

Green Logistics and Supply Chain Management: Issues and Implications

Dr. B.A.Satyamurthy

Associate Professor, School of Management Studies, MahaRajah's Post Graduate College, Phool Baugh, Vizianagaram-2

Corresponding Author: Dr. B.A.Satyamurthy

Abstract: *Built on the concepts of green logistics and green supply chain management, this paper presents the relationship between logistical activities and its related environmental effects and costs. By greening their supply chain, companies can better use their assets, optimize resources- do more with less, improve and create sustainable technology, ensure continuity and strategic, long-term alliances. Business ethics and social responsibility are important components of organizational effectiveness. Most companies recognize that socially responsible activities improve their image among consumers, stakeholders, the financial community and other relevant publics. They have found that environmental and social responsible practices are simply good business, resulting not only in a favorable image, but ultimately to increased sales and cost reduction. Mars Incorporated is one of the companies that have significantly managed to increase operational and capital efficiency, reaching an environmental conscious, social minded and result oriented triple bottom line.*

Key words: *resource crisis, green logistics, externalities, green supply chain management.*

Date of Submission: 01-02-2019

Date of acceptance:18-02-2019

I. Introduction

Organizations adopt numerous business improvement methodologies to improve business performance. Logistics as well as supply chain management has been regarded to be the crucial factor for the companies to obtain competitive edge. In fact, logistics as well as supply chain management has received attention since the early 1980s, yet conceptually the management of supply chains is not particularly well understood, and many authors have highlighted the necessity of clear definitional constructs and conceptual frameworks on supply chain management. In this study, we provide a tutorial on the current research of operations management of logistics and supply chain. We first clarify the conception of logistics and supply chain management in this paper, which defines the scope of our related research credentials. The core of this paper is that we provide several hot issues in this field with examples to show how these researches contribute from different research angles. Finally, we conclude the article with the insights obtained from our analysis and future study directions in this field. The paper is organized as follows. In the next section, we specify the definitions of the terms of logistics and supply chain used in our article, with a comparison between these two popular conceptions. In Section 3, which is the core section of this paper, we provide several hot topics in current research with detailed examples. In Section 4, we provide insights and further research directions.

II. Definitions

Logistics is Part of the supply chain process that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements. Describing the entire process of materials and products moving into, through, and out of firm. Inbound logistics covers the movement of material received from suppliers. Materials management describes the movement of materials and components within a firm. Physical distribution refers to the movement of goods outward from the end of the assembly line to the customer. Finally, supply-chain management is somewhat larger than logistics, and it links logistics more directly with the users' total communications network and with the firm's engineering staff. 3 Process of moving and handling goods and materials, from the beginning to the end of the production, sale process and waste disposal, to satisfy customers and add business competitiveness. Process of anticipating customer needs and wants; acquiring the capital, materials, people, technologies, and information necessary to meet those needs and wants; optimizing the goods- or service-producing network to fulfill customer requests; and utilizing the network to fulfill customer requests in a timely way.

COMPONENTS OF LOGISTICS SYSTEM: The closely linked components of the logistics system are: i. Logistics services ii Information systems iii. Infrastructure/resources

i. Logistics services support the movement of materials and products from inputs through production to consumers, as well as associated waste disposal and reverse flows. They include activities undertaken in-house by the users of the services (e.g. storage or inventory control at a manufacturer's plant) and the operations of external service providers. They comprise physical and non-physical activities (e.g. transport, storage and supply chain design, selection of contractors, freightage negotiations respectively). Most activities of logistics services are bi-direction.

ii. Information systems include modeling and management of decision making, and more important issues are tracking and tracing. It provides essential data and consultation in each step of the interaction among logistics services and the target stations.

iii. Infrastructure comprises human resources, financial resources, packaging materials, warehouses, transport and communications. Most fixed capital is for building those infrastructures. They are concrete foundations and basements within logistics systems.

HISTORY AND ADVANCEMENT OF LOGISTICS: The probable origin of the term logistic is the Greek logistics, meaning 'skilled in calculating'. It was initially developed in the context of military activities in the late 18th and early 19th centuries and it launched from the military logistics of World War II. It was initially a military activity concerned with getting soldiers and munitions to the battlefield in time for flight. Military typically incorporate the supply, movement and quartering of troops in a set. The main background of its development is that the recession of America in the 1950s caused the industrial to place importance on goods circulations. Now it is seen as an integral part of the modern production process. Business logistics was not an academic subject until the 1960s. A key element of logistics, the trade-off between transport and inventory costs, was formally recognized in economics at least as early as the mid-1880s. Before the 1950s, logistics was under the dormant condition. Production was the main part of the managers concerned, and industry logistics was once regarded as "necessary evil" in this period. During the 1950s to and 1960s, applying new ideas of administration on business was a tendency. Due to petroleum price rise in 1973, the effects of logistics activities on enterprises grew. Slow growth of market, pressure of high stagflation, release of transportation control, and competitions of the third world on products and materials all increased the significance of logistics system on planning and business at that time. The further tendency of logistics in the early 21st century is logistics alliance, Third Party Logistics (TPL) and globalized logistics. Logistics circulation is an essential of business activities and sustaining competitiveness, however, to conduct and manage a large company is cost consuming and not economic. Therefore, alliance of international industries could save working costs and cooperation with TPL could specialize in logistics area.

