items, storage with 2 items,batchsizing with 3 items,inventory management with 3 items scale has been established all the construct's eigen value is more than 1 and for the first construct percentage of variance 34.48 hence unideminestionaly of construct has been establsihed.

Table 5.3 Unidimensionality of Environmental impacts

Construct	Items	Eigen Value	% of Variance	Factor Loading
Planet perspective	Ground water pollution	4.590	45.899	0.75
	Packaging material			0.86
	Solid waste			0.75
People perspective	Supply chain activities	1.180	11.800	0.66
	Production processes			0.76
Profit perspective	Eco friendly Transportation system	1.051	10.512	0.78
	Scarcity of raw material Resources.			0.75

Table 5.4 Unidimensionality of social performance as sustainability indicators and business opportunity development

Construct	Items	Eigen Value	% of Variance	Factor Loading
Community	Disaster Relief	6.930	38.497	0.81
	Vocational Training			0.80
	Social Accountability			0.70
Safety	Safety and health issues of employees	2.363	13.127	0.63
	Safety and health issues of surrounding community			0.70
	Safety and health issues of laborers and transporters			0.76
Product responsibility	Green Technology	1.370	7.614	0.66
	Product stewardship			0.34
Sustainable buisness oppurtubities	New Products	1.301	7.230	0.82
	New Processes			0.77
	Cleaner Development Mechanism			0.77
	Carbon Trading			0.81

5.2. Measurement validation

To test the reliability of the scales, two other measures are also used. They are Corrected Item-Total Correlation (CITC) and alpha-if-item-deleted. The use of CITC is suggested by Kerlinger (1986). All items of the same construct are supposed to be closely related to the same underlying latent variable. If an item's correlation with its corrected item total is less than 0.30, then the item should not be included

in the construct. The alpha-if-item-deleted is to measure the importance of each item to its related construct. If the item is critical to the construct, then the Cronbach's alpha will decrease significantly if the item is deleted from the construct. After the item deletion process described above was completed, the final measurement scale analysis was conducted. The results are as shown in below sections.

5.2.1 Sampling Adequacy and Correlation Matrix Sphericity Testing

Besides the reliability and validity of the scales, the normality and outliers are tested by using Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy and Bartlett test of sphericity. KMO is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Small values of KMO indicate that a factor analysis of the variables may not be a good idea, because correlations between pairs of variables cannot be explained by the other variables. A minimum KMO score of 0.50 is considered necessary to reliably use factor analysis.

Bartlett test of sphericity is used to test whether the correlation matrix is an identity matrix. If it is close to an identity matrix, the variables are not correlated with each other. Therefore, the desirable test significance level is smaller than 0.05, i.e. the null hypothesis that the correlation matrix is an identity matrix should be rejected. Table 5.5,5.6, and5.7 shows that all KMO scores are larger than 0.6. Similarly, all Bartlett tests of sphericity have significance levels of $p<.001$. Both results show that it is appropriate to perform the factor analysis with the data set.

Table 5.5: Final results of measurement validation of SCM policy

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading	Scale statistics
Supply chain management policy	Low waste	0.488	0.893	0.79	Cronbach's alpha: 0.898 Kaiser- Meyer - Olkin measure of sampling adequacy : 0.841 Bartlett's test of sphericity χ^2: 686 significance level: 0.000
	Cost cutting	0.577	0.890	0.38	
	Responsiveness	0.643	0.888	0.38	
	Customer satisfaction	0.479	0.893	0.76	
	Capacity utilization	0.445	0.894	0.75	
	Asset turnover	0.522	0.892	0.55	
	SCM Leverage	0.642	0.887	0.69	

Table 5.6 : Final results of measurement validation of environmental impacts

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading	Scale statistics
Environmental impacts	Your perception about the scarcity of raw material ….	0.404	0.858	0.75	Cronbach's alpha: 0.859 Kaiser- Meyer - Olkin measure of sampling adequacy : 0.821 Bartlett's test of sphericity χ^2 : 465 Significance level (0.000)
	The level of gaseous emissions from your organization …	0.665	0.837	0.71	
	Solid waste from your organization …	0.716	0.833	0.58	
	Your organization's liquid waste discharge…	0.742	0.830	0.75	
	The production process in your …..	0.762	0.828	0.76	
	The activities in your supply chain …..	0.692	0.835	0.66	
	Packaging material which is being used by your ….	0.555	0.835	0.86	
	Usage of Products manufactured …..	0.555	0.847	0.80	

Table 5.7: Final results of measurement validation of social performance as sustainability indicators and business opportunity development

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading	Scale statistics
Social performance business opportunity development.	Safety and health issues of employees	0.546	0.891	0.58	Cronbach's alpha: 0.896 Kaiser- Meyer - Olkin measure of sampling adequacy : 0.809 Bartlett's test of sphericity χ^2: 999 Significance level (000)
	Safety and health issues of laborers' and transporters	0.669	0.887	0.76	
	Cleaner Development Mechanism	0.434	0.894	0.77	
	Safety and health issues of surrounding community	0.642	0.887	0.70	
	Product responsibility	0.597	0.889	0.52	
	Green Technology	0.426	0.889	0.66	
	Education	0.571	0.889	0.71	
	Human rights	0.692	0.885	0.75	
	Patient care	0.497	0.892	0.51	
	Disaster Relief	0.710	0.884	0.81	
	Vocational Training	0.461	0.893	0.80	
	Community care	0.625	0.887	0.81	
	New Processes	0.429	0.900	0.77	
	Social Accountability	0.770	0.883	0.70	
	Livelihood	0.636	0.887	0.78	
	Product stewardship	0.530	0.891	0.34	

Table 5.8: Final results of measurement validation of PLAN

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading
Plan	Customer response time	0.517	0.959	0.69
	Cash-cash cycle time	0.405	0.959	0.83
	Order Flexibility	0.654	0.958	0.42
	Over head cost	0.495	0.959	0.65
	Order Lead Time	0.687	0.958	0.34
	Order entry methods	0.498	0.959	0.38
	Information carrying cost	0.402	0.959	0.74
	Total supply chain cycle time	0.742	0.958	0.50
	Total supply chain response time	0.757	0.958	0.46
	Intangible cost	0.482	0.959	0.69

Table 5.9: Final results of measurement validation of SOURCE

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading
Source	Timely available of accurate information	0.520	0.959	0.56
	Supplier ability to respond to quality problems	0.670	0.958	0.72
	Buyer-supplier partnership level	0.589	0.958	0.42
	Satisfaction with supplier relationship	0.539	0.959	0.51
	Efficiency of purchase order cycle time	0.613	0.958	0.57
	Satisfaction with Knowledge Transfer	0.645	0.958	0.34
	Supplier cost saving initiatives	0.369	0.959	0.57
	Purchase order cycle time	0.626	0.958	0.42
	Suppliers booking in procedures	0.420	0.959	0.82
	Supplier assistance in solving technical problems	0.422	0.959	0.82

Table 5.10: Final results of measurement validation of MAKE

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading
Make	Manufacturing cost	0.521	0.959	0.74
	Inventory turnover ratio	0.564	0.959	0.72
	Inventory cost	0.632	0.958	0.53
	Work in Process	0.655	0.958	0.65
	Inventory days of supply	0.609	0.958	0.61
	Economic order quantity	0.535	0.959	0.53
	Manufacturing Lead time	0.599	0.958	0.50
	Production flexibility	0.639	0.958	0.60
	Planned Process cycle time	0.660	0.958	0.52
	Volume flexibility	0.529	0.959	0.50
	Warehouse costs	0.417	0.959	0.72

Table 5.11: Final results of measurement validation of DELIVER

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading
Deliver	Quality of delivery goods	0.513	0.959	0.78
	Quality of delivery documentation	0.607	0.958	0.61
	Delivery reliability	0.677	0.958	0.68
	Transport costs	0.645	0.958	0.69
	Distribution costs	0.387	0.959	0.82
	Total Logistics costs	0.401	0.959	0.82
	Delivery costs	0.593	0.958	0.62
	Delivery efficiency	0.709	0.958	0.55
	Frequency of delivery	0.634	0.958	0.68
	Transport flexibility	0.621	0.958	0.71
	Delivery lead time	0.699	0.958	0.60

Table 5.12: Final results of measurement validation of RETURN

Scale Name	Variable Name	CITC	Alpha if item Deleted	Factor Loading
Return	Customer complaints	0.438	0.959	0.82
	Rate of complaints	0.449	0.959	0.82
	Customer response time	0.572	0.958	0.70
	Level of customer percieved value of product	0.598	0.958	0.51
	Warranty/returns processing costs	0.493	0.959	0.69

5.3 Case studies on Sustainable supply chain management practices with reference to Indian manufacturing industry.

Case let no.1 Nestlé India, a food and beverage company, established a dedicated supplier development department in 2005 to achieve cost savings by relying less on imports to overcome quality and food safety issues, and to create a wider, more flexible supply base. The company invests in working with suppliers through training programmes and by providing technical assistance to suppliers to close safety and quality gaps and improve suppliers' management systems and products. as a result of these supplier development efforts, nestle India has secured local sources of 12 previously imported raw materials, avoided 10 single supplier situations, developed more than 70 new Indian suppliers able to meet Nestlé's specifications and saved $US 5 million. By the end of 2009, this initiative has also been replicated in Bangladesh, Brazil, Indonesia, Iran, Malaysia, Russia and South Africa.

