

## Synopsis

# A SUSTAINABLE SUPPLY CHAIN MANAGEMENT FRAMEWORK FOR IT PRODUCTS: AN EXPLORATORY STUDY

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## **1. INTRODUCTION**

The way the business is done at present has undergone radical change due to globalization, outsourcing, intense competition and changing markets, use of technology and increasing expectations of consumers. The increasing focus on environmental and social issues has made the business environment more dynamic and complex. The focus has shifted from a single organization to a network of organizations collaborating together to provide real-time solutions. Integration of business activities and collaboration with upstream and downstream partners has become an integral part of doing business. Organizations realized the importance of integration and collaboration among the partners (Mentzer, et al., 2001), (Cousins & R. Spekman, 2003), (Chow, et al., 2006), (Lambert, 2008) for efficient and economic utilization of resources leading to the idea of Supply Chain Management (SCM). As the supply chain became more and more complex, it entailed measurement of its performance on different parameters. Sink and Tuttle (1989) claim that “you cannot manage what you cannot measure”. Measurement of supply chain processes and their benchmarking is essential for improving the efficiency and effectiveness of supply chain management. Various performance measurement systems (Beamon, 1998), (Kaplan & Norton, 1992), (Saad & Patel, 2006), (Gunasekaran & Kobu, 2007), (SCC, 2010) were implemented across industry with varying degree of success. Thus for any business organization, measurement of its supply chain performance becomes critical and necessitates a robust performance measurement system.

Recently, the concept of Supply Chain Management (SCM) has embraced the concern for environmental degradation and social responsibility; and the business community apart from reporting on economic parameters, has included environmental and social aspects also. As the environment has become a global concern, governments have started framing rules and business firms have started making their supply chains ‘greener’ by introducing new ideas in their organizations and also to their supply chain partners. Green supply chain management (GrSCM) (Hervani, et al., 2005), (Fortes, 2009), (Srivastava, 2007), (Gupta, et al., 2013), addressed the issues of manufacturing environment friendly products, reverse logistics (Carter & Ellram, 1998), (Dowlatshahi, 2000), (Kopicki, et al., 1993), (Beamon, 1999) (Thierry, et al., 1995), E-waste management, (Dhanda & Peters, 2005), (Fortes, 2009), and ‘end of life’ management (Hervani, et al., 2005), (Zhu, et al., 2010).

The issues such as human rights and safety of the workers as well as of the society at large and concern for enhancing the quality of life also began to appear centre stage in the global outlook and the business community is also not unaffected by it. The concept is rapidly being adopted by the supply chain managers, and organizations have begun reporting on the triple parameters of economic performance, environmental safety and social welfare (Elkington, 1998), (Carter & Rogers, 2008), (Spreckley, 1981 ). This inclusiveness of ideas to SCM is being deliberated by the researchers as Sustainable Supply Chain Management (SSCM). The whole idea is to develop sustainable supply chains which reduce costs as well as help the environment and the society. A sustainable supply chain is a supply chain that is not only optimal for the focal firm, but is optimal relative to its environmental and societal impact.

### **1.1. Rationale of Research**

Supply chains of IT hardware industry are peculiar in nature and are influenced by the innovative nature of its products; reverse logistics procedures required to reuse, refurbish, recycle and cannibalize electronic equipments; and green supply chain initiatives to handle the amount of e-waste generated due to the fast obsolescence. With the enhanced emphasis on 'e-waste' management, the Government of India formulated E-Waste (Management and Handling) Rules 2011 which came into effect on May 1, 2012 for Waste Electrical and Electronic Equipment (WEEE) provisions, and Restriction of Hazardous Substances (RoHS) provisions which were to be enforced from May 1, 2014. Ministry of Corporate Affairs came out with the 'National Voluntary Guidelines (NVG) on Social, Environmental and Economic Responsibilities of Business' and Securities and Exchange Board of India (SEBI) has mandated inclusion of 'Business Responsibility Reports' as part of the Annual Reports for top 100 listed entities based on market capitalisation at BSE and NSE as on March 31, 2012.

Growing concern from civil society, investors and the local authorities has motivated the organizations to improve their corporate image. Global sustainability watchdogs such as Dow Jones Sustainability Indexes and Global Reporting Initiative provide standards for sustainability best practices. By reporting transparently and with accountability, organizations can increase the trust that stakeholders have in them, and in the global economy. Ethical business practices are highlighted as part of this exercise. Transparency in work culture, providing equal opportunity of employment, compliance with regulations and fair implementation of policies and procedures has become noticeable assets and add to the goodwill. Organizations have to be accountable for the actions as part of their business

operations which have a negative impact on the natural resources as well as human resources. Contributing to the social justice, upholding of the human rights, discouraging child labor, handling layoffs and worker disputes, and providing relief during catastrophic disasters are few performance measures for sustainability. Cleaner sources of energy and efficient utilization of using existing processes provide cost benefits along with reducing emission of greenhouse gases. Innovations in manufacturing processes and reduction of hazardous substances help reducing the negative effect on the environment. Rules and regulations formulated and implemented by many governments have encouraged protection of environment as well as community development as part of corporate partnership.

Above mentioned arguments induced the researchers to develop more inclusive framework for supply chain management for addressing not only the economic concern but also the concern for environment and social issues. From the existing literature, it can be observed that the issue of sustainability in supply chain is a recent phenomenon and researchers are suggesting conceptual frameworks and factors to be included for developing SSCM. Sustainable practices that work for one industry may not work for other industries, and the topic being at a nascent stage, no researcher has made an attempt to develop industry specific framework for SSCM. All the researches reviewed on the issue of SSCM proposes framework; but none of them is specific to IT industry or have made an attempt to develop suitable metric and performance measures of SSCM. Considering the current dynamic and ever changing scenario of sustainable supply chain management, it is imperative to develop a suitable sustainable supply chain framework, metric and performance measures for the Indian IT product industry, which caters to the needs of developing nations such as India considering indigenous economic, environmental, social and cultural factors.

## **1.2. Objectives of the Research**

Objectives of the study are as follows:

1. To study the supply chain practices with reference to sustainability parameters in select IT companies.
2. To develop a sustainable supply chain management framework for IT product companies.
3. To develop metric for proposed sustainable supply chain management framework.
4. To develop sustainable supply chain management performance measures for IT product manufacturer.

5. Verification and testing of sustainable supply chain management framework, metric and performance measures with select IT product companies.

## **2. OVERVIEW OF INDIAN IT INDUSTRY**

The Information Technology (IT) is the world's largest and fastest growing industry. IT is increasingly finding applications in all sectors of the economy and thus is accepted as a key enabler in development [1]. The rapid emergence of the Information and Communication Technology (ICT) sector has placed India on the global stage during the last one and a half decades [2]. The IT industry is broadly categorized into IT services and software, Information technology enabled services-business process outsourcing (ITeS-BPO) and IT hardware products segment. [2]. IT Hardware segment includes personal storage devices, printers, servers, Personal Computers (PCs), supercomputers, data processing equipment and peripherals such as monitors, keyboards, disk drives, plotters, SMPS, modems, networking products and add-on cards [3].

The share of hardware in total IT spending is expected by BMI to remain above 50% during the 2012-2016 forecast period. BMI forecasts the PC market will grow at a CAGR of 22% between 2012 and 2016. Overall, the hardware market is predicted to grow from an estimated US\$9.3bn in 2012 to US\$16.0bn in 2016, with PC sales including accessories projected to rise from an estimated US\$7.6bn to US\$13.0bn over the same period. Annual PC sales were estimated at 11.8mn units in 2011 and could rise to more than 30mn by 2016.

## **3. LITERATURE REVIEW**

Literature review helped to identify, appraise, select and synthesize all high quality research evidence relevant to supply chain management. Ever since 1982, when Keith Oliver used the term Supply Chain Management(SCM) for the first time, researchers and practitioners have contributed and developed the concept to great significance. Literature review facilitated to categorize research articles on supply chain optimization, integration, restructuring, performance, efficiency, environment and social parameters. It also provided evidence that the growing importance to environment and social issues are incorporated in supply chain research leading to the concept of Green Supply chain Management and Sustainable Supply Chain management.

The literature review on the related topics of SCM and sustainability helped to identify, appraise, select and synthesize all high quality research evidence, summarized in the Table 1 below.

