CHAPTER II

REVIEW OF LITERATURE

This chapter attempts to make an extensive review of literature on the study area. Literature reviews clearly indicate the need for an in-depth study of the entire SCM-Logistic process across various categories. Review indicates varied opinions across the end user category and hence underlines the need to understand the real situation prevailing across different segments of industrial sectors. The review also indicates the fast emergence of an IT enabled SCM process across the various industrial sector also indicates the slow penetration and acceptance across the actual users rather than the decision makers. This chapter details on the past researches in an exhaustive way with the objective of highlighting the role of e-SCM and e-logistics and identifying methodologies used in previous researches. For each SCM process, the researcher also provides a summary of the existing studies.

2.1 Supply Chain Relationships

SCM is “the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole”[1]. In the traditional SCM, companies strategically segment their relationships and establish arm’s length relationships with supply chain members, strategic partnerships and alliances with others. Internet has an impact on how companies manage all type of relationships. For the strategic partnership approach, Internet enables companies to share information and knowledge and to plan jointly, leading to higher levels of coordination and collaboration. Cagliano et al. explored the actual adoption of Internet technologies in supply chain processes with the aim to analyze relationships between Internet adoption, contingent factors and integration mechanisms.

Four e-business strategies were identified namely traditional companies, e-sellers, e-purchasers and e-integrators. Their relationship with contingent factors and supply chain integration mechanisms were investigated. Their results showed a close link between the use of Internet tools and the level of integration with customers and suppliers, thus suggesting the need to define e-business strategies in coherence with the use of traditional
integration mechanisms [9]. Frohlich and Westbrook's paper empirically addressed two main questions on the existence of a positive relationship between e-integration and performance and the main barriers in integration. E-integration was analyzed in different processes upstream and downstream [10]. Gunasekaran, H.B. Marri et al attempted to define e-commerce and examined major e-commerce elements that linked organizational systems. They examined the application of e-commerce in manufacturing, retailing and service operations, and proposed a framework for describing e-commerce components and their role in different areas of an organization [11]. Johnson and Whang in their paper examined changes in SCM due to the web. Their review on the impact of e-business on SCM was classified into three main categories namely e-commerce, e-procurement and e-collaboration [12]. All this explore the actual adoption of IT technologies in supply chain process and the need for e-integration and performance, investigating the main barriers that decide the integration strategies and performance in manufacturing and services that decides the change in SCM process due to IT implementation.

2.2 SCM Planning and Optimization

When firms anticipate problems, they respond better to the needs of the customer. Key elements of SCM like Planning and optimization require information on customers, markets and channels. In e-SCM they are related to Web decisions based on data management, statistical analysis, forecasting, data mining and heuristic solution methods. Many of these applications are available through Application Service Providers (ASP). ASP'S host specific applications for a charge and can be used by other companies. These services are critical to small firms, who cannot afford the major investments in infrastructure needed to participate in the collaborative supply chain. Internet has impacts technology based decisions. It improves planning and optimization within a supply chain by providing access to an enormous quantity of data and information in decision support systems. Cohen, Kelly et al. presented several case studies of Web-based applications of data management, statistical analysis, forecasting, data mining and operations research. They optimized decision support tools built through web applications ranging from large-scale production and distribution to inventory replenishment problems [13]. Geoffrion, and R. Krishnan in their work presented a general description of Operations Research (OR) contributions to the
digital economy. They reviewed applications and opportunities in four different areas namely information goods and services, supply-chain management, network infrastructure and software tools for decision technologies [iii].

Keskinocak and Tayur described the impact of quantitative models on supporting company decisions and obtain insights for a better management of the supply chain. The techniques can have a significant impact on firms operating based on the Internet. [vii]. Lee and Chen’s work presented a Web-based optimization tool to solve a complex and practical production-planning problems for a chemical manufacturer. The framework allowed users with a Web browser to access this tool and interactively compute optimal production plans on any computer platform [vii]. Shen, Kremer et al. presented Collaborative Agent System Architecture for implementing an agent-based Internet enabled collaborative supply chain management system. The authors also presented a case study where this system was applied to a multi-plant production planning [v]; Sodhi 2001 in a research paper described how Operations Research can improve planning and execution in Internet-enabled supply chains. The work referred to several supply chain processes from customer-relationship management to procurement, and described the relationship between Internet-based OR applications and systems like ERP and APS [vi]. Jayashankar et al. work presented an overview of analytical and operation research models applied to supply chain planning and execution. The authors discussed several supply chain management areas like supplier selection, pricing and distribution, customization and postponement [vi].