Nestlé believes that it is only by creating value for society and shareholders at the same time that we can have long term business success. They call this creating shared value. After analyzing their value chain they have determined that the areas of greatest potential for joint value optimization with society are water, rural development and nutrition. By working closely with their supply base of 540,000 farmers, they can help them be more productive and emerge from poverty. In return they received a higher quality end product which benefits the consumer and ultimately their business. They commend this approach to other companies and hope this new guide will help spread best practice."

Case let no.2 De beers, a diamond company based in Luxembourg, works with other companies in the industry to address a range of historical challenges including conflict diamonds, a lack of commercial transparency and poor working conditions in factories in major cutting and polishing centres like surat in India. Although the Kimberley process certification scheme and the world diamond council system of warranties were launched in 2003 to address the issue of conflict diamonds, no single standard existed to verify full ethical practices throughout the diamond pipeline addressing social, employment, business, health and safety, and environmental issues. Saw an opportunity to lever-age its leadership position in the diamond pipeline to establish a benchmark for best practice not only within the diamond mining sector, but also through the cutting, polishing, and jewellery manufacturing pipeline. To this end, launched the Best Practice Principles (BPP) assurance programme in 2005 and made compliance to the standard a contractual condition of supply to customers and a requirement for all entities within the group.

Case let no.3 Mahindra and Mahindra limited works with selected suppliers to improve their management capabilities in a number of areas. The company's farm equipment sector established the Mahindra yellow belt (MYB) business partners' training program to help build suppliers' capabilities to address quality problems. The training program includes two days of training, a test to verify that the learning objectives have been met and a follow up project to apply the learning that is selected by the supplier and approved by Mahindra.

Case let no.4 Green Supply chain Management practices at Mahindra & Mahindra Ltd., Automotive division Nashik

Sustainability dimension of this case involves both people and planet At first people perspective by training and educating suppliers, contractors on green practices as a business requirement and made it part of strategy.

Methodology used by organizing yearly training sessions workshops, exhibitions for suppliers to make them understand the plant requirements with respect to environment standards.

Planet perspective by promoting reusable packaging & reducing use of corrugated boxes and wooden boxes. Promoting milk runs to minimize CO_2 emissions milk run is a tested and proven method of optimizing vendor's vehicle movement for delivering goods. Reduction in logistics costs by utilization of full load of containers.

Implications of the practices are reduced wood packaging waste from 2208 MT to 554 MT in two years. Reduction of 74% of wood & 45% of card board box used for packaging.487 MT/annum of CO_2 emissions have been reduced due to transport optimization.

Case let no. 5 Reduce, Recycle & Reuse of process hazardous waste as an alternate fuel Mahindra & Mahindra Ltd., Automotive division Zaheerabad.

Objective is use of hazardous waste as an alternate fuel in cement kiln. Methodology hazardous waste is a by product of the paint shop operation in the plant. The chemical composition and the calorific value of the waste were determined. The chemical composition and the calorific value of the waste were determined the samples were offered to various cement industries for trails. Grasim, Tadipatri agreed to undertake the trials and found that the results were promising to use the waste material as fuel.

Meeting A.P.Pollution Control board norms, a team from Grasim worked out the modalties the method of transporting the waste was decided upon and the costs involved.

Results reduction of Waste disposal expenses of Rs 2.5 Million/annum, avoiding disposal of 300 MT/annum of hazardous waste to landfill/incineration. Saving of 200 MT of coal/annum. Reducing green house gas emissions (approx.270 MT/annum of CO_2 gas reduced) as waste is not being incinerated.

Caselet no. 6 Take-Back and Recycling Program (Planet Ke Rakhwale)

Educating mobile phone consumers on the importance of recycling. Methodology adopted is planned sustained and phased program which includes infrastructure set up by installing secure bins at care centre's brand retail stores, adopting reverse logistics and tie up with responsible recycler. Pilot campaign in four major cities resulted in collection of over 68,000 pieces weighing over 3 tons of old phones and accessories in 45 days. Consumer research and development. Set up of an environmental community, and nation - wide campaign. Planting a tree for every phone dropped for recycling and also handling out a set of pens made of recycled plastics to consumers.

Results are over 600,000 pieces of old phones and accessories weighing over 18 MT are collected for recycling. If every mobile phone user across the world recycled, it could prevent nearly 240,000 tonnes of raw materials from being mined. 40,000 trees have already been planted working with NGO's.

They minimized their own ecological footprint. Being environmentally friendly improves risk management, often makes good economic and business sense, and reinforces our brand. During the years of 2006-2008 they reduced the size of their packaging and used more recycled materials to make it. This enabled them to reduce the use of paper based materials by almost 100,000 tones. This translates not only into financial savings but less packaging also means reduced transportation volume enabling us to take at least 12,000 trucks off the roads. During 2008-2009 they introduced a thin packaging alternative for all new Nokia devices. Many Nokia factories are located within industrial areas that combine all of their operations including R&D, marketing services, production, logistics, distribution, and also many of our suppliers. This significantly improves efficiency of operations, slashing their CO_2 and transportation emissions, decreasing the use of packaging materials, and saving on business travel and long-distance shipping costs. Their Telecom SEZ park in India also houses 5 of their suppliers (Salcomp, Perlos, Laird, Wintek and Foxconn) operating out of the SEZ premises. They encourage their employees to use video and teleconferencing as much as possible to replace travel. They currently have 215 video conferencing facilities around the world and our employees used them for about 3,800 hours per month in 2008. They have dedicated teams in R&D and Design looking at new ideas to address social and environmental issues including energy use, recycling, and making the benefits of mobile technology available to more people.

The "Remade" concept is such a project, looking at whether it would be possible to create a device in future from nothing new. They continuously work on finding new ways to increase energy efficiency including using energy saving technologies in their offices, and reducing commuting and travel.

Caselet no.7 Conservation of Wood in glass packing Saint Gobain Glass India Ltd., Sriperimbudur. Minimized the consumption of wood for packaging. Packaging falls under the category of distribution of products which has strong link with transportation which is one of the key driver of SCM. Methodology used is by designed a special type of metal 'A' frame with self inclination and rubber lining to transport the glass without wood packing. The metal frames designed in house underwent stringent testing standards for load and strength involving structural engineering research center (SERC). Thorough study and survey has been done at the customer end to facilitate easy unloading and unpacking. Several training programs were conducted at customer end for safe handling of glass without wood packing. 'A' frames are used for 7 times and reverse logistics has been adopted. Cost of packing with wood: 1600Rs/ton of glass, packing in 'A' frame: 1,600 Rs/ton of glass.

Results are reduction in consumption of wood, 2.7 cubic foot of wood/ton of glass is saved, savings in packing cost Rs 1000/ Ton of glass.

Caselet no. 8 Hero MotoCorp Ltd. (Formerly Hero Honda Motors Ltd.) is the world's largest manufacturer of two - wheelers, based in India.

Hero MotoCorp takes considerable pride in its stakeholder relationships, especially ones developed at the grassroots. The Company believes it has managed to bring an economically and socially backward region in Dharuhera, Haryana, into the national economic mainstream.

Social sustainable practices:

An Integrated Rural Development Centre has been set up on 40 acres of land along the Delhi - Jaipur Highway. The Centre-complete with wide approach roads, clean water and education facilities for both adults and children-now nurtures a vibrant, educated and healthy community.

In order to help local rural people, especially women, Hero MotoCorp has set up a Vocational Training Centre. So far 26 batches comprising of nearly 625 women have been trained in tailoring, embroidery and knitting. The Company has helped women trained at this centre to set up a production unit to stitch uniforms for Hero MotoCorp employees. Interestingly, most of the women are now self-employed.

In order to help local rural people, especially women, Hero MotoCorp has set up a Vocational Training Centre. So far 26 batches comprising of nearly 625 women have been trained in tailoring, embroidery and knitting. The Company has helped women trained at this centre to set up a production unit to stitch uniforms for Hero MotoCorp employees. Interestingly, most of the women are now self-employed.

Besides setting up a modern hospital, the foundation also regularly provides doorstep health care services to the local community. Free health care and medical camps are now a regular feature in the Hero Group's community outreach program

Sustainable development lies at the core of Hero MotoCorp's vision of being one of India's most environment friendly companies.

Hero MotoCorp believes that to create a sustainable enterprise, it is critical to strike the right balance between business, mankind and nature.

