



Cost Effective Utilization of Transportation Services in Today's Business Environment-A Logistics Overview

Dr. Kiran S Nair

Assistant Professor, American University in the Emirates, Dubai, UAE.

Abstract

The function of transportation is the main factor which determines the speed and efficiency of movement of goods from one place to another. The advancement in transportation, its techniques and principles helps in the improvement of quality of movement of goods, its speed of delivery, efficiency in operation cost, quality of service and the better utilization of available resources. Transportation places a crucial role in the global supply chain and logistics function in any organization. Considering the current situation, it is evident that a strong supply chain logistics system needs a fool proof transportation system for the effective movement of goods from the source to manufacturing units till it reach the consumer. Hence the purpose of this study is to define the various roles transport plays with regards to future improvements. This paper is undertaken with the aim of helping the people working in logistics department, students and planners of transportation managers to understand and explore the various methods, views and application of transportation and its application practically.

Keywords: Logistics Management; Supply Chain Management; Transportation Management; Factory Gate Pricing.

1. Introduction

Logistics in general is the organization and implementation of various activities with regards to the operation of any organization. (Anderson D Britt, F. & Favre D. 2007) In today's business world logistics means the science of movement of goods and services from the place where raw material is sourced till the end user location where in the need and want of customer as well as the objectives of the organization is met. There are a wide range of resources which to be transported in today business environment such as raw materials, work in progress, finished goods, living animals, machinery and supplies, goods in liquid form as well as abstract items like information and time. The logistics part of tangible goods includes the coordination and integration of flow of information, inventory and material handling, production, packing, transporting, storing and secured warehousing. (Rushton, A., Oxley, J.& Croucher, P. 2000)

Logistics department in any organization comes under the supply chain management wherein they take care of the responsibility of planning, implementation, controlling, coordinating the forward and backward movement of goods, services and information from the point origin to the point of consumption. Various organization implement and follow customized model of logistics activities as per the nature of their business. The main aim of any logistics department is to minimize the use of resources yet deliver maximum productivity. People specialized in the logistics department are called logistician. (Chang, Y.H. 1998)

The main purpose of this article purpose of this article is to stress and re-define relationship between transportation management its role in the logistics system. This article will be discussing the relationship between transportation and its role and importance in today's logistics management. It will also focus on the advantages and benefits transportation brings to logistics. This paper will discuss about the various modes of transportation, how

transportation plays role in reverse logistics and throw light on green logistics. The paper will conclude by explain the next generation developments in transportation and logistics systems.

2. Overview of Logistics and Transportation

Council of Supply Chain and Logistics Management professionals (1991) defined that logistics is ‘process of planning, implementing and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for conforming to customer requirements. This definition includes inbound and outbound, internal and external movement of goods’.

In practical sense logistics involves combination of getting the right products needed for the organization. It should also involve the right way of getting the same. Also, logistics need to ensure that’s the goods procured is in right quantity and got the right quality. Logistics also involves in getting in the right place at the correct time which will ensure its customers right product at the right price. (John Mangan, Chanfra Lalwani Global Logistics and Supply Chain Management, 2012)

Transportation is the vital part of supply chain management, in olden days it’s been treated as a component which is available any time when manufactures, distributors and suppliers need. Also, transportation was considered just as a cost factor and not as a value-added activity. But this has been challenged in many studies as well as in practical sense as transportation plays a pivotal role in completing the supply chain process. With the efficient management of transportation, the performance and productivity of supply chain increases drastically. (Fair, M.L. and Williams, E.W. (1981))

2.1 Relationship between Transportation and Logistics Management.

Organization need a well-developed transportation system to ensure the efficiency and effectiveness of any logistics department. Excellent transportation facility creates brand value and help in creating customer value by ensuring goods are transported safe and secured at a better cost and lower delivery time. The success of transportation depends quite a lot on each country’s infrastructure, better roads, sea ports and airports and good rail system, which result in stimulating the logistics environment of nations and its economic development. A well-managed and operated multi-mode transportation system increase competitiveness in private and public sector organization which is good for the society and people. (Cooper, M.C., Lambert, D.M. and Pagh, J.D. (1997).