2.3 ERP Information flows

ERP systems provided the ability to access information within the organization. The advantages of ERP’s full potential could not be explored mainly due to lack of common standards and access cost. e-business enabled information sharing with other supply chain members from ERP systems [viii]. Information sharing alters supply chain processes. Inventory can be reduced due to better forecasts. The allocation of inventory in different retail outlets can be done more effectively. Firms can use advanced planning and optimization tools on the available information and implement collaborative planning and design. Bal, Wilding et al. described the information flows in a supply chain. Virtual
teaming, enabled by Internet technologies, was presented as a tool for introducing agility in the supply chain. The paper presented the results of a case study to show that a virtual team could improve the flow of information and dampen turbulence through the ability of members to behave as a team, sharing knowledge and expertise, regardless of location. Chan and Chung in their case-study exemplified the use of a sophisticated information system to support contract manufacturing and a business model to transform SME (Small and Medium Enterprises) business processes in the information [xii]. Mondal and Tiwari in their paper implemented a kernel programming language to efficiently coordinate and streamline the functionality of a supply chain in terms of data transaction using mobile computing [xiii]. Inter-organizational interactions can be transformed by adopting a virtual enterprise.

Automated electronic third party mediation (or brokering) mechanisms play an important role in this environment. Sarkis and Sundarraj’s paper provided an analysis of the brokering situation of the e-commerce enabled organizations [xiv]. Information flows are crucial for carrying out an effective and efficient management of the supply chain. To support the flow of information, communication systems like EDI, have a high cost of implementation, making it out of reach of many SMEs. Stefansson’s paper discussed about new perspectives for SME’s with the advent of Internet [xv]. Tatsiopoulos in their study presented a methodology and a case study for SCM making extensive use of the virtual enterprise paradigm. The main research goal was to design and implement a prototype e-business software component and carry out several tests. The research effort resulted in an extended production data management system, which supported the business processes of customer order management, subcontractor selection and multi-site/multi-firm production orders release [xvi]. Turowski in his paper proposed an approach to support distributed, logically integrated inter-company business processes by applying e-commerce techniques. The paper based this tremendous opportunity to conduct business electronically on the Internet [xvii]. A virtual factory is a community of factories linked by an electronic network, each focusing on their tasks enabling them to operate responsibly and inexpensively. The network continuously exchanges information. Upton and McAfee in their paper identified two critical elements namely broker and the open standard protocols for success of the
factory. The paper specified the demands of a virtual factory and information-brokered internet work solution \[^{19}\].

Van Hoek described the role of the supply chain in an e-business model, and the importance of the integrated flow of information along the supply chain for strategic advantages \[^{20}\]. Wilson and Clarke’s work described a possible the industry standard for the design and development of software for collation and dissemination of traceability data \[^{21}\]. Yoo and Kim In their paper presented a web-based knowledge management system for facilitating seamless sharing of product data amongst application systems in a virtual enterprise. The knowledge management system provided users with a map of the product data to locate required information, enabling a content-based search to improve search effectiveness and supported automatic translation and reuse of product data between application systems throughout a product’s life cycle \[^{22}\].

2.4 Product Developments and Commercialization

Product Development and Commercialization are critical for a firm to succeed. According to Croxton et al\[^{23}\] the aspect includes the activities such as defining new products, establishing the cross-functional product development team, designing and build prototypes, determining the distribution channel for the new product and measuring the process performance. It also includes integrating customers and suppliers into the product development process in order to launch the right product with a reduced time. Cheng, Pan et al, developed a web-based application with an aim to provide design or manufacturing expertise to customers.

The customers could rapidly access the system's built-in design and manufacturing expertise \[^{24}\]. Elliman and Orange proposed an electronic market for the design and supply capability in the construction industry for facilitating the selection of suppliers. The paper also discussed some of the research issues raised by such a prospect. \[^{25}\]. Finch’s objective was to evaluate the potential of the Internet based discussions and provide detailed information about existing products. His work suggested that, for some companies, such information would be a valuable supplement to product design and quality conformance improvement efforts \[^{26}\]. Xie and Salvendy identified major factors that affect the
efficiency of engineering collaboration over the Internet and developed the prototype of a CAD browser taking into account the features that enhance communication, coordination and collaborations [xviii]. Xie, Tu et al. presented a web based integrated product development platform for intelligent concurrent design and manufacturing of sheet metal parts. It allowed multiple designers to participate in the process irrespective of location. The system also allowed the designer to understand the downstream process requirements (such as manufacturing requirements) and to design a product correctly in the first instance [xix]. Xie, Tu et al reviewed the existing systems for one-of-a-kind (OKP) products and the recent approaches of Internet-based design and manufacturing systems and discussed the requirements for the next generation of OKP systems [xx]. The existing studies have covered the areas of e-commerce, information sharing and knowledge sharing, and the upstream, internal and downstream perspectives. However, only one study, out of the six found, is empirically based.

2.5 e-Procurement

Any firm has to define manufacturing and sourcing strategies while identifying the products and services acquired from outside [xxi] both at the strategic and operational levels.

The e-procurement process supports the procurement and sourcing activities via Internet technologies and enables an efficient negotiation between buyers and suppliers. There are Two types of e-procurement namely B2B and marketplaces. B2B e-procurement is a one to one relationship between firms. Marketplaces are a multi-enterprise environment, which enables customers and suppliers to announce buying and selling intentions. The activities are real-time using the Internet medium. Marketplaces bring multiple buyers and sellers together in a virtual market. Several firms have implemented e-procurement solutions to reduce costs and make it more efficient. Knowledge sharing is the key issue in this process and firms can apply analytical models to existing data and obtain important information to make better decisions [xxii]. Boyer and Olson in [xxiii] evaluated the ways firms utilized the Internet to streamline their purchasing process. The survey found that companies realized performance benefits by utilizing the Internet as a purchasing tool. Calosso et al. in [xxiv] their paper presented an Internet platform for business-to-business e-procurement process
for small-and-medium enterprises with make-to-order operations. The authors examined in detail the structure of a standardized negotiation process occurring in a multi-enterprise setting and present three mixed-integer linear programming models for use by the involved parties. Carr [xxxv] presented an online auction model extending previous models by considering service procurement auctions that end without achieving a contract despite active bidding. Emiliani presented a comparison between online auctions and traditional procurement.

Emiliani evaluated the business-to-business online auctions for direct materials and discusses main organizational issues as price, cost and stakeholder reactions generated when online auctions are introduced to traditional purchasing organizations [xxxvi]. Emiliani and Stec in their work examined the use of online reverse auctions for the specific case of custom-designed machined parts, [xxxvii] presented a literature review on Internet-based business-to-business marketplaces (EM), discussing the main aspects and calling for more supply chain management research within this field. The paper also described SCM for EM examination by analyzing different types of EM relationships like transactional, information sharing, and collaborative. Hohner, Rich et al. described a procurement auction web-based system, called Mars-IBM that enabled buyers to incorporate complex bid structures and business constraints into strategic-sourcing auctions. The system was based on solving the winner-determination problem, formulated as an integer-programming problem [xxxviii]. Kaplan and Sawhney presented a description of how electronic hubs work and how they are crucial to creating a successful e-business strategy. The authors presented a classification framework that provides an explanation of different e-hubs and how they add value [xxxix]. Knudsen’s work presented a framework for assessing alignment between corporate strategy, procurement strategy and purchasing tools. The framework was built on generation of rent. [x]. Olson and Boyer in [xi] analyzed how individual users’ views and preferences affected the use of Internet as a purchasing medium. The authors presented an exploratory study, based on clustering analysis of data gathered through a survey of customers. Mahadevan developed a classification scheme for B2B market structures that overcame limitations of previous research work.
Mahadevan presented in his study operation of 200 B2B sites and concluded that electronic markets fall under three distinctive categories: collaborative mechanism, quasi-market mechanism, and pure market mechanism. The mechanisms provide several value-creating opportunities [16]. Sparks and Wagner's work explored the impact of Internet-based retail exchanges on SCM, considering concepts like Quick Response, Efficient Consumer Response and Collaborative Planning, Forecasting and Replenishment [17].

2.6 e-Fulfillment Process

Order fulfillment is related with the effective management of activities needed to deliver the order to customers. At the strategic level, the need to design an efficient supply chain to enable a timely and accurate order fulfillment exists. At the operational level, the order fulfillment process consists on defining activities to generate, communicate and process to pick and to deliver customer orders [18]. The process is an integration of manufacturing, logistics and marketing functions to ensure customer satisfaction and reduce the total cost on order fulfillment. Internet impacts order fulfillment in two main aspects. The first one is related to e-commerce and consists of fulfilling the customer orders placed through Internet, which ensures efficiency in placement of orders. In selling, the order fulfillment might be more expensive. The critical operation of obtaining customer satisfaction and comments can be obtained in order-fulfillment with new innovative strategies based on a good use of information and leveraging on existing resources [19]. The second aspect is related to the use of Internet to improve the efficiency of the order fulfillment process for both online and offline businesses. Order fulfillment process requires accessing and manipulating large amount of data. The advantage of accessing and sharing data along the supply chain using Internet technologies can make this process more efficient and less costly. The possibility of all partners in a supply chain to view real time orders can lead to a significant reduction of variability and costs and at the same time, improve the responsiveness of the firm.

Firms can also use this data to generate knowledge by applying sophisticated analytical tools in anticipating changes and be better prepared to respond to customer demands. At the operational level, these tools can go from statistical forecasting methods to analyze customer’s orders, to inventory systems to obtain the optimal inventory, to vehicle routing
systems to design the most efficient delivery routes. And, at the strategic level, these analytical tools can be used to design the most efficient supply network. Boyd, Hobbs et al. evaluated the impact that customs and inspection fees have on B2C e-commerce for food products. The authors concluded that the customs and inspection fees have an important impact on the expansion of e-commerce into international markets [vii]. Crowley analyzed the impact of information technologies on transportation, and in particular in the demand for transportation and the respective market [vii]. Da Silveira identified the distinctive competencies in the operations and management of e-commerce companies. The study concluded that Operations Management plays an important role in the e-commerce and this requires the development of a series of distinctive competencies [viii]. Delfmann, Albers et al. analysed the impact of e-commerce on logistics service providers. They argued on the logistical implications of e-commerce and differentiated them into two main categories namely the rise of e-marketplaces and the elimination of supply chain elements. The challenge of the e-commerce, flexible capacity management and global presence strategies for logistics service providers was also addressed in their work [ix].

Dewman, Freimer et al. in their article studied the design of distribution channels on goods information using Internet. The authors presented Nash equilibrium between Internet Service Providers and Property Content Providers to analyze the impact of the distribution channel on a firm’s performance. This work is attributed to distribution network design for information service industries [i]. Kämäräinen in his paper examined different solutions for grocery home delivery affecting the service levels offered to consumers. The solutions included pick-up by customers, reception boxes and attended reception. They concluded that the way e-grocery consumers receive goods impacted the grocery supply chain [i]. Kelleher, El-Rahalibi et al presented an Internet-based system, called PISCES, that supported the control, expedition and scheduling of multimodal transportation and specifically container transportation. The paper also demonstrated how information from an Internet system could be used to improve and optimize the transportation routes [ii]. Kotzab and Madlberger developed and applied a Web-scan framework to analyze Web offering and logistics elements of several European e-tailing firms assuming that stored-based retailers considered electronic retailing as an alternative distribution channel [iii]. Lee in his paper described how demand and supply uncertainties can be used to design the right supply chain
strategy. He used Internet as the backbone in the development of this design, since the information sharing and collaboration can lead to more efficient supply chains, in particular for innovative products with unpredictable demand [15]. Marinus and De Koster in their paper investigated the relation between constructs in operational complexity and the company's distribution structure used for the fulfillment of Internet orders.

The authors concluded that different fulfillment options are possible depending on the type of food-retail company [16]. Punakivi, Yrjölä et al. in their work analyzed the problem of the "last mile" in ecommerce, which is particularly an important difficulty in food companies. The authors performed a simulation to evaluate the impact of unattended reception of goods using two main solutions of reception and delivery boxes. They implied that the unattended reception of goods reduced home delivery costs up to 60% [16]. Starr in his paper analyzed the impact of operation maintenance on the profitability of B2C. It analyzed the annual reports of an e-retailer, Webvan, and surveys from other firms operating in the B2C world. The main objective of the work was to evaluate the impact of Operations Management on the Webvan's business failure. The paper discussed on Internet retailing model as a challenge for operations management in dealing with in-store and Internet systems [16]. Vannieuwenhuyse, Gelders et al. analyzed a logistics decision maker’s perception concerning the transportation modes. They also presented an Internet-based tool to support the transportation mode decision process based on Multi-Criteria Decision Making [16]. Yrjölä’s work evaluated the cost structure of supply chain structures using simulation techniques and analyzed several supply chain structures in electronic grocery shopping with a model based on a local distribution center and a hybrid model using a local distribution centers and stores [16].

2.7 Demand Management Process

The Demand Management process needs to balance the customers’ requirements with a firm’s supply capabilities [16]. This includes forecasting demand and synchronizing it with distribution, production and procurement. Internet impacts this process throughout the supply chain. Information sharing on actual sales enables companies to improve their forecasts affecting both the upstream and downstream links. Internally, this information
sharing can improve forecasts, leading to an improvement in production planning and a reduction in stock levels. Sharing also enables the dealer/supplier to eliminate replenished orders. Actual sales sharing with a company’s suppliers can improve supplier forecasts, leading to an improvement in production planning and reduction of stocks. McGuffog and Wadsley in their paper described the impact of e-commerce and collaborative planning through the Internet on reducing costs and uncertainty in supply chains [11].

2.8 Manufacturing Flow Management
This process deals with manufacturing products and establishing flexibility in the process needed for targeted markets. It includes managing the product flow through the manufacturing facilities and flexibility [12]. Internet provides the demanded data’s visibility companies within a manufacturing supply chain, and helps improve the flow through the manufacturing facilities. Companies can anticipate demand fluctuations and respond accordingly. The main objective is to reduce stocks and compress lead times with the help of Internet, which allows companies to be more flexible and respond to changes in demand. It helps reduce production cycles with speed of communication. Internet impacts the Manufacturing Flow Management process along all the supply chain. Internet has an impact on how a company manages the internal part of this process like implementing a production planning system to analyze production requirements and different manufacturing facilities of the company.

Such systems can improve the decision-making process of planners; sales team and reduce planning inaccuracies [13]. It is perceived that the supply chain will change from an order-driven-lot-sizing approach to one more akin to a capacity availability booking approach supported by appropriate Internet search engines [14]. Their paper discussed the role of the Internet within the manufacturing supply chain and, in particular, focused on its impact on manufacturing planning and control. They proposed the development of supply webs and a more interactive approach to supply chain partnering. They also identified some of the research issues within this context to facilitate the development of Internet-based manufacturing planning and control.

The Internet provides a real opportunity for demand data and supply capacity data to be visible to all companies within a manufacturing supply chain. Consequently, organizations
have to explore alternative mechanisms for the manufacturing planning and control. In another paper, they discussed the alignment of supply chain classification with corresponding approaches adapted to operations planning and control in the light of the emerging Internet technologies. This work indicated an alternative to the ERP approach that can be developed by utilizing Internet partnering offering the benefits associated with a more integrated approach to manufacturing planning and control across the supply chain [149].

Ko, Kim et al proposes a design-centered-production Virtual Manufacturing System, where collaborative manufacturing partners with surplus capacity could be chosen to accomplish an assigned task. They proposed a mathematical model that used tabu-search heuristics to solve problems and minimized both operation and transportation costs [150]. Xiong, Tor et al. in their paper described a web-enhanced dynamic BOM-based Available-To-Promise (ATP) system, which provided manufacturing companies with the ability to support decisions made by production planners and managers, independent of their locations. Their information processing system indicated the amount of finished products that can be produced at a specific time bucket with existing material availability. They indicated that the system would improve the decision making process of production planners and sales personnel and reduce planning inaccuracies [151].

2.9 Manufacturing Mobility

Over the past several decades, the globalization of the manufacturing ecosystem has driven more change and impacted the prosperity of more companies, nations and people than at any time since the dawn of the Industrial Revolution.

Nations around the world have taken part in and benefited from the rapid globalization of industry and expansion of manufacturing. Globalization of manufacturing has been a key driver of higher-value job creation and a rising standard of living for the growing middle class in emerging nation economies. This has dramatically changed the nature of competition between emerging and developed nations as well as between companies. Recent research confirms manufacturing has been immensely important to the prosperity of nations, with over 70% of the income variations of 128 nations explained by differences in
manufactured product export data alone[^viii]. A number of factors have enabled this rapid globalization, including a significant change in geopolitical relations between East and West, the widespread growth of digital information, physical and financial infrastructure, computerized manufacturing technologies, and the proliferation of bilateral and multilateral trade agreements[^ix]. These factors, along with others, have permitted the disaggregation of supply chains into complex global networks allowing a company to interact in the design, sourcing of materials and components, and manufacturing of products from virtually anywhere – while satisfying customers almost anywhere[^x]. While digital technology and free trade proliferation will continue to enable the flattening of the world and the globalization of manufacturing supply chains, the dominant factors that shaped the disaggregated supply chains of today will not be the same as those that carry forward through the next several decades. The global environment is changing. Many emerging economies used by multinationals as locations of low-cost labour, have developed significant manufacturing and innovation capabilities permitting them to produce increasingly advanced manufactured products.

At the same time, these economies have begun to experience a corresponding escalation in wages and costs, following in the footsteps of their developed nation counterparts. Greater prosperity and higher wages are helping drive an increased ability and desire to consume by these growing middle classes, making them much more an exciting market of new consumers and much less a source for low-cost labour. With the seeds planted by these multinationals, and the opportunity to serve these new markets, powerful new competitors are growing every day. This will profoundly reshape manufacturing supply chains over the coming several decades[^xi][xii][xiii][xiv]. But this reshaping will also be influenced by complex macroeconomic and geopolitical challenges, including exposure to currency volatility, sovereign debt pressures and emerging protectionist policies of many countries to gain access to emerging and prosperous new markets. All of these factors are driving more localized manufacturing supply chains[^xv]. Mobility, drives Customization with the use of tablets, smartphone, and connectivity[^xvi]. A recent study found that 80 percent of respondents, discovered in a survey own a tablet or iPad. Service as a product is rapidly growing free apps and the consumer demand for better, smaller, and faster devices. In the US, the overwhelming majority (66 percent) of citizens have some smartphone, reports the
Pew Research Center. Mobility Is Cheaper Than Paper Solutions. A non-mobile enterprise incurs the cost of paper, Ink, copiers, work orders, order picking, order sorting, Order processing, billing, shipping, reporting, and customer service. The cost scales up based on the organizations and the cost of operating through mobile connectivity results in savings across your enterprise when compared to paper.

Mobility Allows an Enterprise to Reach More Customers and thus generates better sales. The chain from the desk and allowing a sales associate, customer service representative, or any other employee to take his or her job “on the road” and “across the internet,” which is exactly what the modern consumer expects.

2.10 Customer Service Management

The Customer Service Management process is the front of a firm to customers. It is a single source of information to the customer. Real-time information has to be provided to the customer by interfacing with a firm’s functions like manufacturing and logistics [lxxiv].

In the internal part, Internet can be used to enable real time information sharing amongst business units and functional areas of a firm, thus improving responses. Boyer, Hallowell et al. paper provided an examination of e-services. They developed a model for analyzing the benefits of e-services in customer retention and provided a case study to illustrate a company’s utilization of e-services to expand and streamline its services [lxv]. Småros, Holmström et al investigated on new services in the e-grocery business. The framework systematically examined customer demand and identified corresponding services for offering customers more value and a profitable growth in business [lxxvi].

2.11 Logistics Process

Logistics and SCM practices are defined as a set of activities undertaken to promote effective and efficient management of supply chains. Globalization of business, infrastructural bottlenecks, increasing uncertainty in supply has made Indian firms to look beyond their four walls. Supplier partnership, physical movement of goods, meeting customer demands, information sharing are some of the key logistics and SCM practices that can create performance related impact. More and more firms are shifting their focus to
specialized service providers for minimizing expenses by outsourcing. Taco Vander et. al. in their findings indicate that logistics and SCM practices are influenced by many contextual factors like the type of industry, firm size, its position in the supply chain, supply chain length and the type of supply chain.

Practices are also influenced by regulatory and economic environment, available infrastructure and competition with other supply chains. The identified various emerging trends in logistics and SCM practice as well as areas of concern [\textsuperscript{ivii}], Saxena K.B.C. and Sahay, B.S in their work, indicated that when logistics is streamlined and automated, Benchmarking and good practices should be encouraged by government, industry and other stakeholders. A Government should move from a regulator’s role to a facilitator’s role, since a high degree of operational efficiency and cost efficiency will provide the much-needed competitive edge to various supply chains in India [\textsuperscript{ixviii}]. Feldmann and Muller in their research focused on establishing actual performance improvements in logistics and supply chain management leading to cost-savings and customer satisfaction [\textsuperscript{xxix}]. Lieb et al, discussed two to three decades pros and cons of outsourced logistics provision [\textsuperscript{xxx}]. Mason and Lalwani’s research on logistics providers found that Carriers, play a vital role in supply chains and their development. As a link provider between the Shipper and Consignee they are integral cogs in the chain and act as crucial facilitators of modern supply chain management [\textsuperscript{xxxi}]. Ellram and Hendrick in their study found that a dyadic partnership between the Shipper and the Carrier in logistics provision is a key building block from the supply chain management perspective [\textsuperscript{xxxii}]. Lieb, R. C., Millen, R. A. and Wassenhove, L. foresaw challenges in monitoring improvements and distributing the costs and benefits [\textsuperscript{xxxi}]. Logistics relationship literatures focus on the dyadic interactions between two parties in the supply chain. They are normally underpinned by contracts. The contractual relationship is both custom and legal environment intertwined.

In the case of logistics, this can lead to a weaker relationship between the Carrier and Consignee, which reduces overall supply chain effectiveness [\textsuperscript{xxxiv}]. Lee and Whang in their work presented an evaluation of the impact of an Internet secondary market where resellers could buy and sell excess inventories. The authors presented a two-period model with a
single manufacturer and many resellers. They also studied potential strategies for the manufacturer to increase sales in the presence of the secondary market [xxx].

2.12 Reverse Logistics and Returns

Handling reverse logistics and returns efficiently is an important issue for companies selling through the Internet. The Reverse Logistics and Return process involves decisions on return avoidance practices, gate keeping, disposition guidelines, and development of returns network and flow options [xxxvi]. Internet helps this process in many ways. Managing returns involves managing different fields of data; like reasons for return (defective, in warranty, old, etc.), conditions of the product, point of return, instructions to customers, etc. e-commerce data can give better information and knowledge on all the elements involved in the Reverse Logistics and Return process. E-commerce generates more entries than traditional commerce [xxxvii]. Spengler and Schröter developed an Internet-based platform for providing information and communication to all SCM elements involved in the returns of products. A strategic-planning tool based on system dynamics was also developed to help decision makers simulate and assess various production, recovery and material-recycling policies. They showed Internet and information and knowledge management improve the returns process in a SCM [xxxviii] Vlachos and Dekker’s work presented a mathematical dimension to help decisions choose the best returns options for single period products. The model was an extension of the classical newsboy problem but it incorporated the returns in Internet sales. Their channel leads to new and interesting problems, relevant to academia and business [xxxix].

2.13 ‘IoT’ and ‘Internet of TEA’ Elements

This section addresses the Internet of Things. Main enabling factor of this promising paradigm is the integration of several technologies and communications solutions. Internet of Things has to necessarily be the result of synergetic activities conducted in different fields of knowledge like telecommunications, informatics, logistics and electronics. Different visions of this Internet of Things paradigm are reported and enabling technologies reviewed. Selvam Marudhamuthu would say the world is fast getting moving into an era of ‘Internet of TEA’ in the world of Internet per se. ‘Internet of TEA’ means, Internet of
Things, Internet of Everything and Internet of All-things combined. The synergy is more, the constructs and connectivity is super-fine and the results are great.

2.14 IoT visions

Multiple definitions of Internet of Things enhance the vivacity of the subject. Visions differ between stakeholders, businesses and research.

“Internet of Things” is composed of two terms implying generic objects uniquely addressable, based on standard network communication protocols [^1]. The unique object addressing and representation of information become challenging issues, deriving the need for a Semantic orientation of IOT. Figure 2.1 depicts concepts, technologies and standards with reference to the IOT vision.

![Internet of Things paradigm based on different visions](image)

Fig. 2.1 Internet of Things paradigm based on different visions

The first definition of IOT is a “Things oriented” perspective with simple Radio-Frequency Identification (RFID) tags and the term “Internet of Things” is attributed to The Auto-ID Labs[^2], a worldwide network of academic research laboratories in the field of networked RFID and emerging sensing technologies.
The institutions were targeted to architect IOT, along with EPCglobal[^cvi] with a primary focus on the development of the Electronic Product Code™ (EPC) to support and spread the use of RFID in trading networks and to create an industry-driven global standards for the EPCglobal Network™. The standards were designed to improve traceability of an object and the awareness of its status, current location, etc. An alternative was tried with Unique/Universal/Ubiquitous Identifier (uID) architecture[^cvi] for the global visibility of objects. Complete, IOT visions recognize that the term IOT implies a much wider vision than the idea of a mere objects identification like IOT vision of the IPSO (IP for Smart Objects) Alliance[^cvi], a forum of 25 founding companies to promote the Internet Protocol as the network technology for connecting Smart Objects around the world. Semantic oriented” IOT visions are available in the literature[^cvi][^cvi][^cvi]. Since the number of items involved in IOT can become very high, issues related representation, store, interconnect, search, and organizing information will be challenging, thus making semantic technologies an important key[^cvi].

Another vision is called “‘Web of Things”, according to which Web standards are re-used to connect and integrate into the Web every-day-life objects that contain an embedded device or computer[^cvi].

2.15 IoT in SCM

Enabling the objects in our everyday working or living environment to possibly communicate with each other and elaborate the information collected from the surroundings will make a lot of applications possible[^cvi]. The applications of IOT technologies lower cost and power requirement. Real-time information processing technology based on RFID and NFC in IOT will be widely used in supply chain. Accordingly, accurate and real-time information relating to inventory of finished goods, work-in-progress, and in-transit stages with reliable due dates would be obtained. As a result, the demand forecast would be more accurate and extra buffers would be unnecessary. Automatic replenishment of out-of-stock goods and reduction of inventory would be possible. For example, a manufacturer of soft drinks can identify with the click of a button how many containers of its soda cans are likely to reach their expiration date in the next few days and where they are located at
various grocery outlets. Using this information, it might modify its future production and distribution plans, possibly resulting in significant cost savings [11]. As a result of applications, the reaction time of traditional enterprises is 120 days from orders of customers to the supply of commodities while Wal-Mart applying these technologies only needs few days and can basically work with zero safety stock [20].

2.16 Wireless Sensor Networks (WSN) in SCM

Integrating technologies in the components of supply chain activities creates a competitive advantage for the business firm. The Wireless Sensor Networks create a great potential for the supply chain management because the WSN nodes can be attached to crates, roll containers, pallets and shipping containers to function as an active transport tracking device. These devices has the ability to actively monitor the transportation processes, and verify proper handling conditions of goods like temperature for fresh and perishable goods. Furthermore, these devices can also help detect damage due to sudden shocks, or opening of containers and other forms of contract breach. This also results in significant quality of service improvements and greater efficiency, which in turn lead to lower transport cost [20].

![Wireless Sensor Network Diagram](image)

Fig. 2.2 WSN Tracking and Monitoring

Figure 2.2 explains two major wireless sensor applications, including tracking and monitoring. Tracking application involves human indoor or outdoor tracking, traffic and vehicle tracking. Monitoring includes with inventory, structural, machine and chemical...
monitoring. The main focus in SCM is with the inventories or goods. Before goods are distributed, it is still being processed, made or manufactured. Because the production management deals with very complex processes, the researchers became more driven to design novel manufacturing execution system architecture for intelligent monitoring system, which is based on a wireless sensor network. The impact of RFID investment on complex product by the establishment of a 3-stage supply chain model involving suppliers was studied.

The results of the study contributed significantly on RFID adoption in supply chain [iv]. Mason et al. applied a prototype of WSN in inventory management of packaged cylinders. Results showed an improved the efficiency of the business operations and monitoring [v]. A solution for a real-time perishable food supply chain monitoring system based on ZigBee-standard wireless sensor network was studied in [vi] and [vii]. The researchers were concerned because the monitored were of high value. Wireless Sensor Networks offering with continuous response capabilities; offer complementary advantages over the use of Radio Frequency Identification. Adopting Wireless Sensor Networks in Supply Chain Management can be advantageous. It can be installed in industrial devices to monitor measurements such as proximity, temperature, pressure, level, and power quality, and to transmit or receive control signals for activating the device accordingly.

Data can be easily transmitted without many wires that are interconnected with the systems. If for instance these are attached to delivery vehicles, useful data for in inventory management can be obtained immediately, as long as the devises on the vehicles have already been detected wirelessly. These networks are extendable as they can be installed at any location without running power supply and data communication wires through concrete walls during factory expansion. They are easy to install and maintain as additional wireless devices on the control system after it has been installed with minimal changes to the existing configuration. Industrial WSNs have the potential to beat the existing process control network. This technology has higher data transmission speed. And has multiple wireless communications that can act simultaneously if there is no mutual radio interference. Lastly, this also have more sensors or data points that can be used to beat the performance of traditional wired control system.
2.17 Sensors and Garment Design

e-textile systems have been developed that automatically generate an activity diary of healthcare monitoring applications, allowing the annotation of medical data with different user activities and contexts, without requiring user intervention. A stitched sensor for measuring the elongation of fabrics has been used to sense joint bends \[^{viii}\]. The mechanics of a fabric will have an effect on the relationship between the sensor response and the physical input like bend angle of a joint or, the distance between linear moving parts. The response of the stitched sensor to different types of fabric bending can be analyzed. Wearable sensing through garment-integrated sensors are an alternative for body sensing techniques. The use of inertial sensing units like accelerometers and gyroscopes are bulky and uncomfortable \[^{ix}\] and affect the quality of wearable solutions \[^{"}\]. Sensing techniques that focus on bend and stretch tend to be possible with more textile-like sensors, either fiber-type sensors \[^{xi}\], stitched or knitted sensors \[^{xii}\]\[^{xiii}\] or printed sensors \[^{xiv}\], but for some applications, these may not provide enough information or enough accuracy to fully characterize movement and position. Coupling garment-integrated sensing with existing body sensing techniques could be beneficial to the overall system accuracy and may allow the number of rigid sensing units to be decreased. Sensing approaches that use knitting to create a sensor structure most commonly require that the sensor placement and layout on a garment be planned at the textile-design stage.

Because of the geometry of a knit, it is most convenient to apply sensors in either the horizontal or vertical direction. Both of these variables limit the versatility of the sensor placement and length and require an additional layer of complexity in the garment design and construction process. Approaches that use printing or surface adhesion/lamination of sensors can remove constraints on sensor placement. However, they often change the mechanical properties of the textile substrate, leading to a more perceptible sensor. Stitched techniques provide the benefit of unconstrained placement and length, while minimizing the effect on the mechanical properties of the textile substrate. The sensor described here uses an ISO 406 stitch structure, commonly called a \"coverstitch\", shown in the Figure 2.3, where the \"looper\" is the stitch thread. The stitch is used in seaming and edge finishing of
stretch garments, as well as non-stretch garments. It creates a lock stitch structure with a common bobbin (or looper) thread shared between two to four needles.

![Diagram](image)

Fig. 2.3 The ISO 406 bottom coverstitch.

### 2.18 Radio Frequency Identification (RFID) and SCM

RFID technologies may improve the potential benefits of supply chain management through reduction of inventory losses, increase of the efficiency and speed of processes and improvement of information accuracy. Applications of RFID focus on inventory management, logistics and transportation, assembly and manufacturing, asset tracking and object location, environment sensors, etc [xv]. Some sectors have more opportunity to gain from the various RFID applications, such as retail, healthcare, textile, automotive and luxury good industries [xvi].

Practical papers dealt with pilot projects, case studies and ROI analyzes of RFID implementations in supply chains. Companies deploy pilot projects to test this new technology in a small and simple environment to observe the difficulties and the efficiencies of its integration, to analyze the associated costs and profits and to facilitate the complete integration in the whole company if they decide to implement it. IBM’s white paper is on improving product availability at the Retail Shelf by using Auto-ID technologies. Alexander et al. [xvii] focus on the difficulties for enterprises to adopt RFID systems through the consumer retail value chain. They illustrate the impact of the Auto-ID system on specific problems faced by companies in the consumer retail value chain; Similar papers on the value of RFID in supply chains were published by Kambil and Brooks [xviii], Chappell et al. [xix], Tellkamp [xx] and Lee et al. [xxi]. Many academic papers deal with
potential benefits of RFID in supply chains on supply chain problems that RFID technologies have the possibility to solve like Inventory inaccuracy [xxxii], Atali et al. [xxxiii], Fleisch and Tellkamp [xxxiv...], bullwhip effect (Joshi [xxxv], Lee et al. [xxxvi]), and replenishment policies (Kok and Shang [xxxvii]). Gaukler et. al studied the effects of RFID technologies on supply chains at three decision levels namely strategic, tactical and operational. The developed analytical model analyzed the cost of RFID technology and results showed cost reductions from 2.8% to 4% [xxxviii] The RFID application in a supply chain contained one manufacturer and one retailer. The analysis was done at item level using a centralized case with and without RFID and a decentralized case with item level tagging. In the centralized model, item-level RFID economic feasibility was estimated.

The impact of an item-level RFID implementation on the decentralized model evaluated tag cost sharing between the supply chain actors. The analysis showed that, when a manufacturer is dominant, sharing RFID costs between the actors was not an issue. On the other hand when the retailer is the driving force, an optimal sharing of the tag cost occurs for maximizing the retailer and supply chain profit, which again depends on the retailer’s power to reduce manufacturer profits. Sounderpandian et al. [xxxix] were interested in the costs and benefits of implementations of RFID technologies in a supply chain that contains a manufacturer, a distributor, a retailer and consumers. They developed an analytic approach in order to estimate the load rate of RFID employment by the retailers and the cost benefits obtained through RFID applications for shelf replenishment. They assumed that the RFID technology is applied at item, case, and pallet levels. They found RFID could improve automatic checkout processes at retail stores, reduce inventory costs resulting in efficient shelf replenishment. They also observed additional benefits of RFID like reduced losses due to shoplifting and increased use of point of sale applications.