Green Initiatives:

As part of cleaner processes: Every raw material and chemical is thoroughly evaluated for its environmental impact before it is introduced into our production process. Over the last few years, Hero Moto Corp has proactively eliminated the use of harmful substance like

- Asbestos
- Hexavalent Chromium
- Phenolic Substances

Green Supply Chain:

The process of sustainable development is incomplete without involving the company's supply chain. Hence Hero MotoCorp has therefore put together a "Green Dealer Development Program" for the front end and a "Green Vendor Development Program" for the backend of the supply chain.

In each of these programs, the partners' are made aware of the importance of caring for the environment and are encouraged to manage their material resources, industrial wastes, energy resource, pollution and other effluents based on a number of pre-determined parameters.

Hero MotoCorp supports all its partners in the Green Supply Chain venture by :

- Developing required competencies
- Sharing knowledge
- Providing technical support

Through this program Hero MotoCorp aims to generate sufficient momentum within the industry, and looks forward to the day when the entire automotive industry is made up on a seamless green chain.

Scarce Resources:

Based in Haryana, one of India's driest states; Hero MotoCorp has introduced rainwater harvesting at both its plants in Dharuhera and Gurgaon.

Across both plants, 16 rainwater harvesting catchments have been set up covering a total area of more than 31540 sq mts. In a single year they managed to 18 million litres of water.

One of India's most well known civil society organizations - the Centre for Science and Environment (CSE) has adapted Hero MotoCorp's rainwater harvesting project as a model project for enhancing public awareness.

The Centre also regularly monitors the performance of the system to check ground water level and the water quality.

Green awards and recognitions:

For its diverse environment initiatives, Hero MotoCorp has received the following certifications:

- Environmental Management Systems as per ISO 14001
- Occupational Health and Safety Management Systems as per OHSAS18001
- Quality Management Systems as per ISO-9001

Care for environment:

Green Technology: Constant adoption of innovative green practices has resulted in the introduction of a special Acrylic Cathodic Electro Deposition (ACED) painting process for the frame body. This new process results in 99 per cent paint transfer efficiency and minimizes effluents. The water soluble paint used is environment friendly and delivers better quality and productivity.

Green Roof: The Green Roof was one of the major environment friendly initiatives. Besides restoring ecological and aesthetic value, it helps in substantial amount of energy saving by moderating temperature of roof and surrounding areas. It also helps in reducing storm water runoff volume and peak flow rate, and increases the service life of water proofing membrane. Starting monitoring of power consumption trend also.

Supply chain perspective Green vendor development for protecting and preservation of environment:

Rapid industrialization and advanced technological changes have put Indian economy on fast growth. But such developments pose unprecedented challenges to human society in term of climatic and environmental degradation. Therefore the people and governments have come forward to deal with environmental threats and also to explore many opportunities so as to address the environmental issues and also to create a sustainable environmental future for all.

At Hero MotoCorp are continuously striving for synergy between technology, system and human resources, to provide products and services, to meet the aspiration of their valued customers that too, demonstrating "WE CARE" philosophy. While doing so, they maintain the highest standards of ethics and societal responsibility, constantly innovate the products and process and work in partnership with their supply vendors to take the organization to new excellences.

They believe that their vendors and dealers are key stakeholders and partners to work towards the goal of sustainable development. Green Vendor Development Programme refers to the way in which organizational innovations in industrial supply chain management may be considered in the context of the environment. Organizations which act proactively not only to identified but also to implement actions in process / operation so as to address environmental issues.

Green Vendor Development Programme (GVDP) encourages a collaborative effort between Hero MotoCorp and its suppliers to achieve Hero MotoCorp's overall corporate environmental goal. GVDP calls for partner companies to demonstrate their commitment towards improved environmental performance and striving for continual improvement.

Six pillars have been assigned to GVDP model which are Energy management, Water management, Waste minimization, Prevention of pollution, substitution of hazardous chemical and environmental compliance

management. Partner vendors are given specific training on all six pillars of GVDP and mapping of processes/equipments is carried out based on logical analysis so as to identify the gaps or significant environmental aspect and accordingly improvements projects are undertaken for implementation. The programme works on PDCA approach.

Hero MotoCorp also endeavors to provide a platform on which the vendors can share their environment achievements and problems encountered during implementation of the green vendor program. The objective of this meet is to share success stories on environmental improvements that can be replicated at other vendor facilities. This platform lays the foundation for a mutually beneficial eco-future.
They understand that environmental protection is their responsibility towards their future generations and thus while providing to customers with supreme quality of products and services it is important for us to ensure that environmental considerations are given utmost importance. Continuously taking initiatives towards environmental protection and base all their business decisions on environmental considerations.

Target Key Areas for Maximum Impact:

Though according to some estimates today IT contributes to around 4-5% of Global Carbon Emissions and necessary control that, IT has the potential and power to impact the remaining 95% as well. The critical element in this entire journey is the Green IT intervention strategy where the decision makers agree on areas where IT could influence the environment.

Actions speak louder than plans:

Here are some Green IT Initiatives that they have taken or are underway at Hero MotoCorp:

- Green IT as a focus area in the IT Policy
- New, energy efficient datacenter with power management features
- Virtualization and server consolidation
- Use of TFTs in place of CRTs for displays
- Reduction of printers
- Video conferencing / Collaboration tools - to reduce travel
- Buying of energy certified equipment - replacing old inefficient equipment
- Creating awareness in organisation
- Usage of e-learning to reduce trainee or trainer travel

New IT initiatives to cut paper consumption such as:

- Converting our paper based customer loyalty program to an online card based program
- Cutting down on printing of cheques in a big way and going for electronic fund transfer
- Digitization of workflows needing approvals, e-fax to get fax on email and many others

Reaping benefits:

Implementing Green IT initiatives benefits not only the environment but the enterprise as well. Here are some positive outcomes that they saw after embarking on their Green IT mission:

- Focus on Green IT provided excellent means for opportunity to care for the society and environment
- For the employees, it gave a sense of satisfaction and ownership as they feel that they are also trying to contribute at their level in saving the environment
- Many initiatives also helped to improve productivity in the organisation - e.g. video conferencing, workflow automation, customer loyalty program automation, electronic transfer of funds etc
- There were direct savings in power consumption and cost thereof - whether at datacenter or at user end it was not just considering power consumption by equipment but also considering lower heat generation as the room requires reduced air-conditioning
- Other savings include space, power and administrative cost savings at the datacenter, reduced paper consumption costs, etc.

An enterprise is bound to face challenges while trying to put a Green IT plan into action. For instance, we faced some challenges with disposal and recycling of existing equipment - as to how to dispose off CRTs to replace them with TFTs with least possible damage to the environment. They had to look for a vendor who would take back the existing CRTs and recycle them. But the pros of practicing Green IT clearly outnumber the cons.

All benefits and challenges aside, saving the environment is something that touches every heart today. Each and every employee can contribute to this initiative with the CIO leading the way to a cleaner, greener planet. (*Source: http://www.heromotocorp.com/en-in/wecare/greenit*).

Caselet no: 9 Hindustan Unilever limited

Unilever Sustainable Living Plan:

For HUL, sustainability has always been integral way of doing business. In November 2010, Unilever launched the Sustainable Living Plan, which puts sustainability at the heart of their business strategy. The central objective of the Unilever Sustainable Living Plan is to decouple their growth from our environmental footprint, while at the same time increasing positive social impacts. Proposed Plan will result in three significant outcomes by 2020:

- Help more than a billion people improve their health and well-being
- Halve the environmental footprint of their products
- Source 100% of our agricultural raw materials sustainably

Underpinning these three broad goals are around 60 time-bound targets spanning social, economic, and environmental performance across the value chain from the sourcing of raw materials all the way through to the use of products in the home.

Reducing Environmental Impact:

Their commitment to sustainability requires to go beyond own operations and to reduce total environmental footprint. They ensure that company's activities impact on the environment is minimized across the value chain, from sourcing materials to consumer use.

Greenhouse Gases:

Reduce greenhouse gases from washing clothes

Global target: Reduce the greenhouse gas impact of the laundry process by concentrating liquids and compacting powders. Reformulation of their products to reduce greenhouse gas emissions by 15%, by 2012.

They continue to make good progress in reformulating products to reduce greenhouse gas emissions. In India, the process started in 2009 and continued in 2010 and 2011.

A significant reduction in GHG emissions has been achieved with the reduction of STP (Sodium Tri Poly Phosphate – an ingredient that neutralises the impact of water hardness) in detergent powders.

Reduce GHG from manufacturing:

Global target: By 2020 CO_2 emissions from energy will be at or below 2008 levels, despite significantly higher volumes. Double usage of renewable energy to 40% of total energy requirement by 2020. And, all newly built factories will aim to have less than half the impact of those in 2008 baseline.

In 2011, they reduced $C0_2$ emissions per tonne of production in India by 9.9% compared to 2010 and by 14.7% compared to 2008 baseline. They had earlier made a commitment to reduce $C0_2$ emissions per tonnes of production by 25% by 2012 (against the 2004 baseline). In 2011, progress against the2004 baseline was a 36.1% reduction on per tonne basis.

This was achieved due to the installation of biomass boilers to reduce $C0_2$ emissions at Chiplun, Puducherry, Goa, Nasik, and Mysore factories.

Reduction of Greenhouse Gases from Transport :

Global target: By 2020 $C0_2$emissions from global logistics network will be at or below 2010 levels despite significantly higher volumes. Which represents a 40% improvement in $C0_2$ efficiency.

In India, the biggest challenge was to deliver reduction in $C0_2$ emissions despite significant volume increase. In 2011, delivered 17.8% improvement in logistics $C0_2$ efficiency over 2010.

During 2011, the focus has been on optimizing the distance travelled as well the load ability of products through extensive use of technology. They introduced a new type of truck, with more height, which made a significant change in volumetric packs. This helped company to load more in the same truck base. In some categories in personal care business, load increased by over 55% (from 9 tonnes to 14 tonnes) with the same base for the same pack with the use of the new trucks. They have also started various energy management programmes at distribution centres, such as installation of energy efficient stabilisers and replacing bay lights with CFL.

The logistics team also implemented new IT systems to report transport emissions at minute level. This helped in reporting accurate and minute level data compared to the previous manual process.

Reduction of GHG from refrigeration

Global target: Accelerated their roll-out of freezer cabinets that use climate-friendly (hydrocarbon) refrigerants. They have already purchased 4,50,000 units with the new refrigerant and will purchasing a further 8,50,000 units by 2015.

Company' ice-cream business has moved into procuring technologically advanced Hydrocarbon (HC) refrigerant-based freezers for its retail operations, instead of the Hydrofluorocarbons (HFC) refrigerant-

based freezers. HC has zero ozone depletion potential and negligible global warming potential. These freezers have brought about a significant reduction in carbon footprint and will result in approximately 9% savings in power consumption as well. There are currently 23,775 HC-based freezers in their fleet in India.

Waste: Reduce packaging

Global target: By 2020, they will reduce the weight of packaging that they use by a third through light weighting materials, optimising structural and material design, developing concentrated versions of products, and eliminating unnecessary packaging.

They delivered a significant reduction in overall plastic and paperboard consumption in India. In 2011, more than 30 projects were implemented across categories, resulting in potential annualised reduction of more than 2,000 tonnes of plastic, and over 1,750 tonnes of paper board and corrugated boxes.

Recycle packaging Global target: Working in partnership with industry, governments and NGOs Company aimed to increase recycling and recovery rates on average by 5% by 2015 and by 15% by 2020 in 14 countries. Which will easier for consumers to recycle packaging by using materials that best fit recycling facilities available in the country.

By 2020 they also will increase the recycled material content in packaging to maximum possible levels. This will act as a catalyst to increase recycling rates.

They have initiated a number of projects globally from which the most successful will be rolled out elsewhere. Some of projects incentivise consumers to start recycling. Others explore systemic solutions through improving local waste infrastructure, working with local government and waste services providers.

In India, HUL and Bharti Retail implemented a joint programme, 'Go Recycle' to promote the segregation of post-consumer use packaging waste, by the consumers themselves. The programme was run in all 31 'easyday market' and 'easyday stores' in the National Capital Region of Delhi for three months in 2011. The objective of the programme was to inform and educate consumers about practising waste segregation. As part of the programme, consumers were encouraged to bring empty plastic bottles and pouches of any brand from select FMCG categories. In return, the consumers were given discounts coupons for redemption.

HUL is also supporting a pilot source segregation model in Bangalore. The model is developed by one of their employees for her apartment building that comprises 504 households. The model involves segregation of dry waste into multiple value streams which go through recycle and recovery routes thereby making it self-sustainable. Depending upon the success of the pilot, a decision on scaling it up will be taken.

Reduce waste in manufacturing

Global target: By 2020 total waste sent for disposal will beat or below 2008 levels despite significantly higher volumes. All newly built factories will aim to generate less than half the waste of those in 2008 baseline.

More than 95% of their total waste is recycled in environmentally-friendly ways and 100% of non-hazardous waste generated in their operations is recycled in environment friendly ways. Total waste reduction in 2011 over 2010 was 52.2% and the reduction in 2011 against the 2008 baseline was 52.8%.

Sachet waste

Global target: Goal is to develop and implement a sustainable business model for handling sachet waste streams by 2015.

Sachets and pouches are an efficient use of packaging, creating less waste by weight per millilitre of product sold than bottles. Sachets play an important role in making everyday products affordable and accessible to low income consumers.

However, it has been challenging to find an economically viable way of collecting and recycling sachet waste due to its low weight. By helping to create a value for this waste, there is an incentive for people to collect it. Unilever is therefore working to create a scale-able model which will significantly increase the recovery rate of flexible laminates in general.

The technology options being worked on include Pyrolysis, Cement Co-processing and Mechanical recycling. Pyrolysis offers a closed loop system which involves catalytic de-polymerization of plastics into fuel. The fuel can be used in Unilever's factories as furnace oil or can be used for similar industrial applications. Partnering with a company in Chennai which demonstrated 'technical proof of principle' of turning sachets, pouches, and other flexible plastic waste into fuel oil at a viable cost. Factory in Puducherry has successfully used the fuel to power its boiler. They are progressing on long- term techno-commercial feasibility with a polymer oil manufacturer to take this forward.

Future partnership aims: The task also is to find a way to incentivise collection of plastic waste on a large scale. This will require to work in partnership with other users of flexible plastic waste as well as municipal authorities and NGOs.

People: Reduce Workplace Injuries and Accidents

Global target: Aim for zero workplace injuries. By 2020 target to reduce the Total Recordable Frequency Rate (TRFR) for accidents in their factories and offices by 50% versus 2008.

In India, achieved 46.4% reduction in TRFR at the end of 2011 compared to 2008. Due to robust safety management practices have resulted in zero fatalities across manufacturing operations since the Last four years.

They have embedded behaviour-based safety systems since 2004. To increase the depth of behavioral interventions, a Behavioural Based Safety (BBS) model has been re-Launched in 2012.

Reduce employee travel

Global target: They are investing in advanced video conferencing facilities to make communication easier while reducing travel for employees. By 2011 this network will cover more than 30 countries.

In India, they have video conferencing facilities in 10 offices. They also have advanced telepresence facilities in our Mumbai campus and Bangalore research centre. In 2011, 2,069 meetings were held utilizing telepresence facility in our India office, avoiding many business trips to and from India.

Reduction of energy consumption in offices

Global target: by 2020 they will halve the energy (kwh) purchased per occupant for the offices in our top 21 countries versus 2010.

HUL campus in Andheri, Mumbai is a LEED (Leadership in Energy & Environmental Design) certified building. It has been awarded the 'gold' rating in the new construction category. Their campus had also been awarded 'griha' green building status by the ministry of new and renewable energy, government of India, in 2011.

Reduce office waste

Global target: In their top 21 countries, at least 90% of office waste will be reused, recycled or recovered by 2015 and they will send zero waste to landfill by 2017. By 2015 they will reduce paper consumption by 30% per head in top 21 countries. Elimination of paper in invoicing, goods receipt, purchase order processes, financial reporting and employee expense processing by 2015, where legally allowable and technically possible.

They continue to cut paper use by encouraging employees to print less and reducing the number of printers. At the HUL campus, all printers have been switched to double-sided printing, where possible, by default.

Their campus houses an organic waste converter. This generates around 400 kg of manure per week by converting kitchen and garden waste. A pilot project to grow organic vegetables using the square feet gardening technique will be cascaded across HUL offices to reduce the burden on the city municipalities and in the process, reduce our carbon footprint.

They have simplified the format by eliminating extra elements, optimized printing space by increasing it up to 29 lines per page, from eight lines previously. This project will lead to significant reduction in current consumption of paper for invoices. They went live for all primary invoices from depots to general trade customers in 2011.This initiative is significant as it will simplify the invoicing process, generate cost savings for the business, and also reduce environmental impact.

Caselet no: 10 Tata Motors Limited.

True to the tradition of the Tata Group, Tata Motors limited is committed in letter and spirit to Corporate Social Responsibility. It is a signatory to the United Nations Global Compact, and is engaged in community and social initiatives on labor and environment standards in compliance with the principles of the Global Compact. In accordance with this, it plays an active role in community development, serving rural communities adjacent to its manufacturing locations.

Tata Motors believes in technology for tomorrow. Their products stand testimony to this. Our annual expenditure on R&D is approximately 2% of our turnover. They have also set up two in-house Engineering Research Centers that house India's only Certified Crash Test Facility. They ensure that their products are environmentally sound in a variety of ways. These include reducing hazardous materials in vehicle components, developing extended life lubricants, fluids and using ozone-friendly refrigerants. Tata Motors has been making conscious effort in the implementation of several environmentally sensitive technologies in manufacturing processes. The Company uses some of the world's most advanced equipment for emission check and control.

Tata Motors concern is manifested by a dual approach

1. Reduction of environmental pollution and regular pollution control drives
2. Restoration of ecological balance.

Reducing Pollution:

Their endeavours towards environment protection are soil and water conservation programmes and extensive tree plantation drives. Tata Motors is committed to restoring and preserving environmental balance, by reducing waste and pollutants, conserving resources and recycling materials.

Tata Motors has been at the forefront of the Indian automobile industry's anti-pollution efforts by introducing cleaner engines. It is the first Indian Company to introduce vehicles with Euro norms well

ahead of the mandated dates. Tata Motors' joint venture with Cummins Engine Company, USA, in 1992, was a pioneering effort to introduce emission control technology for India. Over the years, Tata Motors has also made investments in setting up of an advanced emission-testing laboratory.

With the intention of protecting the environment, Tata Motors has upgraded the performance of its entire range of four and six cylinder engines to meet international emission standards. This has been accomplished with the help of world-renowned engine consultants like Ricardo and AVL. These engines are used in Tata Motors vehicles in the Indian market, as well as in over 70 export markets.

Tata Motors is constantly working towards developing alternative fuel engine technologies. It has manufactured CNG version of buses and followed it up with a CNG version of its passenger car, the Indica.

Restoring Ecological Balance:

Tata Motors has set up effluent treatment facilities in its plants, to avoid release of polluted water into the ecosystem. In Pune, the treated water is conserved in lakes attracting various species of birds from around the world thus turning the space into a green belt.

Tree plantation programmes involving villagers and Tata Motors employees, have turned acres of barren village green. Tata Motors has planted as many as 80,000 trees in the works and the township and more than 2.4 million trees have been planted in Jamshedpur region. Over half a million trees have been planted in the Pune region. Tata Motors has directed all its suppliers to package their products in alternate material instead of wood.

Resource Sustainability: End-of-Life Vehicle (ELV) treatment & recyling

India is a recycling society with many people making value out the recovery of waste materials discarded from products at the end of their useful life. However, Europe and some other export markets have recognized that they have become a 'throwaway' society in recent decades, and are now introducing waste prevention regimes in different industry sectors to collect and recycle valuable resource rather than it ending up in landfill.

For the Automotive sector, regulators point responsibility for this issue to vehicle producers and operators in the scrap car recovery industry. In Europe the scrap car issue is driven by the End-of-Life Vehicle (ELV) Directive which sets dismantler standards to safely drain and recycle fluids as part of vehicle disposal; and sets targets to recover metal and non-metallic material such that a maximum of 5% of the vehicle weight becomes waste to landfill. Similar regulations have been introduced in Japan and Korea, and the Indian

Government is also developing a similar regime in anticipation of many more old cars being scrapped in future.

Tata Motors has taken these responsibilities seriously and already meets EU product design requirements such as: compliance to ELV heavy metals and other hazardous substance restrictions; and material code marking of plastic and rubber parts to aid economic recycling towards targets.

A major issue for India is the lack of a specialized scrap car collection, treatment, dismantling and recovery infrastructure. Europe has had a century to develop their scrap car industry network but in the year 2000 still required the ELV Directive to make operator standards provide environmentally sound treatment, recycling and disposal of cars. Tata Motors is participating in Government consultations to ensure the Indian scrap car infrastructure is developed to meet sensible environmental standards from the outset.

Integrated cost reduction – collaborating to create value

The 'Integrated Cost Reduction' drive was a multi functional initiative across the PCBU to reduce redundant costs and resource wastage across the supply chain. The aim was to generate innovative ways of meeting the customer needs without compromising on value. The effort was led by ERC and procurement teams with equal participation from manufacturing and quality departments forming cross functional teams (CFTs) that helped to drive improvements in business areas across the value chain. Each CFT was given a specific target for reduction of cost of aggregates. The teams worked under platforms like direct material cost, variable conversion, fixed conversion cost and working capital. 22 CFTs started working this year along with 200 dedicated officers. The initiative has gathered momentum and has started to provide results through collaboration across locations.

Building a robust supply chain

This year they won an Architecture Excellence Award in the IT Service Management category at the ICMG World conclave. Their competitive advantage includes a world class CRM solution with integrated dealer management system (DMS) used by over 2,500 channel partners. Further the supplier self service initiative with design collaboration solution has been extended to an additional 550 vendors this year.

At an organizational level, they have been successful in implementing the model of third party logistics. These logistics providers immensely cut down on the overall transportation costs and time as they follow a hub and spoke model in delivering the consignments efficiently. This has ensured that they have an

enhanced control on their inventory. This also helps in reducing fuel costs and thereby the related emissions. An important aspect of their initiative to green the supply chain has been to seek transparent disclosure from all their vendors on the hazardous material content in each part that they supply. The amount of heavy metals present in the parts have to be declared and are procured only if they meet our stringent material criteria. The chemical composition of the parts is thoroughly checked by their cross-functional team of experts.

At Sanand and Pantnagar, adjacent to their plant boundary, they have established a vendor park with all basic amenities in place which would house vendors supplying exclusively to Tata Motors. They aim to source more than 60 percent of their components from the vendor park, thus increasing their resource efficiency and decreasing their emissions due to reduction in logistics related transportation. Through these vendor parks they have created employment for about 3,750 persons in and around Sanand, out of which 750 are on fixed roll and 3,000 on contract roll. Apart from this, there are about 1,000 persons employed with tier-2 vendors and support functions like logistics, canteens etc. The employment numbers will increase considerably with the scale of operation. Almost 95 percent of the materials supplied from the vendor park are transported in trolleys and returnable packaging. This initiative is aimed at ensuring flow of component supplies on a real-time basis, and there-by reducing logistics and inventory costs as well as lowering uncertainties in the long-distance supply-chain. In the reporting period, their manufacturing plants sourced approximately 58.57 percent of materials and services from vendors within their state of operations.

Additionally they have specific initiatives to enhance the environmental and social performance of our vendors. Every vendor in the vendor park has installed vortex flow meters for monitoring water usage which gives readings remotely at set frequencies. This helps in analyzing consumption pattern and thus optimizing the water use based on production and manpower engagement.

Environment procurement policy

They aim is to adopt a holistic approach to the procurement process by expanding awareness of their environment policy and Tata code of conduct (TCoC) amongst vendors, contractors and service providers. To this effect they formulated an environment procurement policy that provides guidance on evaluating the environmental performance of their business associates along with quality and cost. In line with this policy they have taken an initiative to encourage their vendors and service providers to establish their own environment management systems. Awareness campaigns to improve their manufacturing process,

reducing their carbon footprint and use of hazardous chemicals have also been formulated under the aegis of this policy.

At Jamshedpur plant, close to 1,120 service providers have participated in the awareness sessions. They have observed vendors implement ideas to reduce packaging material and increase use of recycled material as a result of the various programmes conducted, since the inception of this policy. One such outcome has been the use of retainer bins, which are used to pack the consignments and once delivered, these bins are reclaimed by the supplier for reuse. This has significantly cut down their packaging material footprint. They aim to create awareness and promote good environmental practices and management systems in our supply chain with the aid of ISO14001 certification for our channel partners.

Supplier performance enhancement

Under the policy initiative of supplier performance enhancement, they conduct in house vendor council meetings to formulate a sound system for evaluation and enhancement of supplier performance. At PCBU, the meetings are held under the guidance of the Head-Car Plant, Head-Supply chain management, Head-Quality and Assistant General Manager-Vendor development. In order to make the evaluation system more comprehensive, new metrics were identified for continuous evaluation of supplier performance in this year. These include a monthly quality index, monthly delivery index and a monthly vendor rating system based on quality, cost, delivery, design development and management systems. The grading of suppliers would be done based on these parameters on a scale of 'A' to 'E', with 'A' being the best. This would help our suppliers improve their performance and work towards continuous improvement. Further, we conduct surprise audits under the TCoC framework and third party audits under the purview of SA8000 to ensure that there are no incidents of human rights violations including child labor and forced labor in our supply chain.

Environmental Stewardship

They use a systematic approach to manage environmental issues. They focus on environmental management to help preserve the long-term health of people and ecosystems and build strong positive relationships with local communities. They have been at the fore front in developing vehicles that meet the various environmental protection regulations, while striving to go beyond compliance. They have developed an organization wide environment policy that highlights the use of environmentally sustainable technologies and practices for prevention of pollution and continual improvement in environmental performance. This policy comprehensively addresses the need to conserve natural resources and energy,

minimize waste generation, enhance recovery and recycling of material and develop eco-friendly waste disposal practices. Their endeavour has been to establish environmental management as an integral part of the standard operating systems to achieve best-in-class performance. Further, an intranet web site 'Yugandhara' is used for creating climate change consciousness amongst the employees. This year, they have invested 346.90 million towards environment management activities across operations.