SCOPE OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT:

Logistics is the management of the flow of goods between the point of origin and the point of consumption in order to meet some requirements, for example, of customers or corporations. The resources managed in logistics can include physical items, such as food, materials, animals, equipment, and liquids, as well as abstract items, such as time, information, particles, and energy. The logistics of physical items usually involves the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing, and often security. The complexity of logistics can be modeled, analyzed, visualized, and optimized by dedicated simulation software. The minimization of the use of resources is a common motivation in logistics for import and export. Note that the above definition of logistics is not unified, although it might be indeed, in current environment, a commonly acknowledged one. For example, Council of

Logistics Management (now renamed as Council of Supply Chain Management Professionals) referred to logistics as "the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements," which includes inbound, outbound, internal, and external movements and return of materials for environmental purposes. As we can see, the concept of logistics focuses on the product flow, which is the meaning by which this word has been translated in Chinese. It also puts emphasis on the activities of handling product, which include the storage, transportation, distribution, and packaging and processing. Although business logistics involves many activities, the traditional research of operations management on logistics mainly relates to the fields of logistics facility, transportation, and inventory planning.

Compared to "logistics," there appears to be even less consensus on the definition of the term "supply chain management." Kathawala and Abdou point out that SCM "has been poorly defined and there is a high degree of variability in people's minds about what is meant." Nevertheless, we present a rather widely adopted definition, which is given by Mentzer et al. which is rather broad, not confined to any specific discipline area, and adequately reflecting the breadth of issues that are usually covered under this term: "Supply chain

management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." The terms of "logistics" and "supply chain" are usually comparative in academy and industry, since both of them are closely relevant to the product circulation during its whole life cycle, and both have been regarded as the central unit of competitive analysis of model management science. Generally speaking, supply chain is a more broadened conception with a wider range which can involve other similar subjects, such as network sourcing, supply pipeline management, value chain management, and value stream management. In addition, we can see that the conception of logistics has no relationship with organization, which is the opposite of supply chain, since supply chain is made up of multiple organizations, usually companies. An important issue in supply chain management is that companies will not seek to achieve cost reductions or profit improvement at the expense of their supply chain partners but rather seek to make the supply chain as a whole more competitive. Hence, the contention that it is supply chains, and not a single company, that compete is a central tenet in the field of supply chain management. A central research methodology for supply chain management is game theory (and also incentive theory for the scenario of incomplete information).

ISSUES AND IMPLICATIONS: Due to the wide research ranges in operations management of logistics and supply chain management, we cannot possibly make a complete review in one paper. In this section, we point out several of the most important issues and burning topics in recent research, which draws great attention from both academy and industry. Integration of logistics and e-business is the future trend. In order to get more advantageous position and build a complementary and dependent relationship, networking industries, such as Yahoo and e-Bay, usually cooperate with logistics industries. The integration could reduce the middle-level procedures. The producers could immediately give the products over to the terminal customers. This could reduce expenses and also administer sources more efficiently. Companies do not have to take the costs of inventory and warehouse, and therefore they become modernized industries of low cost, more efficiency and division of specialty. For example, customers could get ordered goods from convenience stores. Through e-logistics, the competition condition of industries could be promoted in knowledge economics. The integration and promotion of business activities have to involve transportation systems at various stages. The integration of various applications brings the convenience through promoting the system of information flow and business operations. Customers and firms could make business more efficient and easier through the help of e-commerce and the Internet. However physical delivery still relies on the transportation system to finish the operations. The cost of transportation operation may be one-third of logistics costs. Meanwhile, transportation systems and techniques are needed in almost every logistics activity. Thus the reform of business patterns has to consider transportation systems

INVENTORY AND TRANSPORT MANAGEMENT: As has been pointed out in the previous section, the operations research on logistics management still mainly focuses on the traditional domain, that is, the inventory (including production planning) and transportation management. However, a noticeable phenomenon is that most papers are putting emphasis on specific fields with remarkable features captured into their models and thus making new contributions to the literature. For example, the inventory management of perishable products (also referred to as deteriorating product) is a rather old and mature field in logistics and supply chain management, with replenishment policies for inventory being the main focus of study. Whitin investigated such a problem, where fashion goods deteriorating at the end of certain storage periods were considered. Since then, considerable attention has been paid to this line of research. Nahmias provides a comprehensive survey of research published before the 1980s. Studies in recent years on the deteriorating inventory models can be found in Raafat and Goyal and Giri's papers, in which relevant literature published in the 1980s and 1990s is reviewed, respectively. A more updated review is given in Blackburn and Scudder's paper. However, new models can still be developed to capture the current management feature and obtain new managerial insights. Generally, two types of perishable loss, quantity loss and quality loss, may take place for a perishable product. The majority of the literature has dealt mainly with only one type of loss. In this regard, Cai et al. adopt a stochastic model to study a supply chain in which a distributor procures from a producer a quantity of a fresh product. During the transportation process, the distributor has to make an appropriate effort to preserve the freshness of the product, and his success in this respect impacts both the quality and quantity of the product delivered to the market.

Cai et al. further extend the model into a III-stage supply chain with outsourcing transportation involved. Another important field is transportation. It is generally known that the research on VRP (Vehicle Routing Problem) and its various extensions has been extensive. However, other new domains on transportation can still be interesting topics. For example, the remarkable growth in intermodal transportation over the past

decade has not been matched by a comparable level of academic activity, and, hence, the research on intermodal transportation appears to have a great potential. Chang explores one of the intermodal operational issues: how to select best routes for shipments through the international intermodal network. The problem is formulated as a multi objective multimodal multi commodity flow problem with time windows and concave costs, and an efficient heuristic is proposed. Verma and Verter present a first attempt for the development of an analytical framework for planning rail-truck intermodal transportation of hazardous materials by developing a biobjective optimization model to plan and manage intermodal shipments to represent the current practice; the routing decisions in the model are driven by the delivery times specified by the customers. Bruns and Knust study the problem of load planning for trains in intermodal container terminals. The objective is to assign load units to wagons of a train such that the utilization of the train is maximized and setup and transportation costs in the terminal are minimized. Bruns et al. further study the problem of robust load planning for trains in intermodal container terminals. The goal of load planning is to choose wagon settings and assign load units to wagons of a train such that the utilization of the train is maximized and setup and transportation costs in the terminal are minimized. Garcia et al. adopt a new hybrid approach by combining OR techniques with AI search methods in order to obtain good quality solutions for complex intermodal transport problems, by exploiting the benefits of both kinds of techniques. The solution has been applied to a real-world problem from one of the largest Spanish companies using intermodal transportation.

SOURCING AND MARKETING IN SUPPLY CHAIN: Sourcing is the first step in a supply chain. The research on sourcing has been extensive in recent years. This leaves open room for a supplier to improve efficiency over time by further optimizing the production processes. In general, OEMs' shifting of more development and engineering work, which require complex tasks and customized products, to their suppliers implies a significant potential for a supplier to accumulate knowledge and experience from learning, thus reducing costs over time. This dynamic change of supply costs affects the negotiation of sourcing contracts. A noticeable issue is the utilization of auctioning in the sourcing strategy. One of the first researches in this regard might be **Chen's**, which studies a procurement problem with one buyer and multiple potential suppliers who hold private information about their own production costs. An optimal procurement strategy is considered for the buyer who first specifies a payment for each possible purchase quantity and then invites the suppliers to bid for this contract. The auction can be conducted in many formats such as the English auction, the Dutch auction, the first-priced auction, sealed bid auction, and the Vickrey auction. Chen and Vulcano study a supply chain where an upstream supplier auctions his **inventory** or capacity as a bundle, which formulates the problem as a two-stage supply chain comprising a single supplier and two resellers. Huh and Janakiraman study periodic-review inventory replenishment problems with auctions and other sales channels and show that the optimality of inventory replenishment policies extends well beyond the traditional sales environments studied so far in the inventory literature. Chen et al. study a supply chain in which a single buyer wishes to procure a package of products or services from various competing suppliers that possess private cost information and show how the buyer can optimize his/her profit and at the same time coordinate the channel by using a contract scheme involving auctions, audits, and profit sharing. For a supplier that provides critical and customized components, the demand closely depends on, and hence is susceptible to, the variation of the final product demand. In the automotive industry, unstable and uncertain domestic volume of individual models is cited as one of the biggest challenges faced by manufacturers due to increased consumer choices. The consumer electronics industry is notorious for risk stemming from short product life cycles and high demand uncertainty. Furthermore, there is typically more uncertainty about the future demand than about the current demand. This demand uncertainty adds another source of future uncertainty, besides possible supplier switching (in a short-term relation ship), that influences the decision of initial capacity investment.

Marketing is another end in supply chain. The collaboration with marketing science massively extends the domain of supply chain management. Pricing, promotion, and channel management are the three most important areas in this regard. Pricing and promotion are the central issues in marketing management, let alone under consideration of the supply chain environment. Li and Graves explore the pricing decisions during intergenerational product transition, by formulating the dynamic pricing problem and deriving the optimal prices for both the old and new products. The optimal initial inventory for each product is also determined, and a heuristic method is discussed. Li and Zhang study the preorder strategy that a seller may use to sell a perishable product in an uncertain market with heterogeneous consumers. They find that accurate demand information may improve the availability of the product, which undermines the seller's ability to charge a high preorder price. As a result, advance demand information may hurt the seller's profit due to its negative impact on the preorder season. Sainathan considers pricing and ordering decisions faced by a retailer selling a perishable product with a two-period shelf life over an infinite horizon. Sinitsyn investigates the outcome of a price competition between two firms, each producing two complementary products. It is found that each firm predominantly promotes its complementary products together, which is correlation ally supported by data in the shampoo and conditioner

and in the cake mix and cake frosting categories. Liu et al. examine the efficacy of cost sharing in a model of two competing manufacturer-retailer supply chains who sell partially substitutable products that may differ in market size. Some counterintuitive findings suggest that the firms performing the advertising would rather bear the costs entirely if this protects their unit profit margin. Gao et al. show that the weather-conditional rebate program can increase sales by price discriminating among a customer's post purchase states. Taking advantage of the early sales, it can also reduce the inventory holding cost and ordering cost and hence can increase the retailer's expected profits. In addition, channel management is also an important interface between marketing and supply chain. Chen et al. study a manufacturer's problem of managing his direct online sales channel together with an independently owned bricks-and-mortar retail channel, when the channels compete in service. They identify optimal dual channel strategies that depend on the channel environment described by factors such as the cost of managing a direct channel, retailer inconvenience, and some product characteristics. Brynjolfsson et al. investigate local market structures for traditional retailers and then match these data to a dataset on consumer demand via two direct channels: Internet and catalog. Their analyses show that Internet retailers face significant

competition from brick-and-mortar retailers when selling mainstream products but are virtually immune from competition when selling niche products. Guo investigates optimal disclosure strategies/formats in a channel setting with bilateral monopolies and shows that retail disclosure leads to more equilibrium information revelation. Chiang extends the single-period vertical price interaction in a manufacturer-retailer dyad to a multi period setting, in which a manufacturer distributes a durable product through an exclusive retailer to an exhaustible population of consumers with heterogeneous reservation prices. The open-loop, feedback, and myopic equilibria for this dynamic pricing game are explored and compared to the centralized solution.