S.No	Topic	Author
1	SCM	Beamon, 1998; Mentzer et al., 2001; Fleischmann et al., 2002; Olhager, et al., 2002; Cousins & Speckman, 2003; Chow, et al., 2006; Lambert, 2008; Naslund & Williamson, 2010; Stock & Boyer, 2009
2	Performance Measurement in SCM	Kaplan & Norton, 1992; Beamon, 1998; Gunasekaran et al., 2001; Singh & Shah, 2001; Saad & Patel, 2006; SCOR Model 10.0, 2010
3	Reverse logistics, Product 'End of life'	Kopicki, et al., 1993; Thierry, et al., 1995; Carter and Ellram, 1998; Beamon, 1999; Dowlatshahi, 2000; Dhanda & Peters, 2005; Zhu, et al., 2007; Zhu, et al., 2010
4	Green SCM	Guide & Srivastava, 1998; Hervani, et al., 2005; Srivastava, 2007; Srivastava, 2007; Fortes, 2009; Ninlawan, et al., 2011; Gupta, et al., 2013
5	Supply Chain Innovation	Schumpeter, 1934; Eric von Hippel, 1988; OECD Oslo Manual, 2005; Storer & Hayland, 2009; Pagell & Zhao, 2009; GRI, 2011
6	E-waste management	Roy & Whelan, 1992; Barve & Muduli, 2011; Dhanda & Peters, 2005; Fortes, 2009;
7	Sustainability	Spreckley, 1981; Brundtland Commission, 1987; Rio Summit, 1992; O'Connor, 1994; New, 1997; Rao & Holt, 2005; Carter & Rogers, 2008; Seuring & Müller, 2008; Pagell & Zhao, 2009; Mann et al, 2010; Ramudhin, et al., 2010; ISO 26000: 2010; Silvius, 2010; GRI, 2011; Dey et al, 2011; Hassini et al., 2012;

**Table 1: Literature Review**

The above literature review traces the origin of concept of SCM, its performance measure, and different related disciplines researcher have explored during its evolution over the years. The review has revealed four distinct branches of SCM research, viz. Planning and Designing SCM, Performance Measurement, Green Supply Chain Management, and Sustainable SCM. Contrary to concept of supply chain, researchers also suggested Demand Chain Management (DCM) in order to sense and proactively manage the demand of the innovative products which have shorter lifecycle and demand uncertainty due to their innovative nature. The aim of supply chain management is to integrate the processes in a supply chain for efficient utilization of resources and reduction in costs, leading to shareholder's profit maximization.

However, the concept of stakeholder's theory (Freeman, 1984) demands that a company's responsibility lies with stakeholders rather than shareholders. Supply chain processes involve exploitation of natural resources as well as the human capital. Thus the stakeholders in a supply chain would include the society as well as the ecological environment. The idea of integrating social and environmental factors to economic activity is termed as sustainability. Sustainable supply chain management would include the economic responsibility as a base level of a supply chain's responsibility.

Organization's innovation capabilities and its alignment towards environmental, social and economic goals lead to an economically viable as well as sustainable supply chain (Pagell & Wu, 2009). Thus sustainability can be achieved by supply chains which are innovative, are environment conscious and have social objectives as one of the basis of doing business. The operational definition of SSCM formulated and utilized in this study is "*Managing network of all actors in a supply chain to improve economic performance and to achieve environmental and social sustainability through innovations*".

#### **4. METHODOLOGY**

The **research design** for this study is primarily exploratory in nature. The study identifies the key dimensions and factors to develop framework, metric and measures on all dimensions of sustainable supply chain. These investigations were carried at three levels, *viz.* literature review, academicians review and practitioner's review, to analyse, discuss, integrate and arrive at SSCM framework for IT product companies.

**Integrative Literature Review:** An integrative literature review is a form of research that reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated [4]. Focussed integrative literature review of existing frameworks of SSCM helped in identifying the dimensions and factors used in the frameworks and also to identify the scope for improvement. Integrative literature review has provided an opportunity to assimilate these perspectives to develop the framework for SSCM.

**Case Study Method:** Considering the nature of the study, an exploratory research design in the form of a case study method is employed. The exploratory case study method is used to study the phenomenon of sustainability in supply chain in its contextual conditions and tries to answer the 'what' question. Specifically, the guidelines for good case study design and

conduct provided by Yin (1994) was used to consider six IT product companies as a case study.

**Sampling Design:** The member companies of Manufacturer's Association of IT companies (MAIT) having manufacturing facilities in the hardware segment in the financial year 2011-12 was considered as sampling frame for this research. The total members of MAIT in this financial year were 75, out of which 41 members were companies having manufacturing facilities in India, which were divided into three categories of large, medium and small sizes based on their turnover. A turnover of more than Rs.1000 Crores is considered as large size company, a turnover of more than Rs.200 Crores but less than Rs.1000 Crores as medium size and less than Rs. 200 Crores as small size companies respectively. This categorization was in line with NASSCOM and puts 21 companies in large scale, 14 in medium scale and 6 in small scale category. Considering judgment sampling technique, on the basis of level of sustainability initiatives taken and willingness to cooperate, three companies each from large and medium scale categories were selected as a case study. Considering the objectives of the study and case study approach to study the SSCM practices, developing framework, metric and measures and to verify the results, a sample size of three companies from each category is well justified.

**Experience Survey:** Churchill (1979) defined experience surveys as discussions with "a judgment sample of persons who can offer some ideas and insights into the phenomenon". Several other researchers (Gerbing and Anderson 1988, Dunn, Seaker, and Waller 1994, Bienstock, Mentzer, and Bird 1997, Min and Mentzer, 2004) recommended the process of developing measurement items as: (1) Item generation through literature review and experience / interviews with industry experts; (2) Academic expert review; (3) Debriefing with experts; and (4) Item purification. Five eminent academic experts from the area of supply chain management were consulted to provide their valuable insights on developed SSCM framework, metric and performance measures. Similarly, two senior manager from each selected large scale and one from each selected medium scale company from the area of supply chain management i.e. total nine practitioners from the IT product companies were interviewed for collecting information about their current practices of the supply chain on the parameters of sustainability. The practitioners were also consulted for verification of developed framework and metric for all the SSCM actors; and performance measures for the manufacturer.

## **5. ANALYSIS AND DISCUSSION**

### **5.1. Case study**

Current practices in supply chains of the six selected companies with respect to their procurement, manufacturing facilities, products, distribution, innovation, recycling and sustainability were explored using case study method. The initial draft of these case studies was developed using secondary information about the company from reports, websites and review of documents as well as published material mainly consisting of business dailies, business weekly, corporate magazines, and the material available online. Subsequently, the existing functions, processes, procedure and policies and future plans were discussed with concerned managers through semi-structured interviews and documented as a separate case for each company given in Appendix 1. In view of the concerns raised by the practitioners regarding the confidentiality of data and their own involvement, the names of the companies and practitioners have been withheld.

### **5.2. SSCM framework**

Literature has defined sustainability within the three major dimensions, viz. economic, environmental and social [5] and highest level of economic performance will occur at the intersection of environmental, social, and economic performance [6]. Few studies have suggested that the organization's innovation capabilities and its alignment towards environmental, social and economic goals lead to an economically viable as well as sustainable supply chain [7], while few have suggested that internal business processes, customer, reverse logistics processes, waste management and legislation influence the sustainability of an organization [8] [9] [10]. Thus sustainability can be achieved by supply chains which are innovative, are environment conscious and have social objectives as one of the basis of doing business. The integrative literature review of the SSCM frameworks is summarized in Table 2.

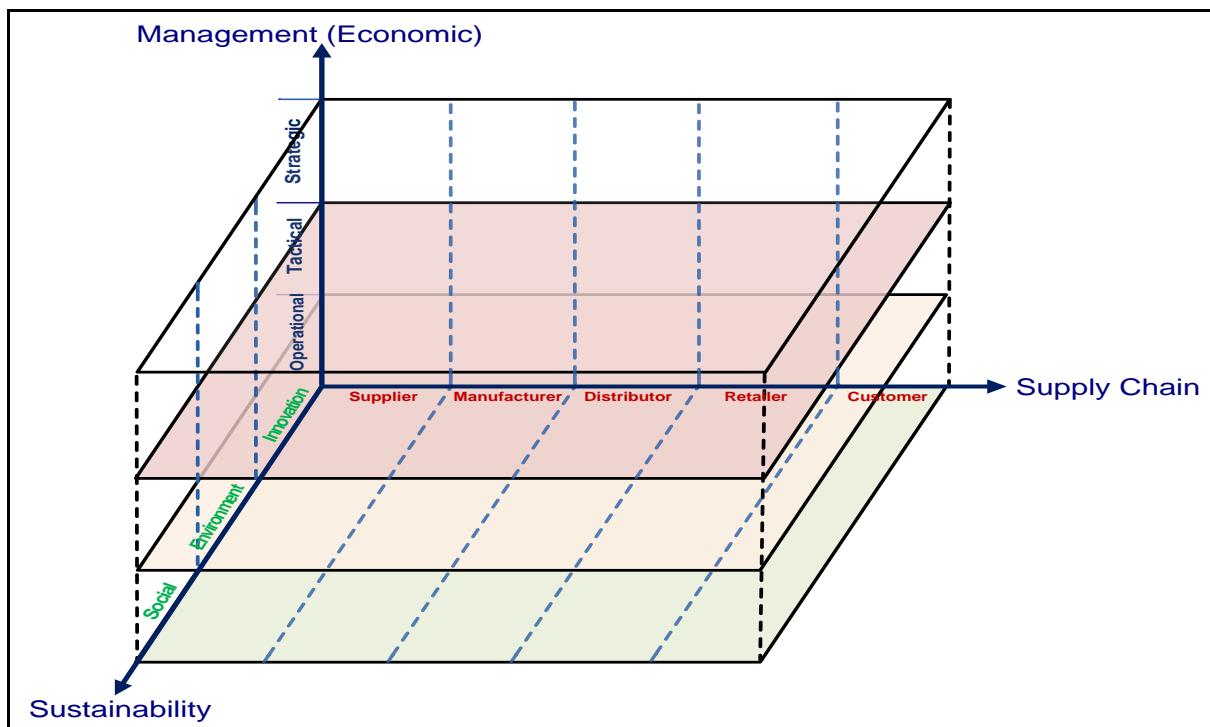
However, this study has a view that the economic responsibility is the base level for any supply chain management. Right application of management (all levels) on supply chain actors addresses the economic responsibility of the supply chain. The economic objectives of the firm may be achieved even when the business does not include the environment or the social aspects. Therefore, an alternate line of thought is proposed which considers economic activity as separate from sustainability objectives, and social and environmental performance complements the economic activities.