Resource Efficiency

The primary materials and components we use in our vehicle production are steel sheets and plates, castings, forgings, tyres, fuel injection equipment, batteries, electrical items and rubber and plastic parts, consumables (paints, oils, thinner, welding consumables, chemicals, adhesives and sealants) and fuels. They also require aggregates like axles, engines, gear boxes and cabs for our vehicles, which are manufactured by us or by our subsidiaries, affiliates or strategic suppliers. Close to 80 percent of the parts in our vehicles are made at our vendor's end and assembled in our plants. Use of alternative material has been a key focus area for our ERC department over the years. This year they have reused 37,373 tonnes of metal scrap and forgings in our process thereby avoiding use of virgin material. Jute and polypropylene based composite was used for the first time for headlining application on Tata Nano as a replacement to glass fibres. Jute fibres are safe for handling and have lower life cycle energy consumption as compared to glass fibres.

Increasing life of aggregates – 'Recon' business their reconditioning business was started to service customers who require an over hauling of aggregates. Instead of going to a local mechanic workshop, the customer can approach any of our designated channel partners and exchange the failed vehicular aggregate assemblies for are conditioned one, thereby avoiding a complete overhaul. This also ensures that the customer is assured of better quality and a renewed warranty for their conditioned part. This has enabled us prevention of pollution and continual improvement in environmental performance. This policy comprehensively addresses the need to conserve natural resources and energy, minimize waste generation, and enhance recovery and recycling of reused 37,373 tonnes of metal scrap and forgings in our process thereby avoiding use of virgin material.

Reasons why these cases were attractive to be included:

- Majority of companies are publishing their sustainability report.
- Majority of companies have significant role in Indian manufacturing industry.
- Significant evidence of sustainable supply chain management practices.

- Cases considered under this study covered sustainability issues i.e social, environment, economic performance.

CHAPTER 6

Conclusions and Future Scope

The study sought to analyze the current scope of Sustainable supply chain management practices in Indian Manufacturing Industries. During the research, it was observed that organizations have started working towards enhancement of sustainable supply chain management systems in India.

The most important aspect is that more organizations must realize the fact that sustainability measures and declarations would genuinely do good to them and would not only be beneficial for their businesses but also for the life span of their organizations which actually would have an enhanced effect, which is strengthened by the fact that, the study has tried to outline that the awareness and importance given to sustainability in manufacturing companies is accepted or tested positively.

Parameters of sustainability may be formalized and universalized as per the need but doesn't seem to be the utmost requirement at this moment.

The detailed systematic literature review and discussions held with professionals, and academicians supported the decision on the study variables. Following this, the scales were developed to find the antecedents through pilot study conducted among first 50 responses. After establishing valid scales, data was collected from 101 middle and top level executives having experience in the area of supply chain management in manufacturing companies in India.

From the collected data, factor analysis and Discriminant analysis was carried out to accomplish the stated objectives of this study. Factor analysis was conducted to propose factor structure as well as for acceptable statistical validation and results.

For supply chain management policy Cronbach alpha (α), Bartlett's test of sphericity, KMO, and significance level are 0.896, 0.841, 686 and 0.000 respectively. For Plan, Source, Make, Deliver, and Return Cronbach alpha (α), KMO, Bartlett's test of sphericity and significance level are 0.95,0.793,4195,and 0.000 respectively. For environmental impacts Cronbach alpha (α), KMO Bartlett's test of sphericity and significance level are 0.859, 0.821, 465 and 0.000 respectively. For social

sustainability & business opportunity development Cronbach alpha (α), KMO, Bartlett's test of sphericity and significance level are 0.896, 0.809,999, 0.000 respectively. From the above results value of cronbach's alpha (α) for all the tested items is exceeded the more than 0.8 for each of the item tested which is acceptable from the previous studies (Zhu and Sarkis,2007). The lower limit of 0.6 is considered acceptable for newly developed scales and 0.7 for established scales (Carmines and Zeller, 1979, Nunnally, 1994).

Besides the reliability and validity of the scales, the normality and outliers are tested by using Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy and Bartlett test of sphericity. KMO is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Small values of KMO indicate that a factor analysis of the variables may not be a good idea, because correlations between pairs of variables cannot be explained by the other variables.

A minimum KMO score of 0.50 is considered necessary to reliably use factor analysis. Bartlett test of sphericity is used to test whether the correlation matrix is an identity matrix. If it is close to an identity matrix, the variables are not correlated with each other. Therefore, the desirable test significance level is smaller than 0.05. (Kaiser,1974) In present research all KMO scores are larger than 0.7.

Similarly, all Bartlett tests of sphericity have significance levels of $p<.001$. Both results show that it is appropriate to perform the factor analysis with the data set hence projected factor analysis results have significant importance.

Factor analysis gave an impetus towards the process of extraction and clubbing the factors in meaningful smaller groups.

Four factors are extracted out of sixteen by using Factor analysis (FA) which are considered in the supply chain policy of the organizations participated in the present research are: customization, flexibility, sustainable partnership integration, supply chain surplus (profitability).

FA has extracted twelve factors from fifty two items in Supply chain performance with sustainability Reliability and unidimensionality of all factors was established. These factors are named as: distribution management, customer relationship, supplier relationship management, manufacturing strategy, logistics

drivers, costing, cash, purchasing operations, delivery costs, storage, batch sizing and inventory management.

Three factors out of ten are extracted, through FA, for environmental impacts and are named as planet perspective (ground water pollution, packaging material and solid waste), people perspective (supply chain activities, production processes) and profit perspective (eco friendly transportation system, scarcity of raw material resources). All the factors are found to have better acceptable level of reliability and KMO.

Four factors out of eighteen items are extracted through FA and are named as community, safety, product responsibility and sustainable business opportunities. All factors are found to have better acceptable level in terms of reliability and KMO.

Discriminant analysis: From the summary of canonical discriminant functions for different items in the questionnaire it is observed that the chi-square value, degrees of freedom and significance level in all the cases is acceptable. The two subgroups i.e. companies publishing the sustainability report and companies not publishing their sustainability report discriminate each other. Thus, these findings provide strong support for concerned hypotheses.

For accomplishing the fourth research objective ten companies which have adopted best practices in their supply chain system amongst Indian manufacturing companies with sustainability perspective were observed and studied as cases.

Selected ten companies which are publishing their sustainability reports from last three years are Mahindra & Mahindra, GMR, Nestle India, Nokia, Saint Gobain glass India limited, Planet Ke Rakhwale, Tata motors limited, Hero Motocop limited, and Hindustan Unilever limited.

Companies chosen for interpreting triple bottom line of sustainability (People, Planet, Profit) practices concerning supply chain in Indian manufacturing companies.

First finding is People perspective all the companies considered in this study are highly concerned about society and contribution as social responsibility through vocational training, health care, safety, environmental issues and rural development.

Few companies are practicing the concept of reuse, recycle, take back and optimization of packaging materials which fall under the dimension category i.e planet concern. As part of green initiatives some companies advocate in avoiding the usage of harmful substances for the manufacturing processes.

Reduction of green house gases from manufacturing, transport, refrigeration, avoidance of employee travel as one of the best sustainable practices under planet perspective by few companies considered in this study.

Majority of companies which participated in this study are evaluating the environmental performance of even their vendors and also participate in the various training programs on environmental issues of SCM

Sustainable supply chain management systems must have models to follow and measures and procedures may also be shared through formal and business arrangements amongst the organizations.

There should be methods of examining and stating tangible and comparative benefits to establish the strengths of sustainable supply chain management systems.

Though the findings are that using environmental friendly transportation system costs additionally, but still they would pursue such measures.

Majority of the companies agreed about the scarcity of raw material resources being used by their organization for next ten years and also majority of the companies are practicing the concept of landfill for solid waste management which is a sustainable practice in manufacturing companies.

Manufacturing costs, distribution cost, supplier selection have significant role in improving SCM performance. Positive impact on environment by the companies practicing the SCM sustainability is significantly larger. Sustainability with respect to business opportunity development in terms of cleaner development mechanism is practiced by major companies, which is a very positive sign suggestive of the fact the business opportunity is an incentive for the organizations for following the sustainability norms.

Awareness about carbon trading scheme is higher among the manufacturing companies though could not efficiently implemented in the light of the absence of government regulations. The positive part is that few companies are practicing the emissions disclosure through the carbon disclosure project.

Safety and health issues of employees, laborers, surrounding communities are highly being considered by majority of the companies which is a good social performance indicator under social sustainability.

During this research we have also found that sustainability issues are not only limited to the supply chain of specific manufacturing industries but it can also be adopted / practiced in the different supply chains like Food Products, Agri business, Garments etc.

Sustainable supply chain management systems have to be popularized as a movement, which always would take place in the light of the fact that in globalized scenario, most of the organizations somehow get associated within a larger system, but the question is that do we have that much of time and if not then it's a matter of creating a well crafted uniform strategy and an integrated environment to propel the adoption and development of SSCM systems.

Factors effecting or influencing success to implement measurement systems for supply chains in financial perspective considering the data from financial statements have been investigated. A key performance indicator for supply chain, financial flows have a significant role in internal benchmarking. Forecasting accuracy is also one of the success factors affecting supply chain performance. By using the suggested methodology for internal benchmarking of supply chain performance measures it has been found that the frequency of conducting the internal bench marking of supply chain performance is at least three years with reference to the organizations considered, however the quantitative analysis of data only should not be considered in making managerial decision making as many factors effect ground reality. With reference to the organizations considered under this study as financial perspective; day's payables outstanding, day's sales outstanding which are financial performance metrics fall under the category of sourcing and pricing respectively. Sourcing and pricing are the two key logistics drivers which play a significant role in internal supply chain decision making frame work.

Limitations of the study

The first limitation of this research study is the collection of the data. Sincere attempt has been made in data collection through e-mail, web links and personal interaction but relatively sample size was small. Also, the authenticity of the respondents' functional area of study variables, particularly sustainable supply chain management is very limited in manufacturing sector. This has affected the magnitude and quality of responses to some extent.

Scope for application of statistical tools tests for this study is an attempt based on the similar studies in the subject area focusing on different variables. It is also not out of place that that the research related to the parameters considered in this study is very restricted concerning Indian manufacturing companies. Finally, the diversification among the sizes of manufacturing companies choosen for unit as analysis is a matter of concern for these findings.

Further Research

For further study, the research itinerary can be broadened as follows: First, the survey instrument should be strengthened and refined. Studies on sustainable supply chain management are still making initial efforts in developing proper measurements on the Indian perspective. Enhancing good estimation tools on SSCM is critical, especially for Indian manufacturers. Due to the dearth of information, Indian companies will be in the need of self diagnostic tools to check their environmental management capabilities. Academic research should provide such diagnostic tools or a checklist to help the firms identify their problem areas and create solutions. Second, repeating this study for comparative analysis in different industries as well as in different countries will be another research direction.

We can compare distinctions such as which factors are more robust in distinctive industries or in different countries.

Third, a new research project can add new constructs such as training or management support. Training has been an important variable for studies about adoption of new technologies or systems (Lee et al., 2007).

Appendix –I

Kottala Sriyogi
Research Scholar
Department of Management Studies
Indian Institute of Technology, Roorkee
Roorkee 247667,Uttarakhand

Roorkee
Dt

Dear Participant,

I am a research scholar pursuing research in the area of sustainable supply chain management (SSCM) at the Department of Management Studies, Indian Institute of Technology, Roorkee.

As part of my doctoral research, I have designed a questionnaire to collect responses from industry on various aspects of SSCM. The responses given by you will provide insight into the understanding and analysis of the sustainable supply chain management practices in Indian manufacturing industries.

The information provided by you will be used for academic purpose only and will be reported as statistical summaries. Please be assured that your personal information will be strictly confidential.

Your participation will be greatly appreciated.

Enclosed is a questionnaire that we are asking you to complete. The questionnaire has 17 questions, and is divided into three sections. The questionnaire is very brief and will take about 15-20 minutes to fill out. Instructions for completing the questionnaire can be found on the form itself. We would appreciate if you would complete the questionnaire through 'Google Spreadsheets', as soon as possible, preferably within the next week.

Your participation represents a valuable contribution to sustainable supply chain management research, and I thank you again for your cooperation.

If you have questions while filling the questionnaire, please email kottalasriyogi@gmail.com or skr09ddm@iitr.ernet.in. You may also contact me at **09045609654** with any questions or concerns**.**

Yours Sincerely

Kottala Sriyogi

Survey Questionnaire

The nature of the business is fast changing. Continous changes in environment, technology, markets are forcing business organizations to adapt these changes by bringing new products or processes. Researchers have given the term "sustainability" to decide the long term success of business organizations with respect to environment, social and economic dimensions. The current study is an attempt to identify sustainable supply chain management practices in Indian manufacturing industries and their relation with the performance of the supply chain.

Section I: Profile of the Company

1. Year of establishment _____
2. Nature of ownership: □ Private □ Public limited □ Public sector
3. Does an MNC or foreign company have an equity stake of 50% or more?
   □ Yes □ No
4. No of employees :
   - □ 1-99
   - □ 100-499
   - □ 500-999
   - □ Greater than 1000
5. Industry :

   □ Engineering □ Automobiles □ Petroleum □ Fertilizer
   □ Power □ Electronics □ Pharmaceutical □ Steel
   □ Cement □ Consumer □ Textiles □ Agro-based
   □ Chemical □ Others_____

Section II General understanding about organization.

6. Write the extent of your agreement about your company's supply chain policy giving importance to

1	2	3	4	5
Extremely unimportant	Not so important	Important	Very Important	Extremely Important

S.No						
1.	Cost cutting	1	2	3	4	5
2.	Responsiveness	1	2	3	4	5
3.	Customization	1	2	3	4	5
4.	Lead time reduction	1	2	3	4	5
5.	Low inventory	1	2	3	4	5
6.	Strive for sustainable partnership integration	1	2	3	4	5
7.	Customer satisfaction	1	2	3	4	5
8.	Supply chain surplus (Profitability)	1	2	3	4	5
9.	SCM leverage	1	2	3	4	5
10.	Distribution channel strategy	1	2	3	4	5
11.	Reliability	1	2	3	4	5
12.	Information sharing	1	2	3	4	5
13.	Flexibility	1	2	3	4	5
14.	Capacity utilization	1	2	3	4	5
15.	Asset turnover	1	2	3	4	5
16.	Low waste	1	2	3	4	5

7. Do you ensure any of the following environmental compliance in your organization?

   - ☐ ISO 14000 Certification
   - ☐ Carbon Disclosure Project
   - ☐ Certification from CPCB
   - ☐ Any Others: _____

8. Do you evaluate environmental performance of your vendors?

   ☐ Yes ☐ No if yes please answer to the question Number 9 or go to question number 10.

9. What criteria would you use when evaluating the environmental performance of your suppliers?

   - ☐ The status of ISO 14001 implementation
   - ☐ Corporate philosophy and environmental policy
   - ☐ Organisation structure for environmental management and planning
   - ☐ Environmental impact assessment of their products and materials
   - ☐ Environmental education and disclosure of information
   - ☐ Reduction of chemical substances

10. Did you ever attend any of the following programs on sustainability or environmental issues in Supply chain management?

    - ☐ Training program
    - ☐ Workshop
    - ☐ Conference
    - ☐ Seminar
    - ☐ None of the above

11. Do you have a system of Waste Recycling in your organization?

    ☐ Yes ☐ No

12. Do you follow green labeling ☐ Yes ☐ No

13. Do you practice any energy efficiency program in your organization?

    ☐ Yes ☐ No

Section III SUSTAINABILITY ISSUES

14. Your organization is practicing sustainability concept. The Supply chain performance is closely linked with sustainability. The areas of Supply chain where concept of sustainability has significant contribution in improvement are listed below. Write your choice from 1 to 5 with respect to a particular area of SC improvement and concept of sustainability.

1	2	3	4	5
Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

S.No	PLAN					
1.	Information carrying cost	1	2	3	4	5
2.	Over head cost	1	2	3	4	5
3.	Intangible cost	1	2	3	4	5
4.	Total supply chain response time	1	2	3	4	5
5.	Total supply chain cycle time	1	2	3	4	5
6.	Order lead time	1	2	3	4	5
7.	Customer response time	1	2	3	4	5
8.	Total cash flow time	1	2	3	4	5
9.	Cash – cash cycle time	1	2	3	4	5
10.	Order entry methods	1	2	3	4	5
11.	Order flexibility	1	2	3	4	5

	SOURCE					
1.	Supplier cost-saving initiatives	1	2	3	4	5
2.	Supplier's booking-in procedures	1	2	3	4	5
3.	Purchase order cycle time	1	2	3	4	5
4.	Efficiency of purchase order cycle time	1	2	3	4	5
5.	Buyer-supplier partnership level	1	2	3	4	5
6.	Supplier rejection rate	1	2	3	4	5
7.	Mutual trust	1	2	3	4	5
8.	Satisfaction with knowledge transfer	1	2	3	4	5
9.	Satisfaction with supplier relationship	1	2	3	4	5
10.	Supplier assistance in solving technical problems	1	2	3	4	5
11.	Timely availability of accurate information	1	2	3	4	5
12.	Supplier ability to respond to quality problems	1	2	3	4	5

	MAKE	1	2	3	4	5
1.	Manufacturing cost	1	2	3	4	5
2.	Work in process	1	2	3	4	5
3.	Inventory cost	1	2	3	4	5
4.	Inventory turnover ratio	1	2	3	4	5
5.	Inventory days of supply	1	2	3	4	5
6.	Economic order quantity	1	2	3	4	5
7.	Warehouse costs	1	2	3	4	5
8.	Disposal costs	1	2	3	4	5
9.	Planned process cycle time	1	2	3	4	5
10.	Manufacturing lead time	1	2	3	4	5
11.	Production flexibility	1	2	3	4	5
12.	Volume flexibility	1	2	3	4	5
	DELIVER	1	2	3	4	5
1.	Total logistics costs	1	2	3	4	5
2.	Distribution costs	1	2	3	4	5
3.	Delivery costs	1	2	3	4	5
4.	Transport costs	1	2	3	4	5
5.	Delivery efficiency	1	2	3	4	5
6.	Delivery lead time	1	2	3	4	5
7.	Delivery reliability	1	2	3	4	5
8.	Quality of delivered goods	1	2	3	4	5
9.	Quality of delivery documentation	1	2	3	4	5
10.	Frequency of delivery	1	2	3	4	5
11.	Delivery flexibility	1	2	3	4	5
12.	Transport flexibility	1	2	3	4	5

	RETURN					
1.	Warranty/returns processing costs	1	2	3	4	5
2.	Customer response time	1	2	3	4	5
3.	Level of customer perceived value of product	1	2	3	4	5
4.	Customer complaints	1	2	3	4	5
5.	Rate of complaint	1	2	3	4	5

15. **<u>Underline</u> the extent of your agreement with the following statements.**

1	2	3	4	5
Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

S. No	**Environmental Impacts**					
1.	The level of gaseous emissions from your organization negatively affects the environment	1	2	3	4	5
2.	Your organization's liquid Waste discharge affects the ground water level.	1	2	3	4	5
3.	Solid waste from your organization have negative effects on the environment.	1	2	3	4	5
4.	Using environmental friendly transportation system costs additionally.	1	2	3	4	5
5.	Your organization practices the concept of landfill for solid waste mass management?	1	2	3	4	5
6.	Your perception about the scarcity of raw material resources being used by your organization in next 10 years?	1	2	3	4	5
7.	Usage of Products manufactured by your organization have negative impact on the environment?	1	2	3	4	5
8.	Packaging material which is being used by your organization has negative impact on the environment.	1	2	3	4	5
9.	The Production process in your organization affects employees	1	2	3	4	5
10.	The activities in your Supply chain affects the people around your organization.	1	2	3	4	5

16. Kindly **circle your choice [1/2/3/4/5]** about the extent of your agreement with the following social sustainability indicators which your organization involve in as a part of social sustainability.

1	2	3	4	5
Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

S. No	**Social Performance**					
1.	Patient care	1	2	3	4	5
2.	Education	1	2	3	4	5
3.	Livelihood	1	2	3	4	5
4.	Community care	1	2	3	4	5
5.	Disaster Relief	1	2	3	4	5
6.	Human Rights	1	2	3	4	5
7.	Product Responsibility	1	2	3	4	5
8.	Vocational Training	1	2	3	4	5
9.	Product Stewardship	1	2	3	4	5
10.	Social Accountability	1	2	3	4	5
11.	Safety and health issues of employees	1	2	3	4	5
12.	Safety and health issues of surrounding community	1	2	3	4	5
13.	Safety and health issues of labourers and transporters	1	2	3	4	5

17. Kindly **circle your choice [1/2/3/4/5]** about the extent of your agreement with the following as a business opportunity due to the implementation of sustainability practices in your organization as a business development.

1	2	3	4	5
Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

S. No	**Business opportunity Development**					
1.	New products	1	2	3	4	5
2.	New processes	1	2	3	4	5
3.	Green Technology	1	2	3	4	5
4.	Cleaner development Mechanism	1	2	3	4	5
5.	Carbon trading	1	2	3	4	5

Please fill in the box below OR attach your visiting card to this sheet.

Name	
Designation	
Company	
Address	
Phone	
Fax	
Email	

APPENDIX – II

For calculating different parameters under proposed methodology: Internal benchmarking for sustainable supply chain performance

List of parameters considered and obtained from the financial statements is as presented

Terms	Expressed as
Cost of raw materials	CRM_i
Cost of distribution	DC_i
Cost of production	CP_i
Cost of sales	CS_i
Net Sales	NS_i
Inventories (Inclusive of raw materials, Semi finished goods and finished goods)	I_i
Raw materials inventory	RM_i
Semi finished goods inventory	SFG_i
Finished goods inventory	FG_i
Accounts receivables	AR_i
Accounts payable	AP_i

Model Calculations, Formulae and assumptions used for Company A :

A. Cost of Sales = Total expenses[1] - other operational exp. of indl. Enterprises[1] -

Other oper. exp. of non fin. service enterprises[1].-------- (i)

B. Cost of production = cost of sales-indirect tax-selling and distribution expenses ---(ii)

C. WACC = $\frac{[(\text{Cost of Debt} \times \text{Total Borrowings}) + (\text{Cost of Equity}) \times (\text{Net worth})]}{[\text{Net worth} + \text{Total Borrowings}]}$ ---(iii)

Cost of Debt = [Total borrowings/Short Term borrowings] ------ (iv)
Cost of Equity = [Provisions / Net worth]-------- (v)
Net sales (Total Income[2])
Income from operations (Sales[2])
Non operating Income (Income from financial services[2])
Accounts Receivables (Sundry Debtors[2])
Provisions (Current Liabilities)
Total Borrowings (Liabilities)
Accounts Payables (Sundry Creditors[2])
Inventories (Inclusive of raw materials, Semi finished goods and finished goods) {From Balance sheet under currents assents}
Raw materials inventory[3] {From Balance sheet under Total expenses}

[1] As quoted in Balance sheet under the subheading Total expenses is considered to calculate cost of sales

[2] As quoted in Balance sheet under the subheading Total income

Semi finished goods inventory[3]

Company A	**2010**
Rs. Crore (Non-Annualised)	
Interest paid	138.05
Net worth (NW)	6469.49
Total borrowings (TB)	523.82
Short term bank borrowings	9.93
Interest accrued	7.33
Provisions	1652.46
Cost of debt (COD)	0.018956894
Cost of equity(COE)	0.255423534
NW+TB	6993.31
COD*TB+COE*NW	1662.39
WACC	0.23771147
	23.771147
Paid up equity capital (net of forfeited capital) PUEC	187.75
COD*TB+COE*PUEC	57.88576854
TB+PUEC	711.57
WACC	**23.77**

Terms		**2010 (Rs. Crore)**
Cost of Raw Materials	CRM_i	1134.5
Cost of Distribution	DC_i	12241
Cost of Production	CP_i	5489.01
Cost of Sales	CS_i	7984.25
Inventories	I_i	7789.8
Net Sales		9048.61
Raw Materials Inventory	RM_i	920.5
Finished goods Inventory	FG_i	880.8
Semi finished Goods Inventory	SFG_i	1689.6
Accounts receivables	AR_i	3486.4
Accounts payable	AP_i	1461.54
WACC/ICC		23.77

Stage : 1 Calculation of the Length of various stages of the chain

	2010 (In days)
Length of Raw material Stage (DRM= RM_i *365)/ CRM_i	296
Length of WIP stage DWIP (SFG*365)/CP	112
Length of Finished Goods Stage DFG=(FG*365)/CS	40
Total Length	448

Step: 2 Calculation of cost addition at various stages

	2010 (Rs. Crore)
Cost at the beginning of the raw material stage CRM_i	1134.5
Cost addition in the raw material stage Δ RM=RM*ICC	43760.57
Cost addition in the finished goods stage i.e Δ FG= FG *ICC	20937
Cost at the end of the raw material stage CRMS(I)=CRM+ Δ RM	49646367
Cost at the end of WIP stage i.e $CWIPS_i$ = CP	5489.01
Cost at the end of finished goods CFGS(I) = $CWIPS_i$ + Δ FG	26425.63

Stage 3: Calculation of normalization

	2010 (Rs. Crore)
Normalized costs of raw material CRW=CRM/CFGSI	0.042932
Normalized cost at end of RM stage	0.99998
Normalized cost at end of the WIP stage	0.000111

Stage: 4 Calculation for analysis of internal supply chain management efficiency

	2010 (Rs. Crore)
Cost of holding inventory for time period CI= I_i * ICC	185163.5
Internal Supply chain management costs for time period ISCC= DC+CI	197404.5
Internal supply chain inefficiency ratio ISCI = ISCC/NS	21.81601
Internal supply chain working capital (C-2-C cycle) ISWC = I+AR-AP	9814.66
Internal supply chain working capital ISWCP=NS/ISCW	0.921948
Days payables outstanding(AP/AR)* 365	153
Days sales out standing (AR/Annual Revenues)* 365	141

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List of Publications:

- Kottala,S. (2012), "Internal benchmarking of supply chain performance measures evidence from selected organizations", *The IUP Journal of Supply Chain Management,* Vol. 9 No.1, pp. 40-71.
- Kottala,S. Agarwal, R. and Sharma,V. (2012),"Sustainable supply chain management practices : Evidence from selected Indian manufacturing companies", 6th ISDSI International Conference on "Decision Sciences for Performance Excellence" to be held on 27-29 Dec 2012 at ICFAI Business School Hyderabad.*(Accepted for presentation)*