LOGISTICS SCENARIOS: What will the logistics marketplace look like in five to ten years? That's still an open question. In this chapter we take a closer look at how some of the key disruptions facing the industry may interact. We have done this by describing four logistics scenarios. In each of these, technology plays a key role, but affects the market in different ways. In two of the models, new entrants are the primary drivers of change, while incumbents retain a dominant position in the other two. The nature of market dynamics, especially the level of collaboration versus competition, also varies between the scenarios.

i. **Sharing the PI(e)** Incumbents increase their efficiency and reduce their environmental impact by collaborating more, and developing new business models, such as sharing networks. Research around the 'Physical Internet' (PI) leads to shared standards for shipment sizes, greater modal connectivity, and IT requirements across carriers.

ii. **Start-up, shake-up** New entrants become significant players and take market share from the incumbents through new business models based on data analytics, block chain, or other technologies. One or two become dominant in specific segments. Last-mile delivery becomes more fragmented, with crowd-delivery solutions gaining ground. These start-ups collaborate with incumbents and complement their service offers.

iii. **Complex competition** Big retail players expand their logistics offerings to fill their own needs and beyond, effectively moving from customers to competitors. They purchase small logistics players to help cover major markets, and draw on their deep understanding of customer behavior to optimise supply chains. Technology firms who used to be suppliers to the industry enter the logistics arena too, offering logistics services and turning into competitors.

iv. **Scale matters** Incumbents increase efficiency by streamlining their operations and taking full advantage of new technology. They fund promising new technologies with venture capital cash, and attract new staff with critical skills and expertise in competition to create a dominant market position. Major players merge to extend their geographical scale and enhance their cross-modal coverage. Access to capital to fund these investments becomes increasingly important.

DEVELOPMENT OF NATIONAL HIGHWAYS: National highways account for more than 40 per cent of the total road traffic. In the 12th Five-Year Plan period, the Government of India has set a target to construct 36,632 km of national highways in the period 2012-17, i.e., 2.65 times the target set in the previous plan period. Launched in 1998, the National Highways Development Programme (NHDP) aims to develop 50,000 km of National Highways by 2015 in seven phases and with an investment of US\$ 600 billion. Once completed, this is expected to further fuel the demand for road transport.

Table I: Important projects of National Highways Development Programme

s.no	Phases	Details
1	Phase 1	Golden Quadrilateral (GQ) - connecting New Delhi, Kolkata, Mumbai and Chennai
2	Phase 2	North South East West (NSEW) corridor connecting Srinagar, Kanyakumari, Porbandar and Silchar
3	Phase 3	Four laning of the two laned roads connecting state capitals and important tier-II and tier-III cities to the Golden Quadrilateral and NSEW corridor
4	Phase4	Improvement of certain national highways
5	Phase5	Six laning of existing four-laned national highways
6	Phase6	Development of expressways
7	phase7	Ring roads, by-passes and flyovers

Source: NHAI

The GQ is complete, while NSEW is close to completion. Other projects are either at the planning or implementation stage. Private sector participation: The Government of India targets to secure 33 per cent of the funding for the total investments in road infrastructure from private players. It has announced several incentives to attract private players; including provision of 100 per cent tax exemptions in any consecutive 10 years out of 20 years after commissioning of the project, and duty free imports of high-capacity construction plant and equipment. Many states in India, including Gujarat, Rajasthan, Madhya Pradesh and Maharashtra, have started awarding state highway contracts on a build-operate-transfer basis to private entities. Under this agreement, the state government delegates the work of ‘design, build and operate’ of state highways to a private sector entity for a certain period. Post the end of the period, the facility is transferred to the state government. Some of the recent road PPP projects approved by National Highways Authority of India include: Four laning of Rohtak-Hissar section of NH-10 in Haryana Four laning of Bhavnagar-Veraval section of NH-8E in Gujarat Six laning of Chakeri-Allahabad section of NH-2 in Uttar Pradesh Four laning of Khed-Sinnar section of NH-50 in Maharashtra

III. Logistics Industry Growth Drivers

RAPID INDUSTRIAL GROWTH: Rapid growth in industries such as automobiles, pharmaceuticals, fast-moving consumer goods (FMCG) and retail has significantly increased the demand for movement of consumer and capital goods across the country, from entry ports to manufacturing or distribution locations or from manufacturers and distributors to consumers and exit ports. The volume of freight traffic is positively related to the GDP of the country. Therefore, as the GDP increases, the volume goods’ movement is expected to increase through all modes. During the period from 2007-2012, the agriculture and manufacturing GDP have increased from US\$ 263.6 billion to US\$ 290.7 billion at constant prices. The corresponding increase in freight traffic was from 1.3 trillion tonne kilometres (TTK) to 2.1 TTK. Globalization: With the growing integration of India’s economy with the world, the country’s total trade has grown at a CAGR of about 20 per cent from US\$ 57 billion in 1997-98 to US\$ 862 billion in 2012-13. The initiative to construct a trilateral highway connecting India, Myanmar and Thailand represents an important step in the establishment of connectivity between India and Southeast Asian countries. The highway is expected to be operational in the year 2015-16 and is likely to boost trade ties of India with other countries. The increase in international trade has effected corresponding growth in cross-border freight traffic, thereby, adding to demand for logistics services

GOVERNMENT INITIATIVES: The Government of India has initiated several policy measures and programmes to attract investments in developing the logistics infrastructure of the country. Some of the key reforms undertaken by the Government of India include the following: FDI regulations: The government allows 100 per cent FDI under the automatic route for all logistics services, except air cargo and courier services. For air transport services including air cargo services, the limit was increased from 49 per cent to 74 per cent in 2008. Also, FDI of up to 100 per cent is permitted for courier services, subject to Foreign Investment Promotion Board (FIPB) approval. Greater investments in development of logistics infrastructure: The government has significantly increased the investment allocated for the development of logistics infrastructure including ports, airports, national highways, logistics parks, freight stations and corridors. Private sector partnerships: Several measures have been undertaken by the Government of India to encourage private sector participation in the logistics industry across all modes. These measures include increasing targeted contributions of private players in the investments set aside for the development of logistics infrastructure, tax exemptions and duty free imports. Apart from speeding up capacity creation, this is also aimed towards incorporating latest technologies and better management practices.

INDIAN LOGISTICS INDUSTRY: Gaining Momentum in Important projects of National Highways Development Programme Phase 1 Golden Quadrilateral (GQ) - connecting New Delhi, Kolkata, Mumbai and Chennai Phase 2 North South East West (NSEW) corridor connecting Srinagar, Kanyakumari, Porbandar and Silchar Phase 3 Four laning of the two laned roads connecting state capitals and important tier-II and tier-III cities to the Golden Quadrilateral and NSEW corridor Phase 4 Improvement of certain national highways Phase

5 Six laning of existing four-laned national highways Phase 6 Development of expressways Phase 7 Ring roads, by-passes and flyovers Source: NHA The GQ is complete, while NSEW is close to completion. Other projects are either at the planning or implementation stage.

IV. Trends In Logistics Industry

ENTRY OF GLOBAL PLAYERS: Several global players view the Indian logistics market favourably and have announced intentions to increase their capacity of transporting goods from/to Indian markets. Several large global logistics companies have entered India by the way of mergers with or acquisitions of Indian logistics companies and joint venture agreements. For example: In 2013, FedEx Express acquired Mumbai-based integrated logistics service provider AFL. In 2012, GATI signed an agreement with Kintesu World Express, a Japan-based air and ocean freight services provider. As per the agreement, GATI transferred its express distribution and supply chain business to the new joint venture under the name GATI-Kintesu World Express. GATI holds 70 per cent stake and Kintesu invested US\$ 53.54 million for 30 per cent stake in the venture. TNT acquired Mumbai-based Speedage Express Cargo Service for about US\$ 40 million in 2006. DHL acquired 68 per cent stake in Blue Dart Express Limited for US\$ 147.04 million in 2004. Increasing number of multi-modal logistics players: The demand for multi-modal transport services by the end users is increasing, because it results in the reduction of overall transportation costs and quicker movement of cargo. It also requires less documentation. Several Indian logistics companies have formed joint ventures with other global and local players so as to provide multi-modal logistics services extending to air, rail, road and water. For example, Container Corporation of India has around 12 strategic joint ventures with companies including Maersk, TCI, Halcon, DPI, APM, Gateway Rail and Allcargo. Increased PE investments: The Indian logistics market has attracted investments from large global and Indian private equity (PE) firms. Some of the deals are as follows: Indian Equity Partners struck deals with two logistics players. It took over the domestic road operations of TNT Express in India in December 2011 and acquired a minority stake in Gwalior-based Swastik Roadlines Private Limited, a food cargo supply chain service provider, in December 2010.

INDIAN LOGISTICS INDUSTRY: Gaining Momentum 13 In April 2011, Warburg Pincus invested US\$ 100 million in Chennai-based Continental Warehousing Corporation Limited, a subsidiary of the NDR Group. Some of the other deals include a US\$ 10 million investment by Ashmore Alchemy Investment Advisors in Siesta Logistics Corporation and Blackstone's investment of US\$ 75 million in Allcargo Logistics.

GREEN LOGISTICS AND SUPPLY CHAIN: A healthy environment is critical for efficient transport and transport, through its capacity to open markets and promote economic growth is essential for effective and lasting environmental management. Green logistics refers to a logistics form which plans and implements green transport, green storage, green packaging, green circulation processing, green recovery, and other activities via advanced logistics technology. It aims to reduce environmental pollution and resource consumption arising from logistics activity so as to realize a "win-win" consequence in logistics development and eco-environmental conservation. As an important avenue for realizing the sustainable development strategy, greater attention has been given to green logistics which will play an important role in industrial upgrading, transformation of economic structure, promotion of logistics development level, and other relevant aspects. Green supply chain is the supply chain management with similar objectives and core implications. Green logistics as well as supply chain management is also usually referred to "sustainable" management. A typical field in green logistics and supply chain management is reverse logistics, sometimes called closed-loop supply chains, in which there are reverse flows of used products (post consumer) back to manufacturers. There has been substantial research into production planning and inventory management in remanufacturing systems. Simpson first studies a periodic review inventory system with stochastic and mutually dependent demands and returns and provides the optimality of a three-parameter inventory policy. Kelle and Silver consider a different model with independent demand and return processes, where all returned products should be remanufactured. Inderfurth shows that the optimal policy derived by Simpson is still optimal in the case of fixed cost when lead times for remanufacturing and manufacturing are identical. Van der Laan et al. analyze a push control strategy and a pull control strategy in a hybrid system and compare them with the traditional systems without remanufacturing. Teunter et al. explore the superior inventory strategies for hybrid manufacturing/ remanufacturing systems with a long lead time for manufacturing and a short lead time for remanufacturing. Wang et al. analyze the impacts of the amount of products manufactured and the proportion of the remanufactured part to the returned products on the total cost of the hybrid system, showing that the cost could be reduced significantly if these two critical values are optimally set. Other related works include Kiesmüller, Tang and Grubbström, Aras et al.. For a comprehensive review, I refer the reader to Fleischmann et al., Dekker et al., and Ilgin and Gupta. A typical feature in reverse logistics and closed-loop supply chains is the quality uncertainty of acquired used product, which is usually expressed by a random remanufacturing yield and has been studied in some recent papers. Inderfurth shows that the uncertainty in returns and demand can be an obstacle to an environmental-benign recovery strategy within a reverse logistics system. Inderfurth and Langella develop heuristics for the problem

of obtaining parts for remanufacturing by disassembling used products or procuring new ones, under the consideration of random disassembly yields. Galbreth and Blackburn explore acquisition and sorting/remanufacturing policies in the case of a continuum of quality levels for cores with fixed quality distribution. The main premise is that remanufacturing costs will go down if only the returned products with better quality are remanufactured. Ketzenberg et al. explore the value of information in the context of a firm that faces uncertainty with respect to demand, product return, and product remanufacturing yield by first analyzing a simple single-period model and then proving that the results carry over multi period setting. Corbacioğlu and van der Laan analyze a two-product system with end-product stock containing both manufactured and remanufactured products while the remanufacturable stock may contain products of different quality. Zikopoulos and Tagaras investigate the production problem in a reverse supply chain consisting of two collection sites and a refurbishing site and examine how the profitability of reuse activities is affected by uncertainty regarding the quality of returned products. Denizel et al. propose a stochastic programming formulation to solve the remanufacturing production planning problem when inputs of the remanufacturing system have different and uncertain quality levels and capacity constraints. Although the research on remanufacturing systems is vast, there are only a few papers that consider a market-driven acquisition channel for used products. Guide and Jayaraman and Guide and van Wassenhove are the first to investigate this field, pointing out the importance of used product acquisition management to deal with the uncertainty in timing, quantity, and quality of the returned products. Guide et al. develop a quantitative model to determine the optimal acquisition prices of used products and the selling price of remanufactured products, assuming that the quantity of return items can be fully controlled by the acquisition price. Bakal and Akcali extend the model of Guide et al. into the case of random remanufacturing yield and analyze the impact of yield on the remanufacturing profitability. Karakayali et al. study the problem of determining the optimal acquisition price of the end-of-life products and the selling price of the remanufactured parts under centralized as well as decentralized remanufacturer-driven and collector driven decentralized channels.

CONSUMERS' PERFORMANCE: The decisions under the consumers' behavior are important for the firms to gain competitive edge and obtain more profit. The customer's behavior can be loss adverse, risk averse, regretful, and strategic, and the papers incorporating such factors are regarded as increasingly important. K'ok and Xu study assortment planning and pricing for a product category with heterogeneous product types from two brands by modeling consumer choice using the nested multinomial logit framework with two different hierarchical structures: a brand-primary model in which consumers choose a brand first and then a product type in the chosen brand and a type-primary model in which consumers choose a product type first and then a brand within that product type. Nasiry and Popescu study the dynamic pricing implications of a new, behaviorally motivated reference price mechanism based on the peak-end memory mode, which suggests that consumers anchor on a reference price that is a weighted average of the lowest and most recent prices. They find that a range of constant pricing policies is optimal for the corresponding dynamic pricing problem. Nasiry and Popescu further characterize the effect of anticipated regret on consumer decisions and on firm profits and policies in an advance selling context where buyers have uncertain valuations.

PRICING AND PRODUCTION: pricing and production decisions for a firm, using the rational expectations framework. They show that firms may offer high availability of goods despite the presence of conspicuous consumption and scarcity strategies are harder to adopt as demand variability increases. Parlaktürk considers a firm that sells two vertically (quality) differentiated products to strategically forward-looking consumers over two periods, setting the prices dynamically in each period. It is found that the loss due to strategic customer behavior can be less with two product variants compared to the single-product benchmark, which indicates that product variety can serve as a lever when dealing with strategic customers. Cachon and Swinney consider a retailer that sells a product with uncertain demand over a finite selling season, with three types of consumers: myopic, bargain-hunting, and strategic consumers. They find that the retailer stocks less, takes smaller price discounts, and earns lower profit if strategic consumers are present than if there are no strategic consumers, and a retailer should generally avoid committing to a price path over the season. Another stream of research focuses on the risk attitude of the firms in the supply chain. Lau's might be the first piece of work that studies the newsvendor boy problem under mean-variance framework, which takes the variance of system profit or cost into the utility function. Other recent works employing similar methodology to investigate supply chain problem include H. S. Lau and A. H. L. Lau on supply chain model with return policy, Buzacott et al. on the commitment-option contracts, Choi et al. on channel coordination, and Wei and Choi on wholesale pricing and profit sharing scheme.

The Indian logistics Industry is highly fragmented. The top-10 listed players have only about 2 per cent share in the overall market³. The top three companies in terms of sales turnover are Container Corporation of India, Transport Corporation of India and Blue Dart Express.

Table II: Financial summary of listed logistics players in India (2011-12)

S.No,	Name	Services	Sales US\$ million	Sales growth on y-o-y basis (per cent)	Operating profit US\$ million	Net profit US\$ million	Net profit margin (per cent)
1	Container Corporation of India	Container haulage and container freight stations (CFS)	812.19	6.1	204.75	175.58	21.6
2	All cargo Logistics#	Multi-modal transport operator (MTO) and CFS	215.89	--	61.80	36.81	17.1
3	Gateway Distriparks	Container haulage and CFS	45.20	23.5	25.19	16.40	36.3
4	Aegis Logistics	Logistics services to the oil, gas and chemical industries	56.70	9.8	12.47	8.21	14.5
5	Transport Corporation of India	Road freight and express logistics	365.59	4.0	28.91	10.37	2.8
6	Arshiya International	Container rail	118.53	30.8	25.73	9.50	8.0
7	GATI*	Express logistics	139.49	-22.5	13.19	14.40	10.3
8	Blue Dart Express*	Express logistics	298.40	29.8	35.72	24.56	8.2
9	Shreyas Shipping and Logistics	Container shipping	33.54	32.2	3.43	1.08	3.2
10	SICAL Logistics	MTO, bulk and container cargo	100.22	-6.8	9.40	2.66	2.7

Source: Company annual reports; company websites; IMaCS Analysis #15 months starting January 2011 to March 2012; *Figures for GATI and Blue Dart Express are for the 12-month period from July 2011 to June 2012 and January 2010 to December 2011, respectively

INTERPRETATION: The II indicator variables for the six supply chain performance attributes were tested and compared within and across cases. Reliability This indicator variable is considered a performance attribute on a similar level by all four of the research cases. This is also found to be in line with the FMCG industry expectation (Richey, Roath, Whipple & Fawcett, 2009). In the dairy segment, for the smaller-sized case, and based on sales revenue, reliability is highly important in order to sustain and grow the customer base. However, in the packaged food segment, reliability is more crucial to meet the volumes of the market, and for the larger-sized case, based on sales revenue, the aim is to achieve reliability more rigorously. Responsiveness In the packaged food segment, the indicator variable of responsiveness was considered a performance attribute on a similar level by the involved cases. The cases are faced with changing customer demand patterns, prompting their supply chains to be responsive. In the dairy segment, the supply chain of the smaller-sized case (based on annual revenue) is more responsive than that of the larger-sized case, with the former being more involved with the introduction of new stock-keeping units (SKUs) into the marketplace, hence a necessity to service those customer bases more promptly and quickly. Agility In the packaged food segment, the associated indicator variables – upside adaptability, downside adaptability and flexibility – are not considered as a performance attribute on a similar level by the involved cases. The larger-sized case is more reliant on the upstream suppliers and larger customer base, while the smaller-sized case has close ties with their suppliers, hence less concern about the upside adaptability KPI, though flexibility is a concern. In the dairy segment, the associated indicator variables for agility are considered equally important by the involved research cases. Both dairy cases are highly reliant and dependent on their primary supplier, the milk producers, and their customer base, hence this performance attribute is critical for their supply chain performance. 34 Journal of Transport and Supply Chain Management | November 2011 Cash-to-cash cycle time In both product segments, this indicator variable is considered equally important by the supply chain managers. This is also found to be in line with the FMCG industry expectation, as cash flow is critical for the survival of the supply chains (Matson, 2009). The growing focus on account receivables and inventory has assisted organizations in controlling this indicator. Return on fixed assets In the packaged food segment, return on fixed assets is considered equally important by the involved research cases. As both research cases are heavily oriented towards manufacturing setups, a greater focus on this indicator variable is required to obtain the return on investment. In the dairy segment, this indicator variable is not considered equally important by the involved research cases. It is higher for the smaller-sized case because of its new existence in the marketplace – hence a greater focus on return on investments as compared to the larger-sized case that has almost depreciated all of its assets. Supply chain management cost In all the four research cases, this indicator variable is considered equally important. This performance attribute is the most used and monitored KPI in FMCG supply chains (as identified by Viswanathan, 2008), and the cost of

planning and executing the supply chain is crucial to its survival and its impact on the organisation's bottom line. It was established that the majority of the SCOR supply chain performance attributes are considered important by the research cases involved, although the findings varied between the product segments due to the nature of the product involved (shelf life and product life cycle). The findings from the dairy food segment's research cases revealed that managers are more concerned about the quality and safety aspects of the supply chain, while the managers from the packaged food segment's research cases focused on product proliferation and supplier reliability. Also, the typology of a particular product segment, as identified in the case studies, was found to be similar to that of any other FMCG supply chain in terms of functional and structural attributes, as identified in the literature review. It was established in all four cases that they adopted simple manufacturing and complex distribution processes.

V. Conclusion

The Indian logistics industry was valued at an estimated US\$ 130 billion in 2012-13. It has grown at a CAGR of over 16 per cent over the last five years. The industry comprises freight and passenger transportation via road, rail, air and water, as well as warehousing and cold-storage. Air cargo volume grew at a CAGR of about 8.5 per cent from 1998-99 to 2012-13. Future growth is expected to be fuelled by trade agreements, expansion of industrial activity beyond existing centres and investments in airport infrastructure. The government has doubled the proposed investment in airport infrastructure in the Twelfth Five-Year Plan period, as compared to the Eleventh Five-Year Plan. The private sector's contribution is expected to be over 74 per cent. The coastal-cargo traffic at major Indian ports has grown at a CAGR of about 2.6 per cent from 1998-99 to 2011-12. The freight via water is expected to grow further in the light of the Maritime Agenda 2010- 2020. The Agenda aims at increasing the port capacity with increased focus on non-major ports and ports on the east coast. The funding of the projects under Maritime Agenda is also likely to be primarily come from the private sector. Freight movement via railways has grown at a CAGR of around 5.1 per cent from 2007-08 to 2011-12. The development of dedicated rail freight corridors is likely to boost freight traffic. The government has also recently allowed private players to construct and own rail lines to transfer goods. The road freight has grown at a CAGR of 8.6 per cent from 1999-2000 to 2011-12. The government's National Highways Development Programme aims to develop 50,000 km of National Highways by 2015. Once completed, this is expected to further fuel the demand of road transport. The government targets to secure 33 per cent of the funding from private players. It has also announced several incentives to attract private players to set up free-trade warehousing zones and cold storage infrastructure. These measures are expected to drive growth in the logistics industry. The key growth drivers are: rapid growth in industries such as automobile, pharmaceuticals, fast-moving consumer goods (FMCG) and retail; increase in trade because of integration of India's economy with world; government initiatives such as FDI regulations, private sector participation and development of logistics infrastructure and increasing trend of outsourcing logistics to third party service providers. In the coming years, the key trends that are likely to affect the industry positively are entry of global players, increase in number of multi-modal logistics service providers, and greater investments.

From the above analysis, we can absorb the following insights and implications in the area of Green logistics and supply chain management. **First**, the logistics issue regarding the people's livelihood becomes a hot spot. The traditional research in this regard is related to perishable product, fashion product, and electronic product, which have short life cycle. Nowadays, such topics might include green logistics, emergency logistics, and agriculture supply chain **Second**, new directions on green logistics and supply chain management can be brought about by the development of economy and technology. A typical example is the information technology which leads to the research on e-business and related distribution channel choice. Nowadays, the common usage of RFID, cloud technique, and big data can be important research directions for future study. **Third**, the environmental related research will continue to be big issue. With the steady increase in global population and economic scale, resource crisis, ecological damage, environmental pollution, and other issues have drawn universal concern. It has been the consensus of the international community to attain socioeconomic sustainable development through a greener economic pattern and lifestyle. Many countries create a new outlook in industrial and technical competition by increasing investment in the green logistics and supply chain management, formulating and implementing various bills, plans, and strategies, and strengthening the implementation of green economic development strategy. In the future, the range of this topic will not only be just remanufacturing, reverse logistics, and closed-loop supply chain. Low-carbon issues can be an important research direction.

Finally, multimethodology is an important direction for future study. Traditionally, major research methodologies in green logistics and supply chain management can be classified into several categories, such as theoretical modeling, computation and simulations, surveys, cases, event studies, and behavioral experiments. In recent years, there is an emerging trend towards combining multiple research methodologies to explore research problems in green logistics and supply chain management. For example, in addressing the issues of supply chain

coordination, some papers establish the respective models and verify the findings by real-world cases and some papers conduct behavioral experiments with the goal of exploring the real-world relevance of some theoretical models. Moreover, the number of the credentials with new applications of the existing methodology, such as green logistics and supply chain management, is expected to grow continuously. At the same time, individual logistics firms are finding a match between environmental considerations and profitability. It is becoming acceptable within the industry to adopt green measures. Sometimes they reduce costs, but more often than not they lead to more intangible benefits such as image and reputation enhancement. It is here that environmental management systems, such as ISO 14000, may offer opportunities to green the logistics industry.

References

- [1]. BTRE (2001) Logistics in Australia: A Preliminary Analysis. Bureau of Transport and Regional Economics, Canberra
- [2]. Carroll, J. (2004) The magical reserve tracing system-RFID. Taiwan CNET
- [3]. Chang, Y.H. (1998) Logistical Management. Hwa-Tai Bookstore Ltd., Taiwan.
- [4]. Cooper, M.C., Lambert, D.M. and Pagh, J.D. (1997) Supply chain management: more than a new name for logistics, *International Journal of Logistics Management*, Vol. 8, No. 1, 1-13.
- [5]. Fair, M.L. and Williams, E.W. (1981) Transportation and Logistics. Business Publication Inc., USA.
- [6]. Ross, D.F. (1998) Competing through Supply Chain Management: Creating Market winning Strategies through Supply Chain Partnerships. Chapman and Hall, New York.
- [7]. Thomas, D.J. and Griffin, P.M. (1996) Invited review coordinated supply chain management, *European Journal of Operational Research*, Vol. 94, 1-15.
- [8]. T. M. Whitin, *Theory of Inventory Management*, Princeton University Press, Princeton, NJ, USA, 1957.
- [9]. S. Nahmias, "Perishable inventory theory: a review," *Operations Research*, vol. 30, no. 4, pp. 680-708, 1982.
- [10]. X. Q. Cai, J. Chen, Y. B. Xiao, and X. L. Xu, "Optimization and coordination of fresh product supply chains with freshness keeping effort," *Production and Operations Management*, vol. 19, no. 3, pp. 261-278, 2010.
- [11]. M. Verma and V. Verter, "A lead-time based approach for planning rail-truck intermodal transportation of dangerous goods," *European Journal of Operational Research*, vol. 202, no. 3, pp. 696-706, 2010.
- [12]. F. BSRuns and S. Knust, "Optimized load planning of trains in intermodal transportation," *OR Spectrum*, vol. 34, no. 3, pp. 511-533, 2012.
- [13]. J. Garc'ia, J. E. Florez, A. Torralba et al., "Combining linear programming and automated planning to solve intermodal transportation problems," *European Journal of Operational Research*, vol. 227, no. 1, pp. 216-226, 2013.
- [14]. R.Monczka, R. Trent, and R. Handfield, *Purchasing and Supply Chain Management*, Thomson South-Western, Mason, Mich, USA, 2005.
- [15]. T. R. Lewis and H. Yildirim, "Managing dynamic competition," *The American Economic Review*, vol. 92, no. 4, pp. 779-797, 2002.
- [16]. Y. J. Chen, S. Seshadri, and E. Zemel, "Sourcing through auctions and audits," *Production and Operations Management*, vol. 17, no. 2, pp. 121-138, 2008.
- [17]. B. Liu, G. Cai, and A. A. Tsay, "Advertising in asymmetric competing supply chains," *Production and Operations Management*.
- [18]. L. Guo, "Quality disclosure formats in a distribution channel," *Management Science*, vol. 55, no. 9, pp. 1513-1526, 2009.
- [19]. V. P. Simpson, "Optimum solution structure for a repairable inventory problem," *Operations Research*, vol. 26, no. 2, pp. 270-281, 1978

Dr. B.A.Satyamurthy." Green Logistics and Supply Chain Management: Issues and Implications". IOSR Journal of Business and Management (IOSR-JBM), Vol. 21, No. 2, 2019, pp. -27-37