2.2 Transportation Effects on Supply Chain

Transportation has a pivotal role in supply chain of every organization. The crucial part of moving raw materials from various source to factory and further movement of the same from the manufacturing units to distribution centers to retail partners and finally to consumers is taken by transportation. Transportation has the biggest effect is connecting various factors of supply chain functions of an organization. Hence this timing and planning in the movement of goods to ensure customer get the same as and when he needs which decides the success of every organization as well as its logistics department. Organization needed to ensure that such systems put in place is managed and followed efficiently and necessary changes are incorporated from time to time. (Fair et al., 1981)

Modern organization got multiple departments in the way they operate. These multiple departments are manufacturing department, warehousing, distribution, wholesaling and retailing and the main connecting factors between all the functional departments and its performance is supported by an efficient transportation system. Organizations can save cost drastically in warehousing by having a quick and effective transportation department, as it takes care of faster delivery which gives the flexibility of keeping a very low inventory either as raw material or finished products depending upon the nature of the business. (Rogers, D.S. and Tibben-Lembke, R.S. 1998) With this organization, can save the deployment of capital in raw material and stocks which in turn benefit having a better cash flow and working capital of the organization. Having an efficient transportation system also saves cost in rent of warehouse or facilities, companies can afford to have their plant and warehouse in interior places where rents and cost of land is less. Efficient transportation help with the move of goods and reduce the disadvantage of not in the center of business. (Fisher.M 1997)

2.3 The Role of Transportation in Service Quality

The main function of any organization is to create customer value and loyalty and this can happen only if the customer is happy and satisfied. (Disney, S.& Towill, D. 2003) Customer satisfaction purely depends on the speed of delivery of goods at the right time and right cost to the customers. Hence having a well-handled transportation service provides organization helping them in gaining customer satisfaction and making those customers loyal to them. With the option of having multiple brand providing the same products at similar pricing, the crucial decision making factor for customer in terms of which brand to buy and from where to buy, is purely based on the service level and transportation becomes the crucial element of service level and company’s competitiveness. (Ferdows, K Lewis, M.& Machuna, J. (2004),)

3. Modes and Characteristics of Transportation

The most commonly used mode of transportation is Road, Rail, Air, Maritime and Pipelines, selecting the right mode of transportation is based on the function, value, volume, urgency and distance from origin to the destination. The cost of transportation to the overall cost of the product plays a major role in deciding the right mode of transportation. There are cases where once the logistics department select the right mode of transportation, still there can be no relationship between the cost of freight compared to the weight and the distance it travels, irrespective of the distance transportation companies need to recover certain costs which will be classified under fixed cost and variable cost. The major parameter considered when the shipment is heavier is rate per kilo, and if the shipment heavy the fixed cost will be lower as the fixed cost get covered across the weight of the shipment. For bulky shipments, logistic providers charge transportation on the basis called volumetric basis. In volumetric shipments, the cost is calculated based on the dimensions of the shipment. There can be cases where the shipments are bulk but less weight and occupies larger space in the carrier. Mostly transportation of goods is outsourced to third party logistics companies hence in these scenarios consignors won't know exactly which mode of transport the logistic partner is shipping the goods. Sometimes these logistic partners decided whether to take single mode or multi-mode of transportation or combination based on the urgency and need of the consignor. (Gattorma, J. 2010)

Summary of cost of transportation and its operating characteristics of various modes of transportation is discussed below.

3.1 Road Transportation

Movement of goods and services via road is called Road Transportation, which is one of the oldest and commonly used mode of transportation. Road logistics plays an important role in linking other modes of transportation. For reaching good to airport and sea port, road transportation is the only option. The penetration and high level of accessibility is the main advantage of road transportation. The fixed cost in road transportation is the lowest compared to other modes of transportation, but the quality and speed of road transportation depends on the infrastructure development of countries. The variable cost in road transportation is medium because of the fluctuations in oil cost, service and maintenance cost of the vehicles, usage and road taxes and tolls, permit cost as well as congestion charges. Road transportation has got the unique feature where in it allows direct connection between the consignor and consignee locations.

3.2 Rail Transportation

The mode of transportation where good and passengers are taken from one to place to another in a wheeled vehicle called trains on rail track commonly known as rail track or railways. These trains rails are anchored perpendicular to each other, railroad train consists of one or more connected vehicles that run on the rails. The main advantage of rail mode is that it can carry very large capacity, face low issues because of weather conditions, low energy consumption and face less number of blockages in terms of traffic and is dependable too. Some of the intercity trains has the capability of travelling at a speed of 430 km/h. Rail mode of transportation have a very high fixed cost because of the high cost of locomotives, wagons of trains the laying of railway tracks and well as cost of construction of freight terminals.

3.3 Air Transportation

Out of the all modes of transportation, the last entrant is Air mode. This is one of the most innovation or blessing regards to movement of cargo in the 20th century. (Reynolds-Leighann, A.J. (2001) In air modes goods are transported in Passenger aircrafts, Cargo flights as well as Helicopters. The characterizes being it doesn't need any cost in setting specific track for commuting. Compared to other modes of transport it doesn't have got any physical barrier but must follow international aviation rules and regulations. The main feature of the air mode is its speed of delivery. Because of its quick nature, the cost is high compared to any other mode of transport. The most common nature of transport in air is passengers, light and high value goods and mails. Air freight logistics is necessary for many industries and services to complete their supply chain and functions. It provides the delivery with speed, lower risk of damage, security, flexibility, accessibility and good frequency for regular destinations, yet the disadvantage is high delivery fee. Another feature of air mode of transportation is that ownership of airports and airplane is difference, hence the service provider need to take care of the flight cost and operations only. Generally, the fixed cost is low in air mode but the variable cost in high because of the very high fuel cost, high cost of maintenance as well as the high cost of handling and security requirements. As goods need to reach airports for reaching it from one place to another Air mode depends on other modes of transport to complete the delivery cycle.

3.4 Maritime Mode Transportation

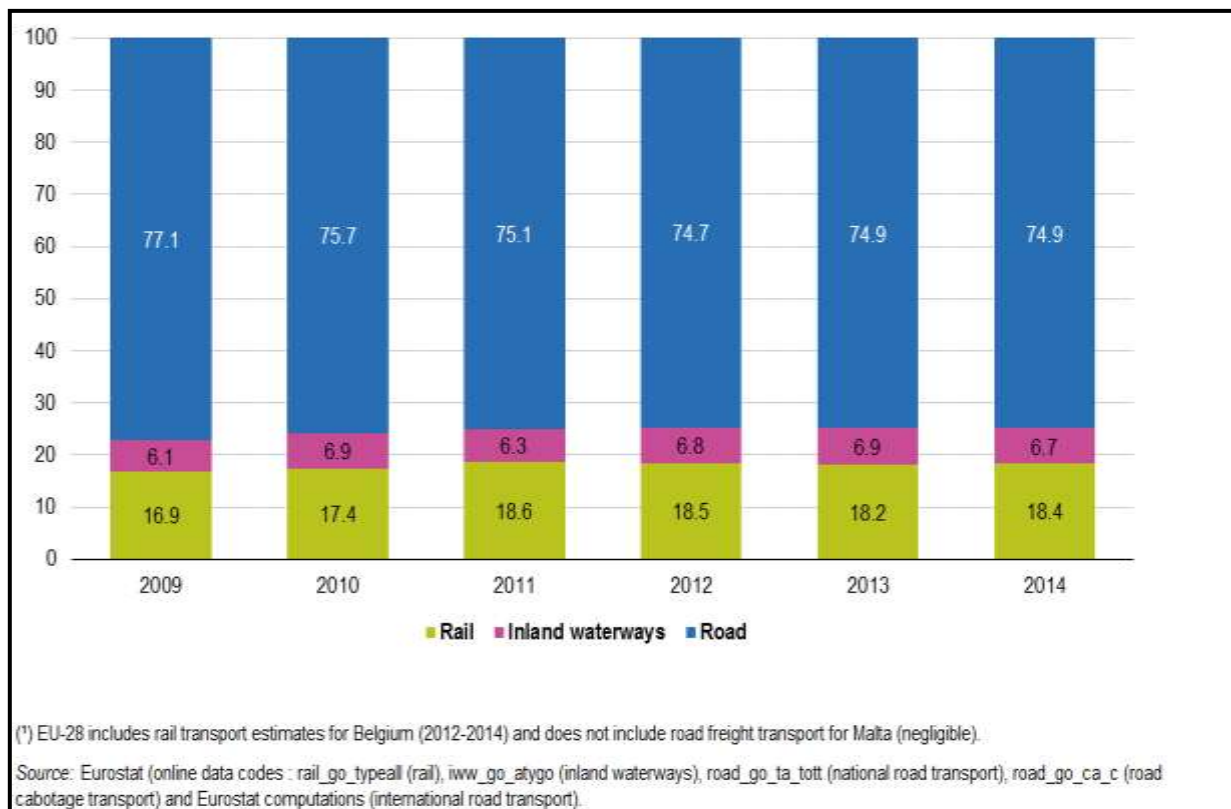
The most efficient and effective mode of transportation where is large volume of cargo can be moved is maritime transportation. In maritime shipments are transported basically via ships and boats depending up on size and

distance. (INCTAD review of Maritime transport 2009) These ships and boats use oceans, seas, rivers and lakes as the route for its movement. Cargo gets loaded and unloaded in ports, hence it's important to have a well develop channels, docks and dredges help to facilitate maritime movement as well as reduces the threat of discontinuity. The major cost factor when it comes to maritime mode is the high cost of construction of the terminals, cost of construction of port and the cost involved in its maintenance and improvements. But for organization maritime shipment is the most cost effective mode of transportation as this mode can carry high volume of shipment from long distance at the lowest cost possible. Maritime transport is basically associated with industries such as steel, oil, petrochemicals, construction, steel etc. To be competitive in today's scenario the shipping corporations use large scaled ships and work on a cooperative mode with other operators. Service quality is also an important factor which influence consignors and consignees to select a shipping company for movement of goods apart from the cost of shipment. Hence these companies are forced to bring in technological innovation into their service where in customers can track the movement and location of the shipment in real time. The major three operation of a maritime transportation company is Liner Shipping, Tramp Shipping as well as Industry Shipping.

3.5 Pipeline

Pipeline is the mode of transportation where goods especially, oil and gas is transported. They follow practically unlimited routes which can be laid either on land or under water. Pipeline carry a very high percentage of fixed cost and a minor variable cost which is basically for maintenance. The main cost factor in pipeline is its construction cost and which is directly proportionate to the distance, diameter as well the viscosity of the fluids planned to move. This mode is very important as it directly correspond to oil and gas refineries with ports and harbors. Once pipelines are operational, the dependability is extremely high, and the main drawback is that this mode can be used in a very limited situation.

The below chart will show the Freight transport in the EU-28 (1 modal split of inland transport modes) (% of total tonne-km) Table 1



4. Transportation Operation and Distribution and the Role of Factory Gate Pricing

In the last 30 years' supply chain logistics function of organization has gone through greater innovations resulting in better performance in service quality, cost and operational efficiency. Concept of distribution centers were established in the 1970s and 1980 especially by retail sector where in they had the central warehouse and distribution concept. Suppliers used to deliver stocks in these central distribution centers where the retailers further transport goods to each of their stores as per stores requirements with their own transportation vehicles. Depending upon the number of stores and location these distribution centers were called Regional distribution centers (RDCs) and Nation Distribution centers (NDCs). (Potter, A.T., Lalwani, C.S Disney, SM & Velho, H. 2003) As the size of these Distribution centers are huge they used to cater the requirements of all the stores of those retail brand.1990 seen an addition of consolidation centers (CCs), where they received goods from multiple suppliers into full loads which further got delivered to distribution centers. The recent change in this system is where in the retailers took control of the delivery of goods into their distribution centers and this concept is called the Factor Gate Pricing- (FGP). (Lee, H., Padmanaghan, P.& Whang, S. 1997). In Factory gate pricing the pricing was calculated by using ex-works pricing plus the optimization and organization of transporting by the buyer to the point of delivery. This helped retailers to save lot of cost due to the increased visibility of its on supply chain as well as its efficient management of transportation help them to reduces delay in getting stocks to their retail store and avoid stock out situations. For the successful implementation of FGP, a single point of control system need to be implemented in the supply chain of the organization. ERP and WMS plays an important role in the successful implementation of a FGP system especially for planning the transportation system. (Potter, AMason, R & Lalwani, C-2007)

5. Prospects of Logistics

With the competition between organization growing day by day, for the success of any organization in achieving their goals and objectives a strong logistics system is a must. (Weeld and Roszemeijer Ho, 1997) explains three revolutions in business which will have a strong impact on the sourcing, purchasing, and supply chain strategies in manufacturing sector. They are (1) Globalization of trade (2) explosion of information and technology, (3) market shifting from a seller market to buyer market where consumers demand keep changing frequently

Hence considering the above discussed factors the characteristic of future logistics and transportation will influenced by the below factors. (Mason, R.J, Lalwani, C.S & Boughton, R 2006)

- **Regularity and Government:** To help the growth of trade and logistics capabilities of the nation and its industrial growth, respective governments have industry friendly laws and regulations as well as invest in the infrastructure development of the country. The facilities and industry friendly policies will provide a better environment for transportation and logistics activities which in turn help organization to have a very cost effective operation. Governments now a day understand the importance of infrastructure and development for them to promote and attract various industries, hence such heavy spending helps industries to grow and contribute to the GDP of the nation.
- **Advancement in International Goods Transport:** There are multiple factors which contribute to the growth of international freight transport in today's world economy. Main reason being the advanced use of E commerce where in buyers and sellers start trading from anywhere in the world and the main factor connecting the supply chain being the transportation function. (Ross, D.F. 1998).The second reason being the change in the production strategy where in organization import raw materials and semi-finished goods from comparatively low cost and assemble final product with greater technology with the help of advanced transportation capabilities. Thirdly, because of the pressure from globalized market, such as World Trade Organization (WTO), which promotes and encourages local industries to enter international markets with competitive products to helping them to face a worldwide competition. (Quinn, F.2004).
- **Increased Service Level:** Service level in your transportation operation is the key to survive in an international competitive market. Quality of service plays the most important factor, in majority of the cases the decision-making factor which affect consumer behavior. The most common service techniques majority of the organizations implement is Efficient Consumer Response (ECR) and Quick Response (QR). As more studies are conducted in this area, we might see new techniques applied in providing improved customer service (Krumwiede, D.W. and Sheu, C. 2002)
- **Evolution in Logistics Operation:** Growth of ERP, WMS and other information technology based programs and bringing efficiency and effectiveness in the modern logistic system. The latest addition in fright movement is the incorporation Radio Frequency ID (RFID) for fright movements as well as inventory related activities. (Carroll, J.2004 The magical reserve tracing system-RFID) The main advantage RFID technology over the conventional bar-code system is that RFID does not need physical action of scanning the barcode on each good. RFID terminal will scan the details of the goods at one go and with the integration of the same to the

organizations ERP solutions, it saves lot of time and money of physical activities and duplication of work. In retail stores RFID systems, could sense the details of goods in terms of item details, quantity, pricing via RFID Tags automatically and immediately when the costumers check out the exit (Carroll, 2004).

- **Challenging Product Life Cycle:** As the technology is growing at a very high speed, manufactures are faced the challenge of products having shorter life cycle as well as the technological getting outdated fast. When global competition is very high where in success of organization depends on how fast they innovate and bring new products, the key success will be the speed to the market. Hence companies having strong logistics and transportation facility will take the advantage as they will have the edge over the competition in delivering products to the customers across the world must faster. Lack of inefficient logistics system can result in product failures as well as profitability of the organization.
- **Automation in logistics facilities:** Automation in logistics facilities play an important role in the effectiveness of overall supply chain function. As technology, has advanced so much in the way innovation are happing in warehousing, like Auto Picking, pick to Light, Robotic Picking, voice picking etc., it helps organizations to have competitive advantages. With warehousing taking very less time in picking, packing and put way, it helps its transportation division to have a better turnaround time in movement of shipments and increasing the efficiency and productivity. The vehicle idle time is cut to zero which increase profitability. Hence organization are investing in the automation of their logistics facility for reducing the operating cost to be more competitive as well as to increase the customer service.
- **Dedicated Transportation Department: One of the key success factor for the logistics center is to have a dedicated transportation facility for delivery service.** This should be in line with the nature of products the organization deal with. Some companies detail with, food, poultry and other FMCG products which need cold storage and climatic control trucks, some need normal trucks, some products need closed and some open. Hence having own dedicated transport fleet as per their product nature help the productivity of the transportation department and saves time. (Potrol 2003)
- **Developing Logistics centers:** The creation and development of logistics centers is one of the key factor which affect the growth of industry and the economy of the nation. Logistics facilities and centers reduces the distance between production and marketing facility vertically and with the integration with various other industries horizontally, results in substation reduction in cost of sales. Majority of the countries government is promoting such logistics centers where all infrastructure is developed so that organizations can enjoy the benefits and in turn improves the efficiency and profitability. The future of logistics will be highly influenced by E-Commerce, and Information Technology as we see more and more companies will be participating in the same. (Thomas, D.J. and Griffin, P.M. 1996).

5. Efficiency in Transportation

The efficiency and effectiveness of transportation service is impacted by variety of issues. Main issues transportation services face is congestion, waste of fuel and running cost because of vehicle running empty, regulatory issues like carob emission, maximum permitted working hours, road taxes and shortage of skilled labors. (Tang. 2006) These issues are the main reason for inefficiencies and waste like long waiting hours, low turnaround time, low vehicle fill rates, bad utilization of assets, administrative waste and excess inventory holding charges. Hence depending upon the strategy implemented by the supply chain department impacts the efficiency of the transportation service. Just in time(JIT) is used regularly by manufacturing organization as it got lot of advantages when it comes to logistics costs but sometimes it can cause issues of inefficiency in the utilization of transportation facility when it comes to low loads of shipments. Other issues related to JIT model can be the inconsistent fleet utilization, reduced pay load optimization and an image of expendable and infinitely flexible resources in the eyes of the customers. (Godsell, J, Harison, A, Emberson, C. & Storey, J. 2006)

Organization can minimize the cost of transportation cost by balancing the demand and supply capacities within the existing transportation network. Also, organization should look for possibility of redesigning the transportation network as well as consolidating the location of the warehouses and distribution centers in relation to the supplier network. (Lalwani, C.s., Mason, R.J., A. T & Yang, B.(Eds) 2004).

6. CONCLUSIONS

This paper try to find out the various logistics activities related to transportation systems and try to find out the important role of transportation in supply chain systems through extensive review. The article basically discusses about the relationship of transportation department with other functions in Supply chain, role of transportation in improving the service quality of an organization, the various modes of transportation and the cost factors of the same. The study also throw light on distribution center its evolution as well as the details about factory gate pricing.

Detailed analysis of future of prospects of transportation and logistics is also mentioned. To conclude, it is important to list relevance between logistics and transportation. (1) Logistics plays a very important role in the supply chain function of any organization (2) Logistics and Transportation functions are strongly interconnected and inter dependent, to perform the end to end logistics activity transportation is a must, also it is important to have a systematic logistics system to improve traffic environment and development of a good transportation department. (3) Since the cost of transportation contributes to a major factor in logistics cost, constant improvement and efficiency and bring the cost of logistics much lower which help in increasing profitability of the organization. (4) Transportation is the vital component in the logistics system of the organization as its activities appear in various stages and sections of logistic process. Absence of a strong transportation system will lead to inefficient logistic operation; hence logistics organizations need to give greater importance to transportation to have a powerful logistics strategy which ensure organizations capacity to full play.

To overcome the current issues and disadvantages in the logistics organizations should do regular review in a broader sense by integrating the advantages from various logistics applications. With the regular review of current transport systems provides organizations with a clearer notion on the latest application in logistic activities. The developments and sophistication in the transportation and logistics function will continue in the coming decades which will take logistics and transportation management an inevitable function of an organization.

References

- [1] Anderson D Britt, F. & Favre D. (2007), The Seven Principles of Supply Chain Management, Supply Chain Management review, April.
- [2] BTRE (2001) Logistics in Australia: A Preliminary Analysis. Bureau of Transport and Regional Economics, Canberra, <http://www.btre.gov.au/docs/wp49_contents.htm>.
- [3] Carroll, J. (2004) The magical reserve tracing system-RFID. CNET Taiwan, <http://taiwan.cnet.com/enterprise/technology/0,2000062852,2008707_1,00.htm> 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] Council of Logistics Management (1991) Definition of Logistics. <<http://www.cscmp.org/>>. Drucker, P.F. (2001) Management Challenges for the 21st Century. Harper Business.
- [6] Disney, S.& Towill, D. (2003) Vendor Managed inventory and bull whip reduction in a two-level supply chain, international journal of operations and production management,23(6),625-651.
- [7] Fair, M.L. and Williams, E.W. (1981) Transportation and Logistics. Business Publication Inc., USA.
- [8] Ferdows, K Lewis, M.& Machuna, