Chapter 2
REVIEW OF LITERATURE

The field of supply chain management has evolved over the years and manufacturing has been a vital driver in any supply chain (Jain et al., 2010). This is because, consistently, manufacturing firms have learnt to improve their supply chain management practices and have produced various success stories in the market (Debra Hofman, 2011).

In today’s changing business landscape, creating a sustainable organization ecologically and economically are the major concern. It is important to know how firms could manage these two paradigms through the supply chain.

An extensive review of literature helps to explore these paradigms and the practices to take advantage of the synergy and strengthen organizational expertise in the international competitive environment.

2.1 Supply Chain Management

The term ‘supply chain’ was coined in the mid 70’s (Banbury, 1975) but not until the 1980’s, the term ‘supply chain management’ came into context. Oliver and Webber (1982) refer to supply chain as the integration of the internal business functions and the flow of materials and information from the point of entry into the firm until delivered to the end consumer. Similarly, Stevens (1989) defined supply chain management as the integration of business functions involving the flow of materials and information from inbound to outbound ends of the business. Later in the early 1990’s, supply chain management evolved dramatically with the increasing importance of the relationship with the suppliers (Harland, 1996; Slack, 1991; Christopher, 1992; LaLonde & Masters, 1994; Quin, 1997; Handfields and Nichols, 1999; Chopra and Mendel, 2001) and the changing requirements for organisations to become responsive to the
needs of customers (Christopher, 2000). This leads to the argument that SCM included demand management as it is driven by the market (Christopher, 1998; Fisher et al., 1997). SCM as a whole can be termed as the system that guides firms to cooperate with a common goal of improved sales and profitability (Cigolini et al., 2004).

Supply Chain Management (SCM) can be defined as the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible (Hamilton, 1982). Supply chain is an interlinked set of relationships connecting customer to supplier through intermediate stages such as manufacturing, warehousing and distribution (Agarwal and Sankar, 2002).

Globalization has changed the perspective of supply chain management making it increasingly global and complex, as firms with a variety of strategies work together (Thublier et al., 2010). The primary goal of any supply chain management strategy is to enhance competitive performance by closely integrating the internal functions within a firm and closely linking them with external operations of suppliers, customers, and other channel members (Kim, 2006). These strategies should be supported by suitable supply chain management practices (Morash, 2011). Supply chain management practices can be defined as the set of activities undertaken by an organization to promote effective management of its supply chain (Li et al., 2005).

Various research models have evolved over the years. Porter (1985) proposed the linear model on SCM, which was the first to emphasize that firms are a collection of activities performed to design, produce, market, deliver and support. Recent research work by Lord Sainsburry (2007), Walter and Rainbird (2006), Coyle et al., (2008) has been an extension of this linear model.
Lambert et al. (1998) evolved the SCM network model based on the fact that the firms are generally part of more than one supply chain and also have multiple customers and suppliers. This model physically divided the supply chain into upstream and downstream supply chain (Helper, 1991; Biemans Bran, 1995; Spekman et al., 1998; Panizola, 1998; Vachon & Klassen, 2006; Rice & Caniato, 2003; Perez & Sanchez, 2000; Shah & Ward, 2003; Berry et al., 2002). This perspective views the focal firm and other members of the supply chain in a static position and hence helps to identify overall process improvements through supply chain thinking (Thublier et al., 2006; Azevedo & Mochado, 2011; Shah & Ward, 2003; Vachon & Klassen, 2006; Doollen & Hacker, 2005). In line with this approach, Juin (2011) defines Supply chain management as a group of partners who collectively convert a basic commodity (upstream) into a finished product (downstream) that is valued by the consumers and who can manage return at each stage (Reverse logistics). Runglustham et al. (2003) noticed a transition towards SCM in his extensive review on Supply chain research during this period.

Subsequently, Supply Chain Council (2005) proposed a reference model, a linear model with integrated process units known as the SCOR model (Supply Chain Operations reference model) for benchmarking supply chain processes. This model is also based on the interaction of the five links in a firm: supplier, supplier’s supplier, the firm, customer and customer’s customer. The model distinguishes several processes across the supply chain as Plan, Source, Make, Deliver and Return. Various researchers have used the SCOR model in their work (Georgise et al., 2011; Han et al., 2007; Schmilz, 20017; Lai et al., 2002; Huan et al., 2004; Samuel et al., 2004). This model requires high amount of resources and time to implement and hence has been more successful in developed economies although in developing economies lack of well-designed infrastructure has imposed pressure on successful implementation (George et al., 2011).
All the models of SCM find their view in alignment with Porter’s (1985) value chain model, which shows that organizations in any supply chain are linked through physical flows and information flows. Physical flows involve the transformation, movement, and storage of goods and materials (Davis, 1993). They are the most visible piece of the supply chain. But just as important are information flows (Jain et al., 2010; Handfield & Nicholas, 1999). Information flows allow the various supply chain partners to collaborate and coordinate with their long-term plans and control the day-to-day flow of goods and material up and down the supply chain (Handfield, 2011).

The above definitions clearly provide us with the four basic building blocks of SCM as; Inbound practices, Operational practices, Outbound practices and Reverse Logistics. Inbound refers to the reception, warehousing and control of raw materials, Operations are the design and manufacturing activities that transform the raw material into finished product. Outbound refers to the activities that deliver the finished product to the end consumer including packaging, warehousing, logistics and order fulfillment. Reverse logistics is the process of retrieving the product from the customer for the purpose of capturing value or proper disposal (Juin, 2011; Shulka, 2004).

The reviews on supply chain management show that today’s supply chain is confronted with an increased number of modern management strategies and practices that strive continuously for new opportunities for supply chain improvement. SCM has also become a promising area to achieve sustainability in this highly volatile economic condition. Linton et al., (2007) has presented the relationship between sustainability and supply chain and its importance in today’s business.

The conversion of raw material to a finished product and delivery and disposal involves coordination and management of a complex network of practices. All stages of a product’s life cycle influences the supply chain management: resource extraction, manufacturing, use and reuse, final recycling, or disposal (Zhu et al., 2007; Harrison & Van Hock, 2005).
Supply chain management thus include the downstream and upstream together and has formed a closed loop and are administered in a coordinated manner towards the common goals of maximizing profit from the standpoint of the triple bottom line, integrating profits, people and planet (Dow Jones Sustainability Index, 2009; Lee, 2010). This interaction between sustainability and supply chain seems to be the recent focus in supply chain research (Linton et al., 2007; Corbett & Kliendorfer, 2003; Kliendorfer et al., 2005; Zhu & Sarkis, 2004; Zink, 2005). The developments has made the focus on supply chain studies from a single function or activity based study towards looking at it as an entire chain (Juin, 2011).

Supply chain management generally focusses on creating efficiency in terms of cost, time, delivery and flexibility. But this century demands a shift in the focus towards efficiency in the implementation of environmentally friendly practices that reduce wastes and pollution and improves corporate image (Hsien et al., 2001). Pagell and Wu (2009) has quoted that sustainable supply chains when formed would reduce inefficiencies, achieve shorter lead times and better quality of products and subsequently enhance the corporate image and competitive advantage. Srivatsava (2007) and Carter (2008) have mentioned in their research that environmentally sustainable supply chains can yield cost savings from the reduction of waste, energy consumptions and reusable components. They also show that environmentally friendly practices also generate improved sales and profitability. Spekman et al., (1998) point out that supply chain management is about working towards creating a value added network to achieve both customer value and competitive advantage. Walters and Rainbird (2006) has kept the end consumer as the center of their SCM model.
The interaction between sustainability and supply chain management practices has caught the attention of researchers and academicians. (Linton et al., 2007; Corbett & Kleindorfer, 2003; Kliendorfer, 2007; Handfield & Nichols, 1999; Zhu & Sarkis, 2004; Zink, 2005). Sustainable Supply Chain Management (SSCM) can be achieved through Green practices focusing on environmental sustainability complemented by Lean practices to achieve profitability (Webster & Mitra, 2007; Mazhar et al., 2007; Ackali et al., 2007; Quak and De Koster, 2007; Juin, 2011; Shukla et al., 2009b). The main challenge faced by SCM in today’s context is balancing economic and environmental priorities (Wu & Pagell, 2011).

Going Lean and Green is a trend more manufacturers are beginning to recognize as important in this era of economic austerity and environmental responsibility. Lean supply chain focuses on ways to improve operations and cut wastes from the customer’s perspective, green initiatives look at ways to eliminate waste from the environment’s perspective. Duarte et al., (2011) has commented that ‘lean and green’ perspective has shown benefits to not only the environment, but also economic benefit to manufacturers and the customers.

Carter and Carter (1998), Zhu and Sarkis (2004) have studied the best practices in lean and green supply chain management and have categorized the practices as collaboration and certification. To create the link between lean and sustainable supply chains, Juin (2011), Pagell and Wu (2009) in their extensive review quote the need to integrate lean principles, sustainability goals, supply chain practices into day-to-day management. Many researchers have proved with evidence in the firm level the link between green and lean as a corporate strategy and how it has helped to integrate sustainability into the organization practices (Azzone & Noci, 1998; Starik & Rands, 1995; Daily & Huand, 2001; Handfield et al., 2001).
The causal relationship between lean processes and environmental sustainability has been much debated in literature (King & Lenox, 2001; Rothenberg et al., 2001). King and Lenox (2001) established that organizations that adopt the quality management standard ISO 9000 are more likely to adopt the environmental management standard ISO 14000. They also show that such compliance efforts result in cleaner, safer operations, reduced use and substitutions for hazardous substances, increased product recyclability and recovery and improved transparency of information sharing among suppliers, trading partners, employees and customers. The most compelling reason for organizations to adopt lean is economic benefits and green is the environmental benefits (Faisal, 2010; Hines, 2010).

To quote Wal-Mart CEO Lee Scott “Being a good steward of the environment and in our communities, and being an efficient and profitable business, is not mutually exclusive. In fact they are one in the same” (Wal-Mart Sustainability Report, 2010). Indian industries are motivated by increased customer expectations and severe global competition to increase productivity at lower cost and produce best product quality. Ravi Kumar and Marimuthu (2011) has shown that implementation of lean manufacturing techniques helps achieve improvement in process, environment, drastic reduction in human fatigue and cost with reasonable investment. Zhu and Sarkis (2006) have shown that adoption of GSCM practices tend to report improved environmental performance and positive improvement in the firm’s economic performance. Hence to preserve the dynamic aspect of the lean paradigm and to assure its harmonization with the economic and environmental aspects a conceptual model ascertaining the relationships between Lean and Green with Environmental performance and Economic performance of the firm was developed in this research.
The compatibility between lean and green paradigms represents a new way of thinking in the context of SCM. Duarate et al., (2010) quote that cost efficiency and environmental responsibilities are not mutually exclusive, they are mutually enforcing. This shows the need to develop a system approach to understand how firms can best manage these paradigms to create sustainable supply chains (Juin, 2011).

In Indian context, Lean and green has been explored in isolated context and normally restricted to the shop floor. Hence revisiting the established strategies of SCM to reassess the viability with the angle of sustainability in general and Lean and green specifically would help organizations to provide tradeoffs between the two to become more competitive and sustainable (Machado & Duarte, 2010; Juin, 2011). Lean and green supply chain management is highly relevant in today’s context as both work towards the same goal, to satisfy the customer needs, at the lowest possible cost to all members in the supply chain (Duarte et al., 2011).

First the lean paradigm and Lean SCM practices are explored in the literature followed by the Green paradigm.

### 2.2 The Lean Paradigm

Toyota Production System (Slack et al., 2004; Jayaram et al., 2007; Liker, 2003) has been the inspiration for the principle of Lean and has been widely used as the business strategy to create a competitive advantage in global organisations like Toyota, Honda, Boeing, General Electric, General Motors. Many manufacturing firms all over the world have started adopting some type of Lean initiative (Liker & Morgan, 2006). They are now replacing conventional methods in manufacturing industries towards building efficient organizations (Venkat & Wakeland, 2006). The theoretical foundation for lean strategy can be traced from the Porters’ value chain model which links the value activities to capitalize on the competitive advantage (Jayaram et al., 2008).
Lean is about creating more value for customers by eliminating waste. Waste here implies that any activity that consumes resources, adds cost or time without creating customer value and it is the target for elimination. The National Institute of Science and Technology (NIST/MEP, 1998) defines Lean as “A systematic approach to identifying and eliminating waste (non-value added activities) through continuous improvement by following the product at the pull of the customer in pursuit of perfection” (Buzby, Gerstemfeld, Voss, & Zeng, 2002).

Ohno (1978) and Shingo (1989) were considered the initiators of Lean in Toyota and the term “muda” or waste was coined by Taiichi Ohno. Womack et al., (1990) coined the word “Lean production” and later lean thinking was expounded towards emphasizing on “Lean enterprise” (Womack et al., 2003) that included the supply chain.

Defining the concept of lean is by itself a challenge (Petterson, 2009), but lean thinking can be summarized by five principles, precisely specifying value by specific product, identify the value stream for each product, make value flow without interruption, let the customer pull value from the producer and pursue perfection (Womack & Jones, 2003).

Slack et al., (2004) also defines the principle of lean as “moving towards the elimination of all waste in order to develop a faster and more dependable operation with higher quality product / service at a low cost”. Though lean thinking is typically applied to manufacturing lean techniques, focus is applicable anywhere there are processes to improve. A lean supply chain is one such process that produces just what and how much is needed, when it is needed, and where it is needed.

Lean SCM is a strategy based on cost and time reduction to improve the effectiveness of the organisation. It is focused on optimizing the processes all over the supply chain, searching for simplification, reducing waste and reducing activities that do not add value (Machado & Duarte, 2010). The
core objective of lean strategy is to systematically integrate activities affecting the products offered to the firm’s customers, from conception of the product though the product life cycle including the activities performed by the external suppliers and channel members (Monczka, 1995; Farley, 1997; Mason-Jones et al., 2000; Yusuf & Adeleye, 2002; Jayaram et al., 2008).

Shah and Ward (2003) and Li et al., (2003) have used the Lean SCM practices to study the practical perspective of Lean in Industries. Researchers have adopted different classifications to Lean SCM. Jayaram et al., (2008) have identified four key practices associated with Lean as, concurrent engineering, design for manufacturability, value analysis and standardization. Shah and Ward (2007) developed a list of lean characteristics in SCM: i) supplier feedback; ii) JIT delivery by suppliers; iii) supplier development; iv) customer involvement; v) pull system; vi) continuous flow; vii) set up time reduction; viii) total preventive maintenance; ix) statistical process control and x) employee involvement.

Lean may be implemented as an SCM practice as mass production, waste elimination, just-in-time, and long-term supplier relationships to eliminate waste and achieve a lower cost (Qi et al., 2009). Srinivasan (2004) has mentioned seven steps in the development of LSCM as systems thinking, understanding customer value, value stream mapping (VSM), benchmark best practices, manage demand volatility, create flow and performance metrics. Ten principles of Lean supply chain management as mentioned by Bozdogan (2002) are focus on suppliers network value stream, eliminate waste, synchronize flow, minimize cost, establish collaborative relationships, ensure visibility and transparency, develop quick response capability, manage uncertainty and risk, align core competencies, foster innovation and knowledge sharing.
Ultimately lean supply chain management is based on cost reduction and flexibility, focused on process improvements, through reduction or elimination of all the wastes (Womack et al., 1991). It embraces all the processes through the product life cycle, starting with product design to product selling, from customer order to delivery (Anand & Kodali, 2008; Corbett & Klassen, 2006). This helps firms to improve quality, reduce costs, and improve service to customers (Larson & Greenwood, 2004). Lean supply chain management also enables firms to align themselves with each other and to coordinate their continuous improvement efforts. This link enables even small firms to participate in the process towards improved efficiency. Lean improves organizational efficiency and effectiveness across the supply chain (George et al., 2003; Hoerl et al., 2004; Zamri et al., 2013). Competitive advantage and leadership in the global marketplace can be gained by applying lean principles to the supply chain.

Research on Lean SCM has been conducted taking into account only certain links of the supply chains. Reichhart and Holweg (2007) have extended the concept of lean production to downstream or the distribution. They define lean distribution as minimizing waste in the downstream supply chain while making the right product available to the end customer at the right time and location. Vonderembse et al., (2006) indicate lean supply chain as the one that employs continuous improvement efforts that focus on eliminating waste or non-value added steps along the chain. Lean is implemented using a number of techniques such as Kanban, 5S, Visual control, takt time, poke yoke, SMED (Adamides et al., 2008).

Lean manufacturing helps to attain better operational performance and manufacturing of zero defect products in compliance with customer needs (Womack et al., 1990; Denis, 2008). But the adoption must happen across the entire supply chain therefore it is very important to include the entire chain towards lean culture.
Lean adoption has also produced significant improvement in the manufacturing firm’s social performance (Greg et al., 2014). Most researchers have identified People as the key for successful Lean implementation (Womack et al., 1990; June, 2011; Wong, 2010; Rechet & Wilderom, 1998; Worley & Doolen, 2006) have mentioned on the importance of the management support on lean implementation in organisations. Zhou (2012) has recognized the importance of training and culture though communications and collaborations for success of Lean. Panizollo (1998) had made an attempt to classify the Lean practices in the organization as process and equipment, manufacturing, planning and control, human resource and product design. Partially extended the same to the supply chain by including relationship with the suppliers and the customers. The importance of extending the lean concept outside the walls of the organisation is emphasized by Jain et al., 2010. Lean principles are also proposed to be a crucial element when firms work on reverse logistics or closing the loop (Wang & Zhou, 2010).


APICS, Oracle, and Supply Chain Vision & Georgia Southern University (2004) research on Lean SCM practices attempt not to represent any particular firm, which is usually the methodology in Lean based studies; it demonstrates APICS’ efforts to provide the insight into current issues and adoption level in Lean supply chain. The research also categorizes Lean SCM practices as demand management, standardization, value addition,
culture and collaboration. The “Lean Supply Chain Management Practice Process Framework”, which forms the basis of this research, is an inspiration of the above research. This framework of practices can be used by firms to identify the potential gaps in their processes. Implementers and practitioners can use this tool to identify every single aspect of the firms’ process strengths and weaknesses and can focus their efforts on those areas where improvement will drive benefits. Various practices that form the framework of Lean SCM practices are discussed in detail below.

2.2.1 Demand Management

Demand is a single forecast across the entire supply chain done at the true source, i.e., from the retail store using POS or Pull data (Ducharme and Lucansky, 2005). Market demand is seldom smooth and the demands over products vary significantly on a day-by-day basis for most of the products/services. Marketing concepts can be considered to be the precursor to demand management (Thublier, 2010). Many research works have quoted that supply chain management should be stated as demand management (Fisher, 1997; Christopher, 2000; Thublier et al., 2010). But this view was contradicted by Huttunen et al., (2000), Korhonen et al., (1998) and Williams et al., (2002). Subsequently Langabeer Rose (2001) suggested that efficiency driven SCM can be made more effective through Demand management practices. Fischer (1997) has claimed the reason for failure of various Lean SCM is because they are wrongly configured with the demand. A mismatch between the processes and the demand gives problems (Juin, 2011). Hence demand management is the most crucial practice for Lean SCM and it coordinates with the first principle of lean – predicting the value of the end consumer.

Walters and Rainbird (2006) have offered integration to demand management and supply chain management models by making the
customer value or the pull as the critical focus for supply chain management. They clearly state that demand management with the focus on supply chain is the way to gain competitive advantage. A Lean system also works based on this philosophy of pull, which means that products or services are pulled when requested by the final customer (Farhana & Amir, 2007; Jayaram et al., 2007). This could be developed by using data from the point of sale and in the purest form will be conveyed upstream to all members of the supply chain from point to point without a change in the volume.

The end-user requirement for the finished product will generally be meaningless to a third-tier supplier, who don’t understand their contribution to the end-product structure. Therefore suppliers at each level of the process must receive the customer’s demand signal and convert it to something usable to their upstream partners. Understanding the demand signal from the end customer all the way back through the supply chain is the real challenge in Lean SCM. The consequences of not managing the demand signal are often referred to as the “bullwhip effect,” (Forester, 1961) where additional units are added to the original demand signal as the signal moves farther upstream. The use of historical data of shipment increases the possibilities of inaccuracies and may lead to excess inventory across the chain or out of stock (Piercy, 2003; Farhana & Amir, 2009).

Takt time is an important metric of lean management; it implies the amount of production needed to meet the customer demand. This metric forms the primary factor for implementation of various tools, product flow smoothing techniques like ‘heijunka’ are used to adapt to the changing demand (Shah & Ward (2007). The implication of demand management in Green supply chain management has also been explored by Mentzer et al., (2006). Demand signal, demand collaboration, sales and operations planning, inventory management, waste and value added activities are
most influencing LSCM practices in manufacturing firms (Duad and Zailani, 2011). A Lean supply chain will work to have products pulled through the channel using customer demand from point-of-sale systems (POS) in real time. This minimizes the need to forecast demand, given the actual and real demand for the product. Hence demand management could be understood by the two practices - Demand Signal and Demand Collaboration Practices (APICS, 2004; Azman Daud & Suhaiza Zailani, 2011).

2.2.2 Value Addition/ Waste Elimination

Lean is identification and elimination of non-value added processes or waste (Zhou, 2012). Lean SCM can be defined as a continuous improvement effort which focuses on eliminating waste and non-value added steps along the chain (Vonderembse et al., 2006; Jabbour et al., 2012; Scherrer-rathje et al., 2009). Value, in the context of lean, is defined as something that the customer is willing to pay for. Value-adding activities transform materials and information into what the customer wants. Non-value added activity can be defined as anything that delays or impedes the supply chain flow (Craig, 2004). Non-value-adding activities consume resources and do not directly contribute to the end result desired by the customer (Wu and Wee, 2009). Elimination of waste is one of the key tenets of Lean manufacturing (Shereshiy et al., 2007).

The term ‘value’ was first introduced by Porter (1985). Porter emphasises that “Value added activities are the discrete building blocks of competitive advantage” (Thublier et al., 2010). Walters and Rainbird (2006) have clearly defined that the value chain can be created by the integration of supply chain and demand management. Various researchers (Gereffit et al., 2005; Lee and Yang, 2000; Jayaram et al., 2007; Lord Sainsbury of Turville, 2007; Evans and Berman, 2001) have made meaningful studies in the perspective of value in an supply chain environment. To create value
in the supply chain, supply chain partners have to work together and individually to eliminate wasteful processes and excess inventory across the chain. Antonoi (2000) has indicated in their research that the practice of treating their suppliers as a part of the extended enterprise has successfully minimized waste to a large extent.

According to David F. Ross (2006) any supply chain with the focus to supply the right product at the right time with as little waste as possible is a Lean Supply chain. This creates the need for creating value for the customer to succeed in tomorrow’s mass customized markets (APICS, 2004; Azman Daud & Suhaiza Zailani, 2011; Thublier et al., 2010). Thus in these market situations members of the supply chain are forced to create value for the end consumer beyond the individual organization. Waste reduction ultimately helps in saving cost and quantity of raw material which causes an impact in the firm’s environmental and economic performance (Hart and Ahuja, 1996; Ghassemi, 2002). Hence value addition / waste elimination is an important practice in developing a Lean supply chain.

2.2.3 Culture

The major challenge of Lean SCM is that they have to be applied by people. These are the same people who have been doing things the old way for a long time. Lean SCM involves a lot more people than lean manufacturing as it is collaboration between supply chain partners. This makes people practices and the culture for continuous improvement the most important in Lean SCM practice (Craig (2004; Ilyas et al., 2008). People and culture has been identified by most of the researchers as a very crucial element for lean implementation (Womack et al., 1990; Zhou, 2012; Whorley & Doolen, 2006; Mann, 2012), since people are the key element in any change. Culture here refers to ways things are done in organisations (Hook & Stehn, 2008). Implementing a Lean culture is vital during the adoption process of Lean processes, techniques or tools.
(Diekman et al., 2004; Liker, 2004; Bicheno, 2004; Veech, 2005). Barriers to Lean has mostly been human and cultural issues (Pavez & Alarcon, 2007; Green, 2000). It can also be found in literature review that one of the main concepts researched in Lean is culture (Alves & Tsao, 2007). A culture of rapid response and faster decisions becomes the expectation and the norm. Once a culture of Lean runs through the veins of the organization, change can be brought about by the people through kaizen.

The culture in Lean is continuous improvement which is the most fundamental element of lean. Continuous improvement in Lean SCM is a belief that it is possible to get closer and closer to perfection (ideal state) in every aspect over time (Slack et al., 2006). Continuous improvement is a culture of incremental changes over time, which means that change is inevitable (Liker, 2004). Culture that embraces change becomes a true Lean practice and foundation for a Lean supply chain. Jabbour et al., (2012) has reported continuous improvement as the most important Lean SCM practice.

2.2.4 Process Standardization

Another important practice in Lean management is standardization (Bonavia & Marin, 2006; John & Brendan, 2010; Young, 2004). Process standardization enables continuous flow to occur, which forms the major step of Lean manufacturing. Flow is the uninterrupted movement of a product or service through the system to the customer. The “flow” or “value-stream” perspective represents a shift from vertical to horizontal thinking (Womack, 1991; Farhana & Amir, 2009; Huang & Lieu, 2005). Horizontal thinking means looking across the traditional vertical structures of functions and departments to connect activities in the stream of the value flowing from suppliers, through the organization, and on to the customers (Lian & Landeghem, 2005; Yadav et al., 2012). In other words, flow means focusing on system efficiency rather than just on the point
efficiency of individual elements in an organization. Flow is enabled when materials and processes are standardized across the supply chain to reduce complexity (Young, 2004; Spath et al., 2011).

These efficiencies can only be gained through collaboration across the supply chain and by developing standardized processes for use in providing products and services that add value and eliminate wasted steps. A thorough understanding of the processes involved through the supply chain will help partners to work towards standardizing important processes and shifting work to the most efficient point in the chain (Spath et al., 2011; Hand, 2009).

Product standardization is an important practice for an efficient supply chain standardization (Krajewski et al., 2003). It is another practice towards Lean SCM (APICS, 2004). This enables using standard subcomponents or parts. Standardization help reduce the number of different components, and reduce inventory levels of finished goods and work in progress (Womack & Jones, 2002; Jayaram et al., 2007).

2.2.5 Industry Standardisation

Standardisation is an important concept of Lean (Womack & Jones, 2002; Jayaram et al., 2007). Product and process standardization between trading partners can still lead to waste. Industry standards are the next important practice in lean SCM (Berger, 1997). Standardisation is the use of standard procedures, materials, parts, and processes for designing and manufacturing a product (Ungan, 2006). Standardization is a benefit to customers who are using the products, and enhances serviceability. However the challenge is it also decreases the proprietary nature of the product. Standardization is not limited to products, but it can also dictate how information is shared across the supply chain.(APIC 2004). Digital waste is defined as information that is not related to or supporting of
defined goals and metrics. Digital waste can be minimized by agreeing to data standards that will enable the free flow of information (Huand & Liu, 2005).

### 2.2.6 Cross-Enterprise Collaboration

Leveraging the Lean principles of defining value and understanding the value stream, supply chain partners work to maximize the added value provided to the customer. The complete supply chain is vital for producing value for the customer, hence they recognize the necessity to collaborate with other organisations (Kotler, 1997). Supply chain can be best perceived as a huge network of many suppliers and customers simultaneously working with each other, hence collaboration becomes a vital weapon for operational alignment (Thublier et al., 2010). This helps organizations to leverage one another’s talents and skills effectively (Lewis, 1995). Collaboration in trading relationships engages partners in joint planning and processes (Anderson et al., 1990; Spekman et al., 1995; Womack et al., 1990).

GM’s Saturn division has exhibited cross enterprise collaboration by not just cooperating with select part suppliers but by partnering with many different part suppliers, inbound logistics carriers, outbound carriers and warehouses and retailer – dealer network (Spekman et al., 1998). The major practice that can bring about cross-enterprise collaboration is the use of teams.
2.3 Relationship between Lean and Green Supply chain Management

As discussed earlier in the review, the integration of lean supply chain management with green supply chain management practices would foster sustainable supply chains in organizations. Lean is an effective method in developing or enhancing a road map for Green (Deloitte, 2008).

Thublier et al., (2010) while providing comprehensive comparison on supply chain models has clearly pointed the need for environmental consideration in the Supply chain models. The supply chain council has also incorporated environmentally friendly practices or a green component in their SCOR model termed as Green SCOR from the earlier version of 9.0 (Wilkerson, 2005).

The U.S. Environmental Protection Agency presents a table of environmental impact associated with wastes targeted by Lean. They recommend that organizations can improve their performance of Lean implementation by considering environmental impacts, so that environmental wastes can be identified explicitly during Lean activity (U.S.EPA, 2007). And in turn moving towards the elimination of all environmental wastes (Slack et al., 2004), the majority of Lean's contributions to business success comes in terms of performance improvement and cost reduction (Harrison & Remko, 2005). But firms do not realize the link and the significance of the benefits of Lean and Green. Hence it needs more attention and becomes an interesting subject for research.

As lean relentlessly focuses on reducing non-value added time and producing just the right amount of a product as needed, an important question is whether it improves or deteriorates environmental performance. Lean provides an excellent platform for environmental management (Venkat & Wakeland, 2006, U.S. EPA, 2003, Devinney, 2009; Curkonic et al., 2000).
Value stream mapping, a standard tool in lean examines the time it takes to produce a product and the proportion of that time that is value-adding (Khaswala & Irani, 2001). It does not explicitly consider the resources consumed and waste generated in manufacturing a product. Sustainable value stream mapping by adding sustainability metric and environmental aspects to the conventional value stream mapping process is advocated by Simons and Mason (2002), Karp (2005). The idea is to use these resource flow maps to address environmental questions in parallel with time compression during the development of future state maps. However, it is not clear how an optimal future state map would be developed if a conflict existed between time compression and environmental performance (Tonkin, 2008; Juin, 2011).

The issue of environmental performance becomes even more complicated when entire supply chains are considered due to long-distance trade but call for distance on the supply chain as short as possible. (Venkat, 2003, Mason & Lalwani, 2003).

Juin, (2011), Franchini et al., 2010, Kainuma and Tawara, 2006 presents the relationship between lean and sustainable paradigms linked to the supply chain and identifies possible synergies. Juin, 2011 classifies the three advantages of lean and green in SCM as Eco-efficiency (cutting out waste, using resources productively and minimizing the carbon footprint), Eco-innovation improving product and service designs so they are based on green processes by products and designing for recycling), Eco-transparency (gaining and sharing full visibility into the value chain so that your business can promote its green brand and enhance and protect its overall brand). Eco efficiency has also been quoted by Hibbert (1998) and Ottman (1990) about a decade before. But it is gaining momentum as mentioned by Stead and Stead (2000) in their research that adoption of GSCM practices as a part of the enterprise policy is turning into a major
strategic thrust in business organisations today. Zamri et al., (2013) has depicted using structural equation modeling the implementation of lean and the adoption of green practices and together their impact on financial performance. The growing interest in SCM research is towards the environmental dimension of sustainability and this green part of sustainability in an SCM context is termed as Green Supply chain management.

There are many studies that have investigated the GSCM practices framework from sustainability perspective and have commented that GSCM initiatives not only impacts environmental sustainability but also influences the economic hand of sustainability (Carter, 2000; Zahlad et al., 2004).

2.4 The Green Paradigm

Environmental concern in supply chain management is the use of natural resources, carbon emission, waste, hazardous substances, energy use which leads to the loss of biodiversity and deforestation, nuclear radiation, ozone depletion and global warming. Green related issues are considerably growing and the challenge is how the industry would move towards sustainability (Faisal, 2010; Bacallan, 2000; Rao, 2002; Rao & Holt, 2005).

Zhu et al., (2008) has mentioned that the green paradigm is related to environmental and ecological efficiency of organizations. Practices connected with the environment are based on green purchasing and integrated into product life-cycle management flowing from supplier, through manufacturer, customer, and closing the loop with reverse logistics (Zhu et al., 2008; Sreevatsava, 2005). This in turn leads to the environmental performance of the organization by removal of environmental waste.
Environmental waste occurs when firms use resources to provide products or services to customers, and/or when customers use and dispose of products. The three major kinds of environmental wastes as quoted by US EPA (2005) are,

- Energy, water, or raw materials consumed in excess of what is needed to meet customer needs.
- Pollutants and material waste released into the environment, such as air emissions, wastewater discharges, hazardous wastes and solid wastes.
- Hazardous substance that adversely affect human health or the environment during their use in production or their presence in products.

Today, the major challenge firms face is the increasing scarcity of resources, consumer awareness, environmental laws and visibility of environmental impacts caused by supply chains operations (Vachon & Klassen, 2006; Srivastava, 2007). Therefore, environmental management in supply chains has been receiving increasing attention among researchers as Green Supply Chain Management (Shaw et al., 2010; Handfield & Nichols, 1999).

Porter and VanDerLinde (1995) and Yu and Son (2008) in their research work also show that investing in the "greening" of the supply chain can save resources, eliminate waste and increase productivity, considering that green refers to everything that is ecologically thought (Svensson, 2007). Greening the supply chains is considered as a process of integrating environmental values into the supply chain (Mudgal et al., 2009). Green supply chain management involves finance flow, logistics flow, information flow, integration, relationships, and environmental management, promoting efficiency and synergy between partners, facilitating environmental performance, minimal waste and cost savings.
(Shang et al., 2010). Therefore it is an important source of organizations’ competitive advantages (Linton et al., 2007; Srivatsava, 2007; Guide & Srivatsava, 2002). But many manufacturing firms have been reported to have shelved their environmental management practices as they have considered it to hinder growth (Chen et al., 2006).

Adding the “green” component, supply chain management is referred to as green supply chain management (GSCM) which is defined as “green procurement + green manufacturing + green distribution + reverse logistics” (Sekshan et al., 2010). The idea of GSCM is to eliminate or minimize waste (energy, emissions, and chemical / hazardous, solid wastes) along the supply chain (Hervani et al., 2005).

Thus, adding the ‘green’ concept to the ‘supply chain’ concept adds a new paradigm where the supply chain will have a direct relation to the environment. This is interesting because these green practices and supply chains management practices were once in head-on collision with each other (Srivastava, 2007).

Green supply chain management (GSCM) is an emerging field that differentiates itself from a traditional supply chain perspective. The “quality revolution in the late 1980’s and the supply chain revolution in the early 1990’s” have evoked businesses to become environmentally conscious (Srivastava, 2007). It works with the aim of reducing waste and preserving the quality of product-life and natural resources. Global market demands and governmental pressures are also pushing businesses to become more sustainable (Guide & Srivastava, 1998; Gungor & Gupta, 1999; Walton et al., 1998, Sanjeev et al., 2012).

The process of using environmentally friendly inputs and transforming these inputs into outputs that can be reclaimed and re-used at the end of their lifecycle creates a sustainable supply chain (Patrick Penfield, 2005). GSCM is the integration of environmental thinking in managing the supply chain, including product design, source and material selection,
manufacturing processes, final product delivery to consumers and management of the product at the end of its life (Srivastava, 2007). These initiatives are being perceived as sound practices that can improve competitiveness, environmental performance and robust partners’ relations.

The very first green supply chain is said to have come into context in 1989. Kelle and Silver’s (1989) was the first to develop an optimal forecasting system for organisations to forecast products that can be potentially reused. It is important to integrate the organizational environmental management practices into the entire supply chain to achieve a sustainable supply chain and maintain competitive advantage (Zhu et al., 2008; Linton et al., 2007). Green supply chain management practices should cover all supply chain activities, from green purchasing to integrated life cycle management, through to manufacturer, customer, and closing the loop with reverse logistics (Zhu et al., 2008).

The key factors that are stated in the literature are the concepts of green design, green operations, reverse logistics, waste management and green manufacturing (Guide & Srivastava, 1998; Srivastava, 2007). This in turn will help achieve corporate profit and market share objectives by reducing environmental risks and impacts while improving ecological efficiency of these organizations and their partners (Zhu et al., 2008; Rao, 2005).

Sarkis et al., (2010) has endorsed the concept of GSCM and defined it as integrating environmental concerns into inter organizational practices of supply chain management including the reverse logistics. GSCM practices and environmental performance has been used by researchers to measure supply chain sustainability (Thipparat 2011; Janbi et al., 2010).

The structure of this research work is based on the extensive review of literature and was classified as four major practices within the green supply chain. These functions included purchasing and in-bound logistics,
design and production, distribution and out-bound logistics, and reverse logistics. A number of integrative issues potentially affecting each of these functional areas are justified with two more supportive components of management support and customer support. As this is a relatively new field, a number of debates have emerged. Most of the literature on green supply chain management has been descriptive, or prescriptive. The literature has investigated only small parts of the whole supply chain. With only a few exploratory studies, the amount of theory development in this area is almost non-existent.

CSR practices and ISO 14000 certifications have improved the environmental practices in many Indian firms (Potoski & Prakash, 2005; Russo, 2002; Melnyk, 2003; Kang, 2005). But the question lies if the same has been extended to the supply chain. It is important to integrate the organizational environmental management practices into the entire supply chain to achieve a sustainable supply chain and maintain competitive advantage (Zhu et al., 2008; Linton et al., 2007). Critics also argue against that improvements are likely to incur within the organization’s operational boundaries rather than being extended throughout the supply chain (Dahlstrom et al., 2003; Matthews, 2001). Previous researchers suggests that the organizational capabilities required to adopt an Environmental Management System (EMS) may facilitate Green SCM implementation (Morrow & Rondineeli, 2002; Melnyk, 2003). Consequently, EMS adopters may have a greater propensity to expand their focus to form a Green supply chain that should cover all the supply chain activities (Zhu et al., 2008).

2.4.1 ISO 14001 Certification

ISO 14001 Environmental Management System (EMS) Certification by International Organization for Standardization (ISO) was introduced as the result of the request from United Nations conference on environment and
development. The goal of ISO 14001 certification is at the corporate level to help businesses reduce their environmental impact and at the societal level to facilitate sustainable development and foster international trade. ISO 14001 certification is not apparent with the benefits in terms of firms’ financial performance (Curkovic & Shoufe, 2010).

Potoski and Prakash (2005), Russo (2002) and Melnyk (2003) and Kang (2005) found that the adoption of an ISO 14001 certified EMS improved environmental performance. Dahlstrom et al., (2003) and Matthews (2001) have shown contradictory results. ISO 14001 certification has been undertaken by firms both proactively and reactively (Francia & Ayerbe, 2009).

Various extensive research has been conducted taking ISO 14001 implementation as the basis for research. Raines (2002) has shown cost benefits of ISO 14001 certificated firms who used it as a tool for proactive environmental management. Padma et al., (2008) have proved empirically that ISO 14001 certification has showed significant improvement in organisational performance of Indian manufacturing firms. It has also been proved to reduce emissions within a year of implementation of ISO 14001 certification (Szymanski & Tiwari, 2007) and also give substantial return on investment (Bansal & Bogner, 2002). The important motivator for ISO 14001 certification is goodwill and enhanced reputation of the firm (Fryxell and Szeto, 2002).

The impact of ISO 14001 certification is primarily social and there are no direct synergies established in research between ISO 9000 quality management system and ISO 14001 EMS certifications. Hence if ISO 14001 certification should go beyond its societal and environmental benefits and enable organisations overall sustainable development, it has
meet the financial objective too (Bansal & Hunter, 2003). Hence it is imperative to study the relationship between ISO 14001 certification, Lean and Green SCM practices and Organizational performance.

2.4.2 Green Drivers

Various research works in the area of GSCM show that there are numerous drivers that influence the implementation of Green SCM practices. (Vachon & Klassen, 2006; Srivastava, 2007; Zhu et al., 2005; Eagan & Kaiser, 2002; Scupola, 2003; Lin, 2007; Peng & Lin, 2008).

Previous studies identified numerous drivers that have a potential to motivate organizations to adopt environmental practices (Ninlawan et al., 2010; Gyaneshwar, 2010, Zhu & Sarkis, 2004, Ma, 2010; Bowen et al., 2001; Zhu et al., 2007). These drivers generally emanate from pressures of external and internal stakeholders such as government, investors, customers, suppliers, community groups and competitors (Donaldson & Preston, 1995; Cetinkaya et al., 2011; Cervera & Flores, 2012; Carter & Jennings (2002; Kilbourne et al., 2002; Rivera, 2004).

In Indian context, increasing pressures from a variety of directions have caused supply chain managers to consider and initiate implementation of green supply chain management (GSCM) practices to improve both their economic and environmental performance (Srikanta, 2009).

Zhu and Sarkis (2004) have shown high and increasing regulatory, market pressure, ecological pressures from governmental and competitive sources have a moderating effect on the relationship between Green SCM practice, environmental performance and economic performance. Spekman et al., (1998), Walker et al., (2008) and Best (1990) have identified the influence of competition on the practices in supply chain
management. High pressure from competitors have also been proved to improve implementation of Green SCM practices in manufacturing firms (Hui et al., 2003; Harwit, 2001).

Harwit (2001) has also revealed that competition was the major driver for implementation of Green SCM practices while export market and regulatory norms were not prominent drivers. Competition has always influenced the paradigm changes in SCM practices in reality (Spekman et al., 1998; Best, 1990). Stakeholder pressure lead firms to pursue green supply chain management practices (Bjorklund, 2010; Maigan & McAlister, 2003; Zhu et al., 2008; Ninlawan et al., 2009; Sarkis, 2001). Since environmental and social issues are interlinked, stakeholders such as NGOs who generally have never been linked to supply chain are also included in few studies (Wu & Pagell, 2011).

New government policies have prohibited products made from environmentally destructive materials and polluting processes. Manufacturers have realized the importance of Green SCM practices due to this regulatory pressure (Huang et al., 2012; Zhu et al., 2005; Eagan & Kaiser, 2002; Scupola, 2003; Lin, 2007; Peng & Lin, 2008; Bai & Rivera, 2004; Hidefumi, 2001; Hoffman & Ventresca, 1999). Changes in government policies have made the industry responsible for post disposal of products forcing the implementation of sustainable operations across the supply chain (Baird & Rowen, 2010; Zhu et al., 2008). Firms that have high regulatory pressures tend to better implement green SCM practices and the pressure driven Green SCM implementation has also resulted in both environmental and economic performance (Zhu & Sarkis, 2007).

Many research works have shown that customer pressure is a primary driver for enterprises to improve their environmental image and practices (Van & Zuidwijk, 2004; Christmann & Taylor, 2001; Baird & Rowen, 2010; Zhu et al., 2008; Hall, 2000). Green purchasing and customer cooperation
on Green SCM practices have also influenced the organizations to practice product take-back and product reintroduction markets (Van Hoek, 1999). A global survey conducted by The Boston Consulting Group in 2009 of more than 9,000 consumers, inferred that 73 percent of consumers consider it important that firms have good environmental records and that a majority of those respondents are willing to pay a premium of 5 percent or more for green products (Kushwaha, 2010). Consumer demand for environmentally friendly products has changed the attitude of the market.

Henriques and Sadorsky (1996) have identified four important types of stakeholders who could exert pressure on the enterprise to adopt GSCM practices: regulatory, organizational, industrial, community groups and environmental. Industry groups hold the primary database of corporate climate change information in the world and have successfully influenced Green SCM practices in various organisations (O'Rourke, 2012).

The literature indicates that there are nine basic drivers for green supply chain initiatives namely; regulations, customer pressures, expected business benefits, social responsibility, supplier pressures, competition, market demand, community pressures, and employee pressures. Most available studies on drivers for green supply chain initiatives support the significant effect of the top four drivers as potential key drivers to green supply chain initiatives (Ninlawan et al., 2010; Gyaneshwar, 2010; Zhu & Sarkis, 2004; Ma, 2010). Some other studies found no significant effect of these drivers on green supply chain initiatives (Bowen et al., 2001; Zhu et al., 2007). The research work has considered the customer, export market, regulation and government policies, industrial group activities, competitors and stakeholders as the six underlying dimensions of Green drivers relevant in Indian context and has investigated the impact on green supply chain initiatives.
2.4.3 Green Support practices

Industry has looked down at green as being optional. But if an organisation wants to maximize profit, being green is no longer an option. Becoming green is no more a fad; it is a change by itself which needs two major change agents to play a role to bring in a drastic change in the supply chain practices as an entity by itself. The support practices are namely Management support and Customer support towards implementation of Green SCM practices.

2.4.3.1 Management Support

For successful adoption and implementation of any technology or change in an organization, top management support is inevitable (Hu and Hsu, 2006; Ninlawan et al., 2010; Murphy et al., 1996; Lippmann, 1999; Zsidin & Siferd, 2001; Trowbridge, 2001; Rice, 2003; Bowen et al., 2001; Zsidisin & Siferd 2001; Chen & Paulraj, 2004). Many such change management has failed due to lack of top management support. Hamel and Prahalad (1989) have stressed the role of the top management and the involvement of senior managers as the main support to implement new technologies, innovations and practices in organisations. GSCM practices to be implemented in any organization involves time, cost and resources (Murphy et al., 1996), it is a strategic decision that has to be implemented with complete support from the top management (Lippmann, 1999; Handfield et al., 2005). It is rather an initiative driven from top to bottom. Total commitment from Senior Managers on GSCM makes the implementation of the practices possible in manufacturing firms (Srikanta, 2009; Hu & Hsu, 2010).

Various studies categorized firms as “Concerned Citizens” because of the Top management commitment and support provided for GSCM practices (Hunt & Auster, 1990), as “Compliance Plus” if the Top management supported Environmental management proactively (Roome, 1992). The
significance of the Top management support in the success of environmental strategy and GSCM practice implementation is cited by many research works (Buysse & Verbeke, 2002; Murillo Luna et al., 2008; York & Rosa, 2008; Crowe & Brennan, 2007; Rice, 2003; Wing & Angel, 2000; Zhu et al., 2008). Eco labeling is considered as a strategic decision from the top management and has been mentioned by various researchers (Klassen & Johnson, 2004; Bowen et al., 2001).

Implementation of any environmental management system and Green SCM practices in organisations is a cross functional activity which makes the commitment from top management inevitable (Yuang & Kielkiewwicz-Yuang, 2001; Bhardwaj et al., 2007, Srikanta, 2009).

Total Quality Management (TQM), is a management philosophy that drives an organization beyond TQM and which arises out of the support from the top management (Toke et al., 2010). TQEM (Total Quality Environment Management) which is an outcome of making a TQM supported work floor green (Curkovic et al., 2003; Corbett & Klassen, 2006). In the context of manufacturing firms, the marriage between environment management and quality management is found to be termed as TQEM (Wu & Pagell, 2011). This emphasis the importance of top management support.

2.4.3.2 Customer Support

Cooperation from customers is very important for a firm to invest on any strategic change in practices (Zhu et al., 2008; Zhu et al., 2010; Ninlawan et al., 2010; Gemi, 2001). In today’s mass customized market, success for firms is based on its responsiveness in creating value propositions that increase the value for the customer. This requires business process integration across the supply chain to create real value for the customer (Jayaram et al., 2008). Customer support can be defined as support from the upstream customers (Zhu & Sarkis, 2007). In today’s business, the term value is moving its meaning from a financial perspective to more a
customer driven one. Environmental practices in the supply chain requires high cooperation from the customer and in today’s customer driven market any change in organizational practices could be successful only if they are substantiated by good cooperation from the customers (Karna & Heiskanen, 1998; Sarkis, 1999). Customers are found to be the motivation for implementation of GSCM practices in many organisations (Zhu & Geng, 2001; Kagan et al., 2003). Customer cooperation and Green purchasing perspective have been studied by Van Nunen and Zuidwijk’s (2004) and Van hoek (1999). GSCM practices require cooperation from customers on Eco-Design, Clean processes and Green packaging (Zhu et al., 2008; Thipparat, 2011; Zhu & Sarkis, 2007). Manufacturers would be reluctant to implement green supply chain management practices if they don’t get the required support and cooperation from the customers (Luthra et al., 2011). Firms today strive for customer cooperation to ensure lifetime share of business (Mentzer et al., 2006). It also forms the basis for inter firm relationships (Lalonde, 1997).

2.4.4 Green SCM Practices

Manufacturing firms have the need to develop a framework to implement Green SCM practices effectively and efficiently (Srikanta, 2009). The extensive review of literature and some findings of the deductive research undertaken on Green SCM practices shows varied approaches. Stephan (2007) conceptualized GSCM practices into two - environmental collaboration and environmental monitoring. Messelbeck & Whaley, (1999) considers the environmental effects of researching, developing, manufacturing, storing, transporting, using and disposing of the product. Researchers have identified four kinds of Green SCM practices, including internal environmental management, external environmental management, investment recovery and eco-design (Zhu et al., 2007; Hu & Hsu, 2008; Ninlawan et al., 2010).
Emmet and Sood (2010) have classified Green SCM practices as Green procurement and supply, Green production, Green packaging, Green marketing, Green Logistics and Supply loop. Shaw et al., (2010) have classified Green SCM practices as green purchasing, waste minimization, TQM, customer focused approach and continuous improvement. Sanjeevkumar et al., (2012) has studied the Indian Supply chain with 14 Green SCM practices including eco-procurement, customer cooperation, eco-logistics, economic and environmental performance. Shang et al., (2010) has used six dimensions of Green SCM practices. Many organisations that implemented Green SCM practices have reported that they have implemented green procurement, green design and manufacturing, green transportation and warehousing and reverse logistics have generated favorable environmental performance and financial performance (Sarkis, 2003; Zhu & Sarkis, 2006; Chien & Shish, 2007; Srikanta, 2009).

An extensive review of literature of Green SCM practices indicates four major functions-Green Inbound practices: Purchasing (Ninlawan et al., 2010; Sanjeevkumar, 2012), and Inbound logistics (Manish, 2011), Green operational practices: Design and Production (Ninlawan et al., 2010; Toke, 2010; Sanjeevkumar, 2012; Halme et al., 2002; Green outbound practices: distribution and Out-bound logistics (Toke, 2010) and Reverse logistics (Toke, 2010; Sreevatsa, 2007; Tonanont, 2008). A number of integrative issues potentially affecting each of these functional areas are justified with two more supportive components - management support (Lippmann 1999; U.S. AEP, 1999; Evans & Johns, 2005; Handfield et al., 2005) and customer support (Zhu et al., 2010; Ninlawan et al., 2010).
2.4.4.1 Green Inbound Practices

The innovation and implementation of the concept of Green in purchasing procurement / supplier and inbound logistics is a well-researched area (Green et al., 1996; Handfield et al., 2005; Yang & Kielkiewicz, 2001; Narasimhan & Carter, 1998).

Green procurement can be defined as environmentally preferable purchasing activities that include the reduction, reuse and recycling of materials (Srikanta, 2009; Min & Galle, 2001; Prevss, 2001). It is a solution for environmentally concerned and economically conservative business (Salam, 2008). Dimensions of Green purchasing includes supplier cooperation and suppliers’ internal management (Zsidisin & Hendrick, 1998). Training programs for employees and suppliers have been reported by researchers to improve organisational sustainability (Wu et al., 2002; Lueneburger & Goleman, 2010).

Green SCM practices such as cooperation with suppliers for environmental objectives (Seksan et al., 2010; Zsidisin & Hendrick, 1998; Zhu and Cote, 2002; Hu and Hsu, 2010; Ninlawan et al., 2010; Baver, 2000), environmental audit for suppliers’ internal management (Handfield et al., 2005; Yang & Kielkiewicz, 2001; Zhu et al., 2005), Suppliers’ ISO14000 certification (Walton et al., 1998; Baver, 2000), Second-tier supplier environmentally friendly practice evaluation (Walton et al., 1998), supplier training (GEMI, 2004).

Green supply chain management practices does not end with Tier 1 suppliers but also includes subsequent tiers of suppliers (Walton et al., 1998). Supplier auditing and certification are increasingly more important for environmental sustainability (Wu et al., 2010). Many Fortune 500 firms including HP, Dell and Walmart have reported regular audit for their suppliers’ environmental footprints (Scarlet & Dallemand, 2011; Berghoef & Dodds, 2011). Green purchasing focuses on the inbound supply chain of
the organisation (Zhu & Cote, 2004). Demand collaboration is noted as a major process in green procurement (Srikanta, 2009; Sarkis et al., 2004) have mentioned that green procurement, supplier relationships and information sharing are the most crucial practices of GSCM. Local sourcing is the physical nearness of the firm and has found that it improves the environmental performance of the organisation (Frosch, 1994).

The major issue in inbound Green SCM practices and the controversy that commonly arises is the use of just-in-time (JIT) practice common in today’s manufacturing industries (Khaswala & Irani, 2001). This practice is meant to reduce inventory, but it also raises a controversy that less amount of inventory also means more number of delivery and small batches production (McIntyre et al., 1998; Penman, 1994; Sarkis, 1995; Wu & Dunn, 1995). Another factor related to JIT and supplier management is that fewer suppliers are usually used in a JIT environment (Wu & Dunn, 1995).

### 2.4.4.2 Green Operational practices

The internal supply chain of the organization that is within the factory premises is considered as green operations. The two major supply chain activities with the organization are Design and Production. Green design and manufacturing are two important aspects of GSCM that has been extensively researched and quoted from various studies (Manish et al., 2011).

#### 2.4.4.2.1 Green Design

Green design is an important sub-attribute to Green supply chain management. It is about designing a product or a service with environmental awareness (Srivatsava, 2007). As a result of the Rio Summit on the Environment (1992), the growing pressures calls for firms to green their design. Several literatures have extensively quoted on
Green Design (U.S. AEP, 1999; Rao, 2002; Pujari et al., 2003; Yuang & Kielkiewicz, 2001; Zhu et al., 2005; Lewis et al., 2001; Hu & Hsu, 2010). The first green design literature came from Navin-Chandra’s (1991), Ashley (1993), Allenby and Richards (1994) and Zhang, Kuo, Lu and Huang (1997) have used the context and have attempted to expand the framework of green design. Life-cycle analysis was an example of a framework that was a contribution of the work on green design (Arena, Mastellone, & Perugini, 2003; Beamon, 1999; De Ron Penev, 1995; Srivastava, 2007; Gungor & Gupta, 1999; Ninlawan et al., 2010).

Green design is also quoted as design for the environment, for disassembly and product life cycle assessment, specifically to consider environmental aspects in products design. The product life cycle assessment is described as a process of analyzing and evaluating the consequences of material and energy flows of a product in relation to the environment in all phases of its life: extraction and processing of raw materials, production, transport and distribution, use, re-manufacturing, recycling and final disposal (Srivastava, 2007; Jonathan et al., 2007; Rebitzer et al., 2004). Environmental impact and design of the product are positively related. (Lewis and Gretskis, 2001). The success of eco-design requires cooperation throughout the supply chain (Zhu et al., 2006; Ninlawan et al., 2010).

2.3.2.2.2 Green Manufacturing

Green manufacturing is defined as production processes using inputs with relatively low environmental impacts, which are highly efficient, and that generate little or no waste or pollution (Atlas & Florida, 1998). This has been a well-researched area (Florida, 1996; Gupta, 1995; Klassen & McClaughlin, 1996; Sarkis, 1995). Clean production, the common name for green manufacturing is noted as the main component of organizational sustainability (Halme et al., 2002).
Green Manufacturing concept was first conceptualized in the research work of Crainic et al. (1993). The concept of green manufacturing was then developed further by Van Der Laan and Salomon (1997), Guide and Srivastava (1998), White et al., (2003), Ninlawan et al., (2010), and Srikanta (2012). Many extensive reviews exist on GSCM, quote on green production (Bras & McIntosh, 1999; Sarkis & Cordeiro, 2001; Van derLaan, Salomon & Dekker, 1996; Zhang et al., 1997).

Darnall et al (2008) critique Green SCM practices in production floor by citing that Environmental Management Systems (EMS) are making less progress in reducing environmental harms. This is a very common controversy to quote GSCM as just a management philosophy and as not successful in practice. Closed-loop manufacturing is one of the measures that can be used to improve the environmental performance of the internal supply chain (Jayaram et al., 2007). The philosophy of zero-emissions drives closed-loop manufacturing practice. It is a process of producing products with no negative environmental impact (Hasek, 1997).

Many international firms have implemented closed loop manufacturing in their shop floor with a popular technique called the onsite material recovery facility (MRF) (Toke et al., 2010). In Indian context, Green manufacturing has been studied with fifteen underlying dimensions and were reported to be low (Sanjeevkumar et al., 2012). It is a system designed in manufacturing to minimize the environmental impact of the products and processes. It helps organisations to reduce waste and pollution (Hui et al., 2001; increase market share and profit (Zhu & Sarkis, 2006), lower environmental impact and enhance production efficiency (Chien & Shih, 2007). Minimise energy and resource consumption in order to reduce the use of virgin materials (Srivatsava, 2007). In this research Green manufacturing practices was measured by six dimensions, ongoing
assessment of Green SCM compliances, reduced carbon emission on production process, use of fuel efficient tools and machines, optimized processes to reduce waste, cleaner technology processes to save energy and resources and internal recycling of materials within the shop floor (Toke et al., 2010; Manish et al., 2011; Zhu & Sarkis, 2006; Ninlawan et al., 2010; Sanjeevkumar et al., 2012; Chein & Shih, 2007).

2.4.2.3 Green Outbound Practices

Green outbound practices consist of green packaging and green logistics. Packaging characteristics such as size, shape, and materials have an impact on distribution because of their effect on the transport of the product (Seksan et al., 2010). Better packaging, along with rearranged loading patterns can reduce materials usage, increase space utilization in the warehouse and reduce the amount of handling required (Ho et al., 2009).

Purchasing and in-bound logistics focuses on managing the vendor-organization relationships of the supply chain while distribution and out-bound logistics function is meant to address the organization-customer relationship issues (Toke et al., 2010; Ninlawan et al., 2010).

The design of a logistics network and its planning are two important strategic issues facing logistics managers in this function. Many trade-off decisions need to be made with regard to the firm's market, customer, product and logistical resources. Logistics decisions include options such as direct shipping or hub-and-spoke, central warehouse or distributed network, intermodal or single mode, and third party services or private fleet. Some of the design and management criteria that support environmental planning in this area include fewer shipments, less handling, shorter movements, more direct routes, and better space
utilization. But, each of these issues includes tradeoffs among delivery time, responsiveness, quality and cost, as well as environmental performance (Toke et al., 2010).

The green supply chain prescribes a reduction in the delivery frequency in order to reduce the carbon emission. It could be resolved not only through the reduction in delivery frequency but also using other strategies as proper selection of transportation modes, reducing geographic distances between entities and order consolidation (Helana & Machado, 2008). There is yet another major challenge in outbound practices called warehousing (Mentzer et al., 2006) and freight consolidation (Wu et al., 1995).

Among Indian firms Green outbound practices seem to be in quite advanced level (Bhateja et al., 2011). This is most likely due to the high cost of transportation and logistics handling. Organisations foster green outbound practices as it also adds to the speed and overall efficiency of delivery from the manufacturers to the customer. From extensive literature review green outbound practices was determined by five underlying dimensions, use of less or recyclable packaging materials, reduced inventory and handling of products, use of green warehousing techniques, optimization of location of distribution hubs and order consolidation (Bhateja et al., 2011; Chein & Shih, 2007; Zhu & Sarkis, 2004; Wever et al., 2007).

2.4.2.4 Reverse Logistics

Reverse Logistics is the opposite of traditional or forward logistics (Beamon, 1999; Dowlatshahi, 2000; Krikk et al., 2004; Schuttmann et al., 2006). It is defined as a process where a manufacturer accepts previously shipped products from the point of consumption for possible recycling and
re-manufacturing (Carter & Ellram, 1998; Dowlatshahi, 2000). Reverse logistics has been widely used in automobile industries such as BMW and General Motors. Other firms such as Hewlett Packard, Nokia are also using reverse logistics as a supply chain process (Thierry et al., 1995). This eventually helps firms become more competitive in their own industry (Srivastava, 2007; Ninlawan et al., 2010) and has become a field of rapidly growing importance (Linton et al., 2007). This helps green supply chain management to form a closed loop supply chain including the disposal of products (Europa & Witt, 2000; Defie et al., 2009).

An increasing number of organisations in Asia, Europe and North America engage in voluntary or mandatory end-of-life product management. Moreover, since developments in product take-back are driven by a mixture of environmental concerns and economic opportunities, the most promising corporate end-of-life strategies create both economic and environmental values (Geyer & Jackson, 2004).

GSCM and logistics efforts have caused organizations to consider closing the supply chain loop (Beamon, 1999; Seuring, 2004). Many researchers have provided conceptual studies on reverse logistics (Kelle & Silver’s, 1989; Pohlen & Farris, 1992; Stock, 1998; Tibben & Limbke, 2002; Carter & Ellram, 1998; Srivastava & Srivastava, 2005; Shih, 2001; Nagorney & Toyasaki, 2005; Min et al., 2006). But reverse logistics is a roadblock in many organisations due to its low adoption level (Rao, 2002; Puckett and Smith, 2002).

2.5 Organisational performance

Organisational performance can be defined as the output or results of an organization as measured against its intended outputs (Richard et al., 2009). The measure of organizational performance is a challenge to define
due to the multidimensional nature of performance. Many research works have reported multiple measures for organizational performance (Baum & Wally, 2004; Contractor et al., 2003; Miller, 2004; Peng, 2003; Monge et al., 2006).

Research on organizational performance is being carried out to understand and improve performance. Hence they adopt disciplined specific measures (Chenall & Cangfield-Smith, 2007). Quality management study by Prajogo and Sohal measured organisational performance as quality performance and innovation performance, Lin et al., (2005) measured with three variables - satisfaction level, business results and quality performance. Lakhal et al., (2006) measured organizational performance by financial performance, operational performance and product quality. Link between the context of research and the variables to predict organizational performance is critical. In this research work organizational performance will be measured through two categories, which are environmental performance and financial performance.

2.5.1 Environmental Performance

Environmental performance is defined as the measure of reduction of substances, emissions and environmental improvement in a business organization (Zhu et al., 2004; Wu et al., 2010; Ninlawan et al., 2010; Sanjeevkumar et al., 2012; Bhateja et al., 2011; Sarkis, 2003; Chein & Shih, 2007). It also helps to improve efficiency and synergy among business partners and helps to enhance environmental presence, minimize waste and achieve cost saving (Rao & Holt, 2005) and goodwill (Cervera & Flores, 2012). Globalisation has caused various pressures and drives the manufacturing industry to improve their environmental performance (Zhu & Sarkis, 2006). Environmental performance is measured in many research works. Researchers have proved that GSCM
practices enhance environmental performance in organisations (Chan et al., cited in Lou, 2011; Hu & Hsu, 2010; Efron, 2009; Cervera & Flores, 2012; Ninlawan et al., 2009; Zhu et al., 2007; VarioCorderio & Sarkis, 1997; Walley & Whitehead, 1994).


Green supply chain management practices help improve the performances of the organization upon sharing required relative environmental information and joint planning environment-related solutions among upstream suppliers and downstream customers (Vachon & Klassen, 2008). Environmental performance focused on the reduction of polluting substances, emissions and environmental improvements, while economic performance focused on the reduction of manufacturer waste cost and environmental disaster fine. The main purpose of green supply chain management is to reduce environmental pollution by creating green products starting from adapting green materials, designs, manufacturing and packaging to reduce resource and environmental pollution (Wu et al, 2010).

Many research works have proved that GSCM practices enhance environmental and economic performance in the organisations (Zhu & Sarkis, 2004; Chan et al., 2011; Hu & Hsu, 2010; Efron, 2009; Cervera & Flores, 2012; Ninlawan et al., 2009; Zhu et al., 2007; Alvarez
et al., 2001; Rurso & Fouts, 1997; Judge & Douglas, 1998; Melnyk et al., 2003; Christmann, 2000). There are also controversial results showing that there was a slightly improved environmental and operational performance, and no significant economic performance improvement. There have also been controversial arguments. Some researchers have also shown a negative relationship between economic performance and GSCM practices (Bowen et al., 2001). Zhu and Sarkis (2004) in their research established a positive relationship between Green SCM practices and Environmental and economic performance in firms with high Quality management or lean practices. Poor environmental performance actually impairs firms’ performance (Corbett and Klassen (2006).

An improved environmental performance in firms actually doesn’t increase the cost but rather leads to better economic performance of the firm (Ambec & Lanoie, 2008; Iwata & Okada, 2011; Hart & Ahuja, 1996; Zamri et al., 2013).

2.5.2 Financial Performance

Supply chain management practices have always played a significant role in improving the firm’s performance (Jain et al., 2010; Croom et al., 2000; Wisner & Tan (2000); Tan et al., 1998, Baird & Rowen, 2010).

Srinivasan (2004) reports that a case study of Fortune 1000 firms from across the world has proved that implementation of LSCM practices has directly enhanced the firm’s financial performance. Green supply chain management (GSCM) has emerged as an important new approach for enterprises to achieve profit and market share objectives (Hu & Hsu (2010). Research works on GSCM practices have proved that a green supply chain is not only necessary for sound environmental management, but it is also profitable and provides sound financial management, despite the myth that says it involves additional expenses (Alvarez et al., 2001; Zhu et al., 2005; Tooru, 2001; Pagell et al., 2004; Dodgson, 2000;
Samyadip, 2010; Sarkis & Corderio, 2001; Melnyk et al., 2003; Cervera & Flores, 2012). A firm’s performance has both a short term goal to improve productivity and reduce inventory and lead time and a long term goal to increase market share and integration (Koh et al., 2007). Some researchers have measured firm’s performance by lead time, inventory product return, sales, cost reduction and meeting customer requirements (Ardianto et al., 2013; Petrovic-Lazarevic et al., 2007).

Various research works have proved that information sharing among the members of the supply chain has improved the firm’s performance (Boubekri, 2001; Molwani et al., 2000; Anatdespnaide, 2012). Lean adopters have improved financial performance relative to the non-adopters and profit margin improvement has been the primary source of the improvement in the financial performance of the organization (Micheal & Wempe, 2002; Green & Inman, 2005; Tan et al., 1998).

Zhu and Sarkis (2004) have reported a positive economic performance improvement in relation to the adoption level of GSCM practices. But Corderio and Sarkis (1997), Bowen et al., (2001) has reported a negative relationship between GSCM practices and financial performance. The relationship between firms’ environmental and economic performance is measured to ascertain the performance of the firm (Wagner et al., 2001).

Lean processes are found to help organisations reduce inefficiencies in the supply chain and subsequently improve the financial performance of the firm (Jamshed, 2005). The value creation or waste elimination that forms the important practice of lean always has a positive impact on the firm’s financial performance (Walker, 2005; Antony, 2005). In contrary some studies have also reported no positive relationship between Lean and firm performance (Jayaram et al., 2007; Womack et al., 1991; Boyer, 1999; Shah & Ward, 2003).
Many empirical studies have used subjective ratings to measure the dimensions of a firm’s performance since respondents are often unwilling to release sensitive financial and market performance (Porter, 1979; Vickery et al., 1993; Ward et al., 1994; Ninlawan et al., 2010; Jayaram et al., 2007).

Financial performance is a cumulative effect of the all the factors influencing the overall working of the organization and it can be represented by market share growth, sales increase, ROI, profit margins and reduced inventories (Tan et al., 1999; Donton et al., 1996; Lambert et al., 2004; Li et al., 2005; Venkatraman & Ramanujam, 1987; Anantdeshpande, 2012; Stock et al., 2000; Li, 2002; Hu & Hsu, 2010; Montabon et al., 2007; Boyer et al., 1997. Kaynak (2003) has included ROI, sales growth, profit growth, market share growth and lower inventory turnover as the variables to ascertain firms’ performance.

Today’s business organisations are facing the increasing pressure of balancing the economic and environmental performance (Khoo et al., 2001). With global competition for natural resources and tightening of environmental regulations, the debate of whether or not Green pays or costs has moved towards finding ways to be green and profitable (Kleindorfer, 2005; Wu & Pagell, 2008). Combination of Lean and Green can help firms increase environmental and economic performance, while they together help traverse a path towards sustainability (Zamri et al., 2013). Under pressure of competition, regulations and export market, firms now work towards balancing environmental and economic performance. In response to this, the implementation of Lean and Green SCM practices can help managers walk towards organizational performance. Hence sustainability is the challenge to be resolved with the methodology followed in the research.