S.No	Year	Author	Contribution	Sustainability Parameters
1	1999	Elkington	Triple Bottom Line concept of Economic, Environment and Social	Economic, Environment and Social
2	2008	Carter & Rogers	Highest level of economic performance will occur at the intersection of environmental, social, and economic performance	Economic, Environment and Social
3	2009	Pagell & Wu	Organization's innovation capabilities and its alignment towards environmental, social and economic goals lead to sustainable supply chain	Economic, Environment and Social, <b>added Innovation</b>
4	2010	Mann et al.,	Identified drivers for sustainable SCM practices based on the 'balanced scorecard configuration' viz. financial, internal business process, customer, environment, legislation and social.	<b>Financial, Social, Environment, Internal processes, Customer, legislation</b>
5	2010	Ramudhin et al.,	Framework incorporating all three dimensions of sustainability, added green house gases (GHGs) emissions, energy conservation, noise, traffic congestion and stress as factors	Environment – <b>Reverse Logistics, Energy conservation; Societal wellbeing</b>
6	2011	Dey et al.,	Integrated sustainability with the different processes in a supply chain, sustainable end of product life.	<b>Value Chain, Distribution Chain, Product 'End of Life' management</b>
7	2012	Hassini et al.,	Added policies, regulations, ethics, fair trade practices as dimension is social sustainability.	<b>Green design, RoHS, Recycle, Regulations, Fair trade practices</b>

**Table 2: Integrative Review of SSCM Frameworks**

The research integrates the idea of sustainability in supply chain management and suggests a Supply Chain (SC), Management (M) and Sustainability (S) as three dimensions of SSCM and delineates its constituents and their inter-relationships. To make a SC sustainable, all SC actors have to ensure their performance on all the three levels of management and sustainability dimension. This discussion leads us to a three-dimensional framework for SSCM in which the first dimension represented on X-Axis is “Supply Chain” actors, the

second dimension on Y-Axis refers to the “Management” while the third dimension on Z-Axis show the “Sustainability”. The sequence of actors in supply chain and levels in management and sustainability of the framework are shown in Figure 1 given below. Sustainability may be added as a dimension to the existing economic objective of the firm. Therefore, sustainability would exclude economic dimension and include social and environment dimensions [11]. In case of industries where technology changes very fast and organizations need to continuously improve their products and processes, study includes ‘innovation’ as a third dimension to the sustainability definition. The proposed three-dimensional SSCM suggests that the supply chain actors (X-Axis) economic (efficiency) can be accomplished by applying management (Y-Axis) on it and measuring on



**Figure 1: Three-Dimensional Framework for Sustainable Supply Chain Management**

three levels, viz. strategic, tactical and operational. The performance of actors on sustainability (Z-Axis) should be measured on innovation, environment and social parameters. The interaction of management and sustainability on actors of supply chain makes in three-dimensional.

### 5.3. SSCM framework (Detailed View)

The three dimensional framework has subsequently been further detailed in terms of specific functions and activities to be performed by any organization at the intersection of each dimensions. The study has identified the sub dimensions of each of the sustainability

parameters and developed the detailed framework showing the linkage and interaction of sustainability parameters as well as value chain parameters with the supply chain actors. Innovation has been categorized in five levels, while environment aspects include the reverse logistics process and five factors, viz. green manufacturing, green products, green distribution, waste management and compliance. The social sub dimension includes aspects of equity, transparency, human rights, social welfare and compliance to government laws and regulations. All the factors in each sub-dimension are linked to the specific supply chain actors with whom the responsibility of planning and execution lies.

The review with academic experts suggested changes in the nomenclature of supply chain actors ('Distributor' in IT industry context was detailed into 'Channel Partner' and 'Dealer/Reseller'). It also suggested adding 'Organization Level Innovation' as a metric for defining Innovation, while excluding 'Source Level Innovation' which is only applicable to supply side. Similarly, academicians also suggested defining environment sub dimension with 'Green Manufacturing', 'Green Products', 'Green Distribution', 'Waste Management' and 'Environmental Compliance and Reporting'. In the Social sub dimension, 'Equity' and 'Governance' were added to, 'Ethics and Transparency' were clubbed together, and 'Social Welfare' was enhanced to 'Human Rights and Social welfare'.

Review with industry practitioners validated the three dimensional view of SSCM. It suggested that IT supply chain identifies 'Dealer/Value Added Reseller' as 'System Integrators' or 'Assemblers'. 'Social Innovation' was added as responsibility of all the supply chain partners including customers. 'Equity' in organization is named as "Equity and Non discrimination Policy" while the 'Governance' factor was better defined as 'Compliance to Government Regulations'. Accountability as a separate policy did not exist in any of the organization studied, and was thus removed. Sub dimensions of 'Human Rights' and "Social Welfare" were separated, with Sexual Harassment Policy, Health and Safety as a part of Human Rights. The detailed framework for SSCM of IT products, after review and verification by academic and industry practitioners, is represented in Figure 2.

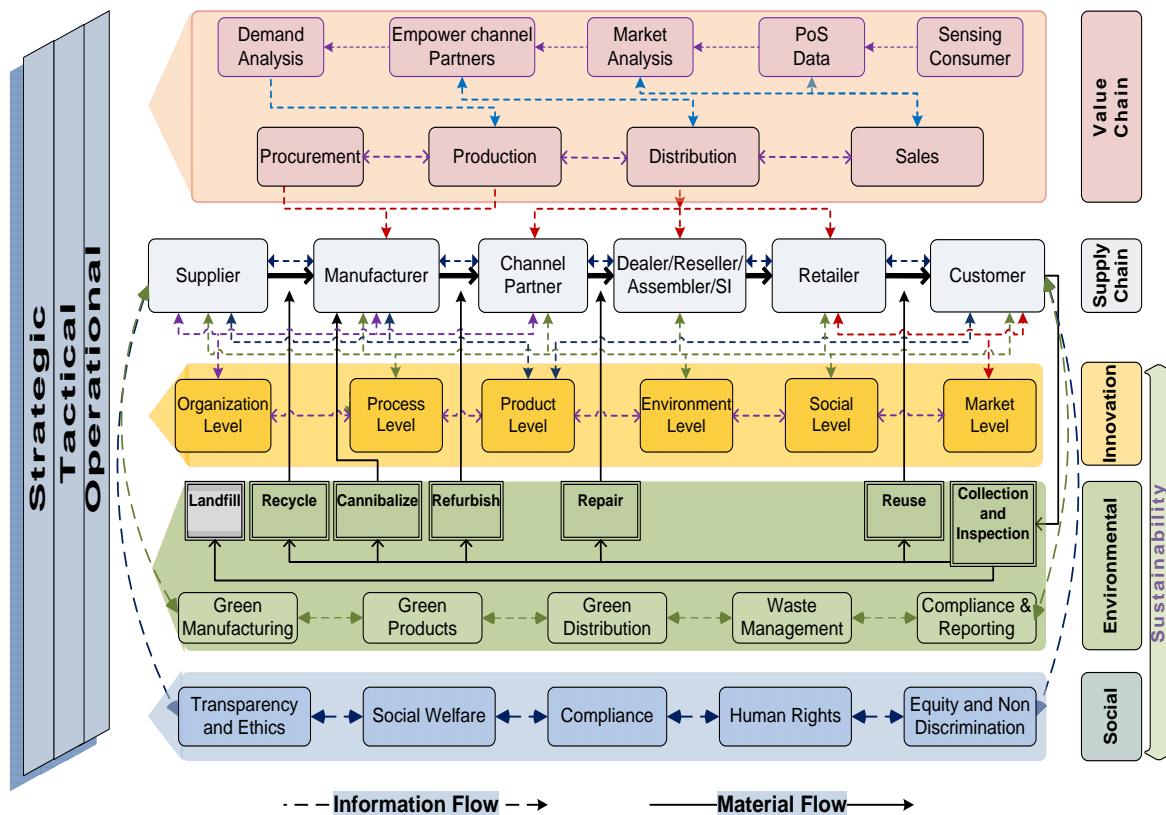
### **5.3.1. Dimension 1: Supply Chain**

The literature provides two broad classification of supply chain. One is based on process i.e. procurement, production, distribution and sales, while the other one is based on actors. The

actors in a supply chain generally include the supplier, manufacturer, distributor, retailer and the customer.

### 5.3.2. Dimension 2: Management

The “Management” functions of supply chain are traditionally being managed at strategic, tactical and operational levels [12] [13]. Each level is distinguished by the period of time over which decisions are made, and the granularity of decisions during that period.



**Figure 2: Detailed Framework for Sustainable Supply Chain Management**

### 5.3.3. Dimension 3: Sustainability

The study suggests that similar to the levels of management, dimension of sustainability also have three levels such as innovation, environment and social.

**Innovation:** This is the base level of sustainability dimension comparable to the operational level of management dimension. Innovations may be introduced across the supply chain, starting from the organization level (innovations in way of managing business), process level (introduction of a new process for making or delivering goods and services; organization's management systems), product level (the introduction of a new product, or a significant qualitative change in an existing product), environment and social level (spread across the

supply chain, include steps taken by suppliers, manufacturer, distributors and customers), and market level (competitors, customers).

**Environment:** This is the middle level of the sustainability dimension, comparable to tactical level of management dimension. The organizations moving towards achieving sustainability must include green practices to save environment, and social initiatives to contribute to the societal wellbeing. This will entail innovations in existing way of doing business. Cleaner sources of energy and efficient utilization of using existing processes provide cost benefits along with reducing emission of greenhouse gases. Compliance to rules and regulations formulated and implemented by government ensure protection of environment and ecology.

**Social:** This is the highest level in sustainability dimension comparable to strategic level of management dimension. The actors in supply chain have to be accountable for their actions as part of their business operations which have a negative impact on human resources as well as on society at large. Transparency in work culture, providing equal opportunity of employment, compliance with regulations and fair implementation of policies and procedures contribute to the goodwill of the organization.

#### **5.4. SSCM Metric**

For any business organization, measurement of its performance is critical. The performance metric needs to be integrated and aligned with the organization's business goals. Previous studies on developing a framework on sustainable supply chain management have identified the sub dimensions of sustainability parameters, but none of them details their metric which may be used by the practitioners to identify and implement. Similarly, none of the studies identifies the performance measures which can help practitioners to judge the level of sustenance of their supply chain operations. However, this study identifies not only the metrics of each dimension, but also attempts to define the performance measures for the manufacturer of IT products with respect to its management (economic) and sustainability dimensions.

The new framework developed for designing and managing a sustainable supply chain requires parameters to measure the performance, which are represented in the framework of metric in this research. With respect to the two corresponding dimensions of economic management and sustainability, two separate metric have been developed for each of the supply chain actor. The metric for economic (management) aspects of the supply chain were

identified and categorized at three levels, viz. Strategic, Tactical and operational. Each actor in the supply chain has different set of metric for measuring the performance of it efficiency and effectiveness. The metric for economic (management) and sustainability dimension of SSCM framework for all supply chain actors have been reviewed by the academicians and practitioners for their appropriateness and content and have been refined as per their inputs provided in Appendix-2 and Appendix-3 respectively.

### **5.5. SSCM Performance Measures for Manufacturer**

In the sustainable supply chain of IT products, out of the five identified actors, viz. supplier, manufacturer, channel partner, dealer/retailer and customer, manufacturer is the focal firm which derives the supply chain and therefore is the most vital link. This study in its present form has focused on the performance measures of the manufacturer only, with respect to the two corresponding dimensions of economic (management) and sustainability.

Review of performance measure of manufacturer by academic experts suggested using SCOR measures as basis to develop the economic performance measures. Three additional measures were suggested by the practitioners to be incorporated for measuring the economic performance of the manufacturer (refer Appendix-4). Practitioners also suggested adding CSR budget spend, social policies covering the partner employees and role of organization in shaping industry standards and government legislations as part of network bodies to sustainability measures (refer Appendix-5).

**Economic Measures:** Performance measures for the economic management of the SSCM are largely based on Supply Chain Council SCOR model [14]. SCOR is the most comprehensive model and it translates qualitative performance in metric and gives a comprehensive list of metrics for supply chain. However, measures suggested by practitioners additional to SCOR were also incorporated, which were specific to Indian industry as many a time data regarding SCOR measures is not maintained in Indian organizations. These measures for economic dimensions are further classified into strategic, tactical and operational levels. The data captured at the operational level leads to calculation of tactical level measures which can be further utilized to take strategic level decisions.

**Sustainability Measures:** Similarly, this research also identifies the performance measures for all the three sustainability dimensions. The measures have been divided as General measures, Policy level measures, Implementation level measures, and measures

related to compliance to government laws and regulations. General measures relate to the data independent of financial year. Rest of the measures relate to the particular financial year. At the policy level, 2 measures are related to Innovation, 6 measures for Environment and 6 measures for Social sub-dimension, which makes a total of 14 policy measures. At the implementation level, 32 measures identified to capture the operational details of implementation of sustainability parameters have been delineated, with 7 measures judging the innovation, and 13 measures for environment and 12 for social parameters of a supply chain. The 14 compliance level measures try to identify any action taken by the enforcement agencies against any violation/complaint as per the applicable regulation and laws.

### **5.6. Sustainability Index for Manufacturer**

The Sustainability measures have been quantified and an index has been developed which may be used by a manufacturing organization to measure its annual score on SSCM. The Sustainability Index (SI) is divided into four parts, with Part A includes General Measures and Part B, C and D are the three levels namely Policy level, Implementation level, and Compliance level. Since such an index does not previously exist, and this study makes a first attempt towards quantifying the sustainability of supply chain for an IT manufacturer, no standards/benchmarks are available to compare the scores. Therefore, this study proposes scoring of parameters of sustainability for the base year on actual data at each facility of the organization. The measures at the operational level need to be captured for each manufacturing facility. The scores of all facilities will be aggregated for a composite sustainability score of the organization. However, in the next year, the scores of each facility will be relative to its own previous measures. The data provided by each facility for each financial year needs to be maintained with relevant supporting documents for audit by internal as well as external independent agency.

**Scoring Rationale:** The General Measures of SI comprising basic information related to organization including number of products which are RoHS compliant, number of facilities certified by LEED /ISO 14001, the reporting to GRI/Dow Jones Index and total patents the manufacturer holds etc. Since this information is basic and static in nature, no scores are assigned to them.

**Scoring Rationale for the base year:** The financial year in which a manufacturer starts evaluating its performance on the sustainability index will be considered as the base year. At

the policy level, scoring is based on the response of the practitioners against each policy at three levels such as

1. Policy exist in the organization,
2. Policy is documented and
3. Accessible to all stakeholders.

These can be answered as ‘Yes’ or ‘No’ and will draw 1 point if the policy exists in the organization, considering the fact that most organizations agree with the statement. It requires strategic orientation, organizational will and due diligence for an organization to have a documented policy on each relevant sub-dimensions of sustainability. So, in case a policy on any of the sub-dimension of sustainability is available in written form, the organization is awarded 3 points. To ensure effective implementation of policy, organization needs to promote, encourage and make it easily available to all stakeholders. Organizations making their policies easily accessible to all stakeholders are awarded 5 points. A total of maximum 5 points can be earned on each policy and a total maximum score from policy level would be 70.

At the operational level, there are total 36 measures on 3 sub-dimensions of sustainability (7 for innovation, 13 for environment and 16 for social) to judge the level of implementation of policies on sustainability. Each facility needs to input actual data for the operational measures and each measure is accorded 5 points in the base year of assessment. In case, no data is provided, the measure will earn zero points. Thus the innovation dimension will earn a maximum of 35 points, 65 points for environment measures and 80 points for social measures, making a total of 180 points. In case the value of the measure is zero, it needs to be entered to earn 5 points, for example, cases of reported child labor at the facility is ‘zero’, then number ‘0’ needs to be entered against the statement rather than leaving it blank. The base year scoring rationale is given in Table 3.

Each sub-dimension of sustainability will have a maximum score derived by adding the policy level and the implementation level scores. Thus the sub dimension Innovation will have a maximum score of 45; Environment would have a maximum score of 95 and in the Social sub dimension, a maximum of 110 points. In total it will be of 250 points for all three sub-dimensions.

Scoring Matrix for Base Year								
	Policy Level				Maximum Score at Policy Level	Implementation Level	Score at Implementation Level	Maximum Total Score
		Exist	Written	Accessible				
Innovation	2 Policies	1	3	5	10	7 Measures	35	45
Environment	6 Policies	1	3	5	30	13 Measures	65	95
Social	6 Policies	1	3	5	30	16 Measures	80	110
All	14 Policies				70	36 Measures	180	250
Compliance Level						13 Measures	-25 * N	-(25N)
Overall Score (Policy Score + Implementation Score - Compliance Score)								250 - 25N

(Where N = Number of notices received for Non compliance)

**Table 3: Scoring Matrix for Base Year**

At the compliance level measures, penalty is awarded in case there is any violation of the existing government laws and regulations by the facility of the organization. With an intention to inflict a harsh penalty for any notice received for a breach from a competent authority, a higher penalty of 10% of the total maximum score will be awarded. This will amount to deduction of 25 points (10% of maximum score of 250) for each violation notice either from same or different authority. These penalty points will be subtracted from the total points earned. The overall SI score of the facility is derived by adding policy level (70 points) and implementation level (180 points) and subtracting penalty points earned on compliance level. At present 13 government regulations are listed under the category of compliance level with an additional option for “other if any” to accommodate for any newer regulation/compliance added in future.

Based on the overall SI score earned by each facility of the organization, they have been graded as poor, moderate, good or excellent on sustainability dimension. A score of up to 40% has been categorized as ‘Poor’, while a score between ‘41% to 70% will earn a ‘Moderate’ grade. However, the performance is judged as ‘Good’ if the score lies between ‘71% to 90%. A score of above 90% is graded as an “Excellent” SI score. These SI scores of each facility will help the organizations to assess and manage sustainability dimension. An organization with multiple manufacturing facilities can calculate its SI score by taking average of SI scores of all the facilities.

**Scoring Rationale for the subsequent year:** Since no industry benchmark/standards are available for SI scores of IT product manufacturer, therefore scoring in the base year is considered on actual data while scoring on subsequent year will be relative to previous year’s

data. The relative comparison of scores will help to chalk out the progress made, and identify the areas for improvement as well.

In case an improvement is observed in the subsequent year over the base year, each measure will get a score of 5 points. If the data remains unchanged, i.e. there is no improvement and status quo is maintained, a lower score of 3 points will be awarded. However, in case of decline in performance over the last year reported data, a lower score of 1 point is scored. In case a measure was not reported in the previous year as it was not captured by the facility, but is reported in this year, it will be considered as base value and scored at 5 points. However, if an organization fails to report on a particular measure, on which it has reported earlier, it would be seen as deliberate avoidance/dereliction, and a penalty of '-1' point will be awarded for that measure.

Based on the nature of data for all 36 measures, they have been categorized and scored as depicted in the Table 4 below.

- Category A: A higher value is considered as improvement and will score 5 points. For example, for the measure "Percent reduction in e-waste generation", if there is an increase in the value over previous year's data, 5 points will be awarded, In case the status quo is maintained 3 points, or if the data show a decline, a single point will be scored.
- Category B: A lower value is considered as improvement and will score 5 points. For example, for the measure "Overall carbon footprint of your manufacturing processes (In Carbon Dioxide equivalent (CO<sub>2</sub>e))", if there is a decrease in the value over previous year's data, 5 points will be awarded, In case the status quo is maintained 3 points, or if the data show an increase, a single point will be scored.
- Category C: Measures in this category have an ideal value to compare, such as 100%, 1:1 ratio or 0. For example, 'Percentage of work force covered under PF Act' measure has an ideal value of 100%. This category measures are divided into two sub-categories C1 and C2. C1 category comprise of measures in which having higher value as compared to base year vale is considered as better measure, while in C2 a lower value as compared to base year value is considered a better measure.

Scoring Rationale for Subsequent Year						
Number of measures per category		Score as compared to Base Year				
		Higher Value	Unchanged Value	Lower Value	Not reported in the base year	Reported in the base year but not reported in subsequent year
Category A	24 Measures	5	3	1	5	-1
Category B	3 Measures	1	3	5	5	-1
Category C1	4 Measures	5	5	1	5	-1
Category C2	5 Measures	1	5	5	5	-1

**Table 4: Scoring Rationale for Subsequent Year**

- For C1 category, if the facility has reported an ideal value in the base year, then the unchanged values will also score 5 points. For example, in ‘Percentage of work force covered under PF Act’, if the base year value is ‘100%’, then the same ideal value ‘100%’ will earn 5 points as no further improvement is possible. In case the value in the subsequent year is higher than the base year value, 5 points will be scored, while for a lower value only 1 point will be awarded. However, in case a value reported in the base year is unreported in the subsequent year, it would be penalized with 1 point.
- For C2 category, if the facility has reported an ideal value in the base year, then the unchanged values will also score 5 points. For example, in ‘Cases of reported child labor’, if the base year value is ‘Zero’, then the same ideal value ‘Zero’ will earn 5 points as no further improvement is possible. In case the value in the subsequent year is lower than the base year value, 5 points will be scored, while for a higher value only 1 point will be awarded. However, in case a value reported in the base year is unreported in the subsequent year, it would be penalized with 1 point.

### 5.7. Verification and testing

The conceptual framework, metric and measures for SSCM developed on the basis of integrative literature review was reviewed and refined on the basis of inputs from academicians in the area of SCM and industry practitioners for its suitability and applicability in their supply chain processes. The refined SSCM framework, metric and performance measure for manufacturer were verified with practitioners in selected companies for their applicability. The verified framework, metric and measures are described in section 5.3, 5.4 and 5.5 respectively.

The real-time data of the selected manufacturing companies was tested as per the developed sustainability performance measure index. The analysis shows that the large size companies have framed policies and procedures to efficiently merge the sustainability parameters into

their SC processes. They are also capturing the data to measure their environmental and societal impact as well as generating new ideas and innovation to become sustainable. Medium size companies contacted in this study were found not reporting on most of the parameters of sustainability. Policies related to social dimension do exist but they lack at the implementation level. However, they are following the E-waste and RoHS regulations implemented by the Indian government and have framed policies as per the rules. They have also set up e-waste collections centers, their own or through an external agency, for reverse logistics processes. However, much needs to be done to increase the amount of recycled material, and proper infrastructure needs to be developed to manage the reverse logistics processes.

## **6. CONCLUSIONS**

The increasing environmental and social concerns at global, regional, national and local levels are being embraced by the researchers, governments and the business firms with varying degree of commitments. This research has used integrative literature review approach to assimilate the emerging concepts on design and planning innovation, environment, social issues and performance measures in supply chains. Representative literature on the topic of sustainability frameworks were reviewed, criticized and synthesized with the help of integrative literature review. Following inputs from these reviews a more inclusive framework of SSCM for IT product companies is developed and further detailed in terms of specific linkage and interaction of sustainability parameters as well as value chain parameters with the supply chain actors.

The three-dimensional framework for SSCM may help organizations to conceptualize and redesign their supply chain based on sustainability parameters. The managers need to think at strategic, tactical and operational levels and delineate the activities that need to be performed at each level to manage the economic as well as sustainable aspects of the supply chain. Thus the SSCM needs to be understood in terms of economic prosperity of the supply chain along with its sustainability, and management at strategic, tactical and operational levels.

Apart from proposing a new framework for SSCM, this research further identifies the metric applicable to each dimension of the SSCM for all the actors in the supply chain of IT products industry. SSCM performance metric for management (economic) and sustainability dimensions were developed for each actor in the supply chain, and the metric have been

divided at three levels of management, viz. strategic, tactical and operational. The metric for innovation, environment and social parameters may be focused upon by the practitioners to develop the measurement systems for sustainable supply chains. Subsequently, moving down to the implementation level, the performance measures for evaluating the economic and sustainability aspects for the IT product manufacturer have been identified and verified by the academic and industry experts. The sustainability measures have been quantified and an index has been developed which may be used by a manufacturing organization to score its supply chain on the parameters of sustainability.

## **7. IMPLICATIONS OF RESEARCH**

This research has practical implication for the IT product industry as it provides a framework for the organizations to conceptualize and redesign their supply chains. The metric and measures may be utilized by the SCM practitioners to measure their supply chain on the parameters of sustainability. The Sustainability Index (SI) for IT product industry may help the organization to calculate its scores and judge its own sustainability performance on annual basis. Sustainability performance of supply chain actors may be compared with the previous year's data to identify the progress, and also recognize the areas for improvement.

## **8. SCOPE OF FUTURE RESEARCH**

Since the performance measure of other actors, viz. supplier, channel partner, retailer and customer on economic and sustainability parameters were not in the scope of study, further research may measure their performance on these parameters. An overall sustainability score of the entire supply chain may be arrived at by aggregating the indices of all supply chain actors. Further, research may be carried on developing indices, best practices and benchmarks.

Since it is imperative for the businesses to inculcate sustainability practices in their supply chains, the adoption and implementation of a ‘SSCM framework’ will provide a starting point. However, the implementation of such a framework would require commitment of the management and necessitate additional resources. Sustainability objective may be achieved by realization of environment and social goals of an organization through innovative practices, while financial implications of these initiatives will require a separate in-depth analysis. The returns on investing in sustainability initiative may not be direct and might manifest in long term, and may not always be in monetary terms. Therefore, the financial

implications of adopting such a sustainability framework and its cost benefit analysis may be undertaken as a scope of future research, after testing and verification of the framework on a larger sample size.

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## 10. LIST OF PUBLICATIONS

1. Gupta, V., Abidi, N., Bansal, T. and Jain, R.K. (2013) 'Green Supply Chain Management Initiatives by IT Companies in India', The IUP Journal of Operations Management, vol. XII, no. 2, pp. 6-24. (National Journal Indexed in EBSCO & Proquest)
2. Gupta, V., Abidi, N. and Bandyopadhyay, A. (2013) 'Supply Chain Management - A Three Dimensional Framework', Journal of Management Research, vol. 5, no. 4, pp. 76-97, Macrothink Institute, Las Vegas, Nevada 89108, USA. (International Journal Indexed in Web of Science, Proquest)
3. Gupta, V., Abidi, N. and Bandyopadhyay, A. (2013) 'Framework for Managing Innovations in Supply Chains of ICT Products', International Journal Of Innovative Research And Development, vol. 2, no. 12, pp. 160-66. (International Journal)

## **APPENDIX 1: Case Study**

### **Company A1**

A1 is India's premier hardware, services and Information and Communication Technology (ICT) systems Integration Company, which offers a wide spectrum of ICT products that includes Computing, Storage, Networking, Security, Telecommunication, Imaging and Retail solutions. A1 has four hardware manufacturing plants, 2 at Puducherry, 1 at Chennai in South India while 1 at Rudrapur in North India. A1 has India's largest distribution and retail network with 27 warehouses across 24 states, 700 plus re-distribution stockists, 93000 outlets in 11000 plus towns in India.

A1 always focused on developing a sustainable future through environment friendly ICT products and services. A1 has been recognized as one of the greenest company among Indian ICT manufacturing companies. The company launched 'A1 ecoSafe' program which ensures that all A1 products are matching standards and compliances. This led to introduction of Green desktops, equipped with the unique DES (Dynamic Energy Saver) technology, that cut overall power consumption by 20-35%. It also developed RoHS compliant Desktops Servers and Laptops and is a leader in Green Integrated Circuit Technology (GICT) manufacturers. A1 also has a comprehensive e-waste recycling policy, wherein A1 facilitates its consumers to recycle / dispose their 'end of life' products in an environmentally safe manner. The A1 initiatives for Green Manufacturing, Recycling and Safe Disposal of unused ICT products, have helped the supply chain to be more environment-friendly.

In line with its Code of Business Ethics and Conduct (COBEC), A1 places significant emphasis on the respect and dignity of every employee. A1 employees are empowered to drive innovation, transforming client engagements and markedly improving client satisfaction. A1 complies with anti-corruption and anti-bribery laws as applicable. A1 is an equal opportunity employer and has a strong, clear and documented stand against any form of harassment at the workplace.

### **Company A2**

A2 Infotech is a leading manufacturer of computer hardware and provider of IT services in India and the Middle East region. The IT Products segment sells a range of A2 personal desktop computers, A2 servers and A2 notebooks. The Company is also a value added reseller of desktops, servers, notebooks, storage products, networking solutions and packaged software for leading international brands. A2 PC products are manufactured at a state-of-the-art facility in Puducherry and Kotdwara. These Green manufacturing units facilitate 100% ROHS compliant products in line with ecological sustainability directives. 83% of the total waste from IT India operations is recycled through both in-house recycling units and through authorized vendor tie-ups. All manufacturing locations have quality, EMS (Environmental Management System) and Health & Safety, which does thorough audit of the sustainable practices within the organization as a part of certification process.

The core of A2's social and community initiatives is focused Eco-eye policy which enables engagement with stakeholders - on the journey to more sustainable business practices. The

initiative focuses on reducing ecological footprint of its business operations, engagement with employees and its supply chain, partners and customers to create a more sustainable society, and transparent reporting/disclosures.

Engagement with employees focuses on health and safety, people development, and increasing diversity and inclusivity at workplace. The key pillars of diversity in A2 are Gender, Nationality, Persons with Disabilities and socio economic background. Transparent reporting is important for its internal and external stakeholders. Having a robust whistleblower policy that employees and other stakeholders can use without fear or apprehension is a sine non qua for a transparent and ethical company. A2 has revamped its sexual harassment investigation process and procedure to make it more comprehensive, spread awareness, make the reporting easy and faster resolution of complaints

### **Company A3**

A3 Computer India Private Ltd. was established in the city of Bangalore, India in the year 1996, and it has been among the fastest growing technology companies in India and continues to be among the top three IT companies. A3 manufacturing (*India Customer Center-ICC*) facility was inaugurated in Sriperumbudur, near Chennai, in Tamil Nadu in 2007. A3 had pioneered a unique direct model of selling PCs bypassing the conventional model of selling them through the retail channel. Using the direct model, A3 provided consumers with tailor-made products, built only after procuring the order from them. In the process, it was able to reduce inventory costs and overheads as it didn't need any intermediaries.

As a strategy for reducing its carbon footprints the company has taken several initiatives to make the processes more environments friendly. All A3 products and solutions are designed with the environment in mind and without sacrificing performance or reliability. A3 is committed to developing innovative products that help you do more while minimizing your environmental impact. A3 is committed to reducing impact of its operations and those of its supply chain on the planet and the communities. Central to this idea is the practice of using resources efficiently and managing wastes effectively. A3's industry-leading packaging solutions focus on reducing packaging volume, increasing the use of sustainable content and making it easy for you to responsibly dispose of packaging through recycling or even composting.

A3 targets to establish itself as a transparent and ethical company. Being an equal opportunity employer, A3 discourages any form of undue influence or canvassing by candidates. It protects employees to engage directly without fear or apprehension as per the robust whistleblower policy. It encourages diversity and inclusivity across its location round the globe. A3 has clearly laid down anti-sexual harassment policy which envisages easy reporting and quick action.

### **Company B1**

B1 Technologies, incepted in the year 1996 is an IT and Consumer Electronics Company. The company has a pan-India presence through its wide network comprising 30 branches and

over 700 service points. B1's manufacturing domain comprises of three associate manufacturing units located at Jammu (30,000 sq.ft. and 20,000 sq. ft area) and Manpura (Baddi, HP 51,000 sq. ft area). The company has a strong Centre for Design and Development in Delhi. B1 is ISO 9001:2008 certified. Sales are routed through a channel network comprising of 1100+ distributors and 40,000+ dealers spread across the country. The company launched its chain of exclusive retail outlets- B1 SQUARE and has 42 stores operational across country and also has a new fully-equipped service centre in Nehru Place.

B1 has put in place an all India collection mechanism to assist its customers for disposal of e-waste as per the new Rules effective May 1, 2012. B1 assures all its customers that all its e-waste collected under these Rules will be recycled/disposed by an authorized recycling agency.

B1 is known for its consistent policy of transparent, fair and ethical trade practices. B1 has no legal case regarding corrupt practices. B1 believes in Equal Opportunity Employment and affirmative action. It does not discriminate against or harass any employee or applicant for the employment on the basis of race, color, and creed, religion, national origin, sex and sexual orientation, disability, age, marital status or status with regard to public assistance.

## **Company B2**

An ISO 9001:2008, 14001:2004 & 18001:2007 certified Company, B2 Infosystems Limited has built its reputation through the brand Chirag - an indigenous range of desktops and workstations. The Company's latest innovation is called 'Greenputer™', a range of eco-friendly desktops that require only one-third of the power that other PCs normally consume. The business segments at B2 are PC & Laptop integration – CHIRAG Brand, Hardware and Network Integration and Maintenance and Facility management services. B2 has state-of-the-art factories at Parwanoo in Himachal Pradesh and Howrah in West Bengal. At present B2 network covers 400+ dealers and Value Added Retailers and over 200+ dedicated retail outlets across India.

B2 adheres to the draft e-waste (Management and Handling) Rules, 2012. B2's overall e-waste management policy aims at providing efficient and easy product recovery options to consumers under IPR/EPR to facilitate responsible product retirement of all its manufactured products along with taking financial responsibility for the same. Chirag manufacturing facilities are fully ISO 14001:2004 compliant. B2 has also adopted OHSAS 18001:2007 standards for health &safety. B2 Infosystems is working towards moving from RoHS compliance to getting its products RoHS certified.

B2 is fully committed to develop and operate a safe, healthy and clean environment to protect vital human resources. The Company has clearly defined policy against sexual harassment as defined in the Indian laws and has zero Tolerance towards instances of sexual harassment and discrimination. B2 is an equal opportunity employer and any type of canvassing by the candidate leads to immediate disqualification. B2 does not employ anybody who is less than

18 years directly or indirectly. Also, B2 does not practice forced labour, in any form, for any reason whatsoever.

### **Company B3**

B3 Systems Ltd. is one of India's leading networking companies, established in the year 1993. The company has a robust product portfolio and a nationwide reach through its network of national and regional distributors, resellers and system integrators. B3 business outline includes DIGISOL - Active Networking Solutions, DIGILITE – Motherboards and More, DIGICARE - Service & Support, Research & Development, Electronic Manufacturing Services and Contract & In-house Manufacturing. The existing manufacturing facility located at Goa has ISO ISO9001: 2008 and ISO 14001:2004 certified plants. B3's unique distribution system comprises of 17 Branch Offices, 22 Regional Distributors, over 200 Empower Value System Integrators, over 1000 Empower Value Added Resellers and over 5000 Empower Authorised Partners.

B3 adheres to the draft e-waste (Management and Handling) Rules, 2012. B3's overall e-waste management policy aims at providing efficient and easy product recovery options to consumers under IPR/EPR to facilitate responsible product retirement of all its manufactured products along with taking financial responsibility for the same. It is also the first of its kind IT organization to adapt OHSAS 18001:2007 standards for health &safety. B3 is working towards moving from RoHS compliance to getting its products RoHS certified.

## APPENDIX 2: SSCM PERFORMANCE METRIC FOR MANAGEMENT (ECONOMIC)

	<b>Supplier</b>	<b>Manufacturer</b>	<b>Channel Partner</b>	<b>Retailer</b>	<b>Customer</b>
<b>Strategic</b>	<ul style="list-style-type: none"> <li>• Delivery Reliability</li> <li>• Quality level</li> <li>• Transportation strategy and investments</li> <li>• Supply Contracts</li> <li>• Lead time against industry norm</li> <li>• Supply Chain efficiency</li> <li>• Supply Chain responsiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Delivery Reliability</li> <li>• Supply Chain responsiveness</li> <li>• Supply Chain Agility</li> <li>• Cost of managing supply chain</li> <li>• Supply Chain efficiency</li> <li>• Assets</li> <li>• Supplier Reliability</li> <li>• Strategic Investments</li> </ul>	<ul style="list-style-type: none"> <li>• Delivery Reliability</li> <li>• Warehouse location</li> <li>• Investment in logistics resources</li> <li>• Contracts with logistics providers</li> <li>• Supply chain and logistics cost</li> <li>• Investment in IT and planning systems(e.g. ERP)</li> <li>• Supply Chain efficiency</li> <li>• Supply Chain responsiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Pricing Strategy</li> <li>• Services Strategy</li> <li>• Flexibility of service systems to meet customer needs</li> <li>• Investment in IT</li> <li>• Target Markets and Customer segmentation</li> <li>• Supply Chain efficiency &amp; responsiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Consumer behavior</li> <li>• Customer profile</li> </ul>
<b>Tactical</b>	<ul style="list-style-type: none"> <li>• Supplier Delivery Inefficiency</li> <li>• Supplier rejection rate</li> <li>• Efficiency of purchase order cycle time</li> <li>• Booking in procedures</li> <li>• Cash flow</li> <li>• Quality assurance methodology</li> <li>• Capacity flexibility</li> <li>• Aggregate planning</li> <li>• Supplier delivery performance</li> </ul>	<ul style="list-style-type: none"> <li>• Delivery Inefficiency Ratio</li> <li>• Delivery Performance Perfect Condition</li> <li>• Customer query response time</li> <li>• Source Cycle Time</li> <li>• Make Cycle Time</li> <li>• Deliver Cycle Time</li> <li>• Utilization of resources</li> <li>• Measures for Inventory</li> <li>• Total Length of the chain</li> <li>• % of Defects &amp; Returns</li> <li>• Channel Partner Order Inefficiency</li> </ul>	<ul style="list-style-type: none"> <li>• Delivery Inefficiency Ratio</li> <li>• Delivery Performance</li> <li>• Perfect Condition</li> <li>• Responsiveness to urgent deliveries</li> <li>• Total Distribution costs</li> <li>• Allocation of dealers to distribution centers</li> <li>• Order entry process</li> <li>• Enterprise distribution planning schedule</li> <li>• Channel Partner Order Inefficiency</li> <li>• 3PL Contracts</li> </ul>	<ul style="list-style-type: none"> <li>• Responsiveness to urgent deliveries</li> <li>• Safety stocks</li> <li>• Allocation of distribution centers to customers</li> <li>• Aggregate demand planning per segment</li> </ul>	<ul style="list-style-type: none"> <li>• Promotional campaign</li> <li>• Customer Relationship Management</li> <li>• Customer contracts</li> <li>• Consumer forums</li> </ul>
<b>Operational</b>	<ul style="list-style-type: none"> <li>• Ability in day to day technical representation</li> <li>• Ability to avoid complaints</li> <li>• Defect free deliveries</li> <li>• Delivery performance</li> </ul>	<ul style="list-style-type: none"> <li>• Cost</li> <li>• Asset</li> <li>• Response time</li> <li>• Reliability</li> <li>• Agility</li> </ul>	<ul style="list-style-type: none"> <li>• Total logistics cost</li> <li>• Number of faultless notes invoiced</li> <li>• Order Lead time</li> <li>• On time order fill</li> <li>• Inventory Management</li> <li>• Vehicle load and routing</li> </ul>	<ul style="list-style-type: none"> <li>• The number of faultless invoices</li> <li>• Online ordering and tracking</li> <li>• Customer Inventory management and replenishment</li> </ul>	<ul style="list-style-type: none"> <li>• Customer service</li> <li>• After sales service</li> <li>• Cross selling and Up selling</li> </ul>

## APPENDIX 3: SSCM PERFORMANCE METRIC FOR SUSTAINABILITY

	<b>Supplier</b>	<b>Manufacturer</b>	<b>Channel Partner</b>	<b>Retailer</b>	<b>Customer</b>
<b>Innovation</b>	<ul style="list-style-type: none"> <li>• Product Innovation</li> <li>• Process Innovation</li> <li>• Eco Innovation</li> <li>• Packaging innovation</li> <li>• Supply Chain Process Innovation</li> </ul>	<ul style="list-style-type: none"> <li>• Innovation Management Process</li> <li>• Product &amp; Process Innovation</li> <li>• Packaging innovation</li> <li>• Market Innovation</li> <li>• Organizational Innovation</li> <li>• Supply Chain Process Innovation</li> </ul>	<ul style="list-style-type: none"> <li>• Innovation in logistics and transportation</li> <li>• Market Innovation</li> <li>• Supply Chain Process Innovation</li> <li>• Warehousing Innovations</li> </ul>	<ul style="list-style-type: none"> <li>• Supply Chain Process Innovation</li> <li>• Market Innovation</li> <li>• Innovation in after-sales/ Service</li> </ul>	<ul style="list-style-type: none"> <li>• Customer Innovation</li> </ul>
<b>Environment</b>	<ul style="list-style-type: none"> <li>• Green Components and Supplies</li> <li>• Waste Management</li> <li>• Compliance and Reporting</li> <li>• Alternative energy sources</li> </ul>	<ul style="list-style-type: none"> <li>• Green Manufacturing</li> <li>• Green Products and Packaging</li> <li>• Waste Management</li> <li>• Recycling</li> <li>• Alternative energy sources</li> <li>• Compliance and Reporting</li> </ul>	<ul style="list-style-type: none"> <li>• Green Distribution</li> <li>• Reverse logistics</li> <li>• Alternative energy sources</li> <li>• Green warehousing</li> <li>• Ecological Impact</li> </ul>	<ul style="list-style-type: none"> <li>• Recycling</li> <li>• Environment Consciousness</li> </ul>	<ul style="list-style-type: none"> <li>• Recycling</li> <li>• Environment Consciousness</li> <li>• Product use</li> </ul>
<b>Social</b>	<ul style="list-style-type: none"> <li>• Compliance</li> <li>• Transparency and Ethics</li> <li>• Equity and non-discrimination</li> <li>• Human rights</li> <li>• Social welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance</li> <li>• Transparency and Ethics</li> <li>• Safety and health</li> <li>• Equity and non-discrimination</li> <li>• Human rights</li> <li>• Social welfare</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance</li> <li>• Transparency and Ethics</li> <li>• Safety and health</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance</li> <li>• Transparency and Ethics</li> <li>• Safety and health</li> </ul>	<ul style="list-style-type: none"> <li>• Social Consciousness</li> <li>• Donation/reuse</li> </ul>

## APPENDIX 4: ECONOMIC PERFORMANCE MEASURE FOR SSCM - MANUFACTURER

<b>Economic Measures for SSCM - Manufacturer</b> Financial Year 2012 - 2013				
<b>S.no</b>	<b>Operational</b>	<b>YES/NO</b>	<b>Tactical</b>	<b>Strategic Level</b>
1	Total orders delivered per day		<b>Delivery Inefficiency Ratio</b> = [Total orders delivered per day with variations] / [Total orders delivered per day]	
2	Total orders delivered per day with variations			
3	Total orders where products ordered are the products provided		<b>% of Orders Delivered in Full</b> = [Total orders where products ordered are the products provided and the quantities ordered match the quantities provided] / [Total orders delivered per day] x 100	
4	Total orders where products quantities ordered match the quantities provided			
5	Total orders where location and specified customer entity is met upon receipt		<b>Delivery Performance to Customer Commit Date</b>	
6	Total orders where delivery time ordered is met upon receipt		= [Total orders where location, specified customer entity and delivery time ordered is met upon receipt] / [Total orders delivered per day] x 100	<b>Perfect Order Fulfillment</b> = [Total Perfect Orders] / [Total Number of Orders Delivered] x 100%
7	Total orders where documentation supporting the order line is considered perfect if it is all accurate, complete, and on time		<b>Documentation Accuracy</b> = [Total number of orders delivered with accurate documentation] / [Total number of orders delivered] x 100%	
8	Total orders where the product is delivered/faultlessly installed meeting specification and has correct configuration		<b>Perfect Condition</b> = [Number of orders delivered in Perfect Condition] / [Number of orders delivered] x 100%	
9	Total orders where the product is delivered/faultlessly installed with no damage and is accepted by the customer			
10	Total orders where the product is delivered/faultlessly installed and is not returned for repair or replacement			
11	Number of Days to achieve an unplanned sustainable 20 percent increase/decrease in production labor			
12	Number of Days to achieve an unplanned sustainable 20 percent increase/decrease in material			
13	Number of Days to achieve an unplanned sustainable 20 percent increase/decrease in capacity			
14	Number of Days to achieve an unplanned sustainable 20 percent increase/decrease in capital			
15	Time in days associated with source processes for an order		<b>Source Cycle Time</b> = Average time associated with source processes	
16	Time in days associated with make processes for an order		<b>Make Cycle Time</b> = Average time associated with make processes	
17	Time in days associated with deliver processes for an order		<b>Deliver Cycle Time</b> = Average time associated with deliver processes	
18	Time in days associated to acquire, merchandise, and sell finished goods at a retail store		<b>Deliver Retail Cycle Time</b> = Average time of processes used to acquire, merchandise, and sell finished goods at a retail store	
19	Total number of daily receipts from suppliers		<b>Supplier Delivery Inefficiency</b> = [Total number of daily receipts from suppliers having variation with respect to specifications, on-time delivery or quantity] / [Total number of daily receipts from suppliers]	
20	Total number of daily receipts from suppliers having variation with respect to specifications, on-time delivery or quantity			<b>Supplier Reliability</b>
21	Total number of orders received from channel partners daily		<b>Channel Partners Order Inefficiency</b> = [Total number of orders received from channel partners in which changes were requested] / [Total number of orders received from channel partners daily]	
22	Total number of orders received from channel partners in which changes were requested			
23	Total number of partners having overdue outstanding receivables		<b>Channel Partners Inefficiency</b> = [Total number of partners having overdue outstanding receivables] / [Total number of channel partners in your supply chain] x 100	
24	Direct Material Cost			<b>Cost of Goods Sold</b>
25	Direct Labor Cost			
26	Overhead Cost			
27	Order Management Cost			
28	Material handling cost			
29	Distribution Cost			
30	Finance and planning related cost			
31	Inventory Carrying Cost			
32	MIS Costs			
33	Supply Chain Revenue/ Net Sales			<b>Total Supply Chain Management Cost</b> = Total supply chain inefficiency ratio * Total Supply Chain Management Cost/Net Sales
34	Direct Material Cost			
35	Revenue			<b>Value Added Productivity</b> = [Revenue - Direct material cost] / [Number of units produced]
36	Employees in FTE			
37	Returns warehouse costs			
38	Returns authorization processing costs			
39	Returns transportation costs			
40	Returns maintenance costs			
41	Warranty Costs for replacements			
42	Average Standard cost of item in Inventory		<b>Gross Value of Inventory</b> = [Total quantity of items in inventory] / [Average Standard cost of item in Inventory]	
43	Total quantity of items in inventory			<b>Inventory turnover Ratio</b> = [Cost of Goods Sold] / [Average Inventory]
44	Inventory number of days : Raw Material		<b>Total Length of the chain</b> = Days RM Inventory + Days WIP Inventory + Days FG Inventory	<b>Inventory Days of Supply</b> = [5 point rolling average of gross value of inventory at standard cost] / [Annual Cost of Goods Sold (COGS)] /
45	Inventory number of days : Work in progress			
46	Inventory number of days : Finished goods			
47			<b>Recycle Days of Supply</b>	
48			<b>Percentage Defective Inventory</b>	
49			<b>Percentage Excess Inventory</b>	
50	Gross value of inventory at standard cost		<b>Inventory Days of Supply</b>	
51	Gross Annual Accounts Payable		<b>Days Payables Outstanding</b> = [5 point rolling average of gross accounts payable (AP)] / [total gross annual material purchases / 365] in days	<b>Cash to Cash cycle Time (return on working capital)</b> = [Inventory Days of Supply] + [Days Sales Outstanding] - [Days Payable Outstanding] in days
52	Gross Annual Accounts Receivable		<b>Days Receivables Outstanding</b> = [5 point annual average of gross accounts receivable / (total gross annual sales / 365)] in days.	
53	Supply Chain Fixed Assets			<b>Asset Turns</b> = [Supply Chain Revenue/Net Sales] / [Supply Chain fixed assets + Working capital]
54	Working Capital			
55				<b>Return on Supply Chain Fixed Assets</b> = [Net Sales] / [Supply Chain Fixed Assets]
56				<b>Supply chain working capital</b> = [Inventory] + ([Accounts Receivable] - [Accounts Payable])
57				<b>Supply chain working capital productivity</b> = Net Sales/ Supply chain working capital
58	Total number of products manufactured daily		<b>% of Defects</b> = [Total Number of products with defect] / [Total number of products]	
59	Total Number of products with defect			
60	Total No of product sold daily		<b>% of Returns</b> = [Number of Product Returns to manufacturer] / [Total No of product sold]	
61	Number of Product Returns to manufacturer			
62	Daily Capacity Utilization			

**APPENDIX 5: SUSTAINABILITY PERFORMANCE MEASURE FOR SSCM –  
MANUFACTURER**

**Sustainability Index of SSCM - Manufacturer (Financial Year 2012-13)**

<b>Part A: General Measures</b>									<b>Sustainability Score</b>		
a	Name of organization		e	Number of products which are RoHS compliant					Policy, Implementation & Non Compliance	Max	Score
b	Turnover		f	No. of facilities/buildings certified by LEED /ISO 14001					Innovation	45	0
c	Number of employees		g	Do you report to GRI/Dow Jones Index					Environment	95	0
d	Location and Total/Built-Up area of the manufacturing plant		h	Total number of patents your organization holds					Social	110	0
<b>Part B: Policy Measures</b> [Instructions : In your organization a policy, EXISTS (means is in regular practice), DOCUMENTED (means is available in written form), ACCESSIBLE (means is accessible to all the stakeholders). Kindly mark the following as Y= Yes, N=No]									<b>Overall</b>	<b>250</b>	<b>0</b>
i	Products and Process Innovation		viii	Suppliers Selection/Evaluation (based on Environment norms)					<b>Policy</b>		
ii	Supply Chain Innovation		ix	Suppliers Selection/Evaluation (based on Social norms)					Sustainability Parameter	Max	Score
iii	Reverse logistics		x	Ethics and Transparency					Innovation	10	0
iv	Reduction of hazardous substances(RoHS)		xi	Equity/Non-Discrimination					Environment	30	0
v	E-waste management		xii	Social welfare					Social	30	0
vi	Energy Conservation		xiii	Occupational Health and safety					Total	70	0
vii	Environmental and Social Regulations		xiv	Human Rights (Child labour//Minimum Wages/Anti Sexual Harrassment)					<b>Implementation</b>		
<b>Part C: Implementation Measures</b> [Kindly provide the data for the financial year 2012 - 2013]									Sustainability Parameter	Max	Score
i.a	Number of Certificate/Award/Recognition received by your organization related to innovation?		vii.b	Percent reduction in GHG emissions over base year					Innovation	35	0
i.b	Number of employees awarded for creativity/innovations by an external agency		viii.a	Percentage of suppliers complying with environmental norms					Environment	65	0
i.c	Number of employees awarded/recognized for creativity/innovations internally by the organization		ix.a	Percentage of suppliers complying with social norms					Social	80	0
i.d	Number of events/workshops/seminars organized to promote innovations		x.a	Number of reported cases of unethical practices (Including partner employees onsite)					Total	180	0
i.e	Number of Patents filed by your organization		x.b	Number of resolved cases of unethical practices (Including partner employees onsite)					<b>Legend</b>		
ii.a	Number of Supply Chain innovations		x.c	Percentage of external scrutiny/queries resolved					Poor (Upto 40%)		
ii.b	Amount in rupees spent by innovation cell to monitor innovations		x.d	Number of network/ government bodies your organization is a part of?					Moderate (41-70%)		
iii.a	Percentage of material that is recycled		xi.a	Number of reported incidents of discrimination (Including partner employees onsite)					Good (71-90%)		
iii.b	Percentage of water recycled and reused.		xi.b	Number of cases of discrimination where corrective actions taken (Including partner employees onsite)					Excellent (91-100%)		
iii.c	Percentage reduction in use of packing material		xi.c	Ratio of basic salary of men to women by employee category.					<b>Non Compliance</b>		
iii.d	Percentage of packaging that is recycled		xi.d	Percentage of women in total workforce					Total	0	0
iv.a	Percentage reduction in use of hazardous materials		xii.a	Percentage of work force covered under PF Act					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		
iv.b	No. of products which are certified RoHS compliant in current year		xii.b	Any certificate/Award/Recognition related to CSR?					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		
v.a	Percent reduction in e-waste generation		xii.c	Total Spend on CSR activities (as % of Profit after tax)					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		
v.b	Number of e-waste collection centers		xiii.a	Number of Safety related incidences (Including partner employees onsite)					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		
v.i.a	Percent of alternate energy consumption to total energy consumption		xiv.a	Cases of reported child labour					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		
v.i.b	Percent reduction in energy costs		xiv.b	Cases of reported violation of minimum wages to factory employees (Including partner employees)					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		
vii.a	Overall carbon footprint of your manufacturing processes (In Carbon Dioxide equivalent (CO <sub>2</sub> e))		xiv.c	Cases of reported sexual harrassment (Including partner employees onsite)					[Does your organization receive any notice regarding violation of following government laws? Kindly mark as Y= Yes, N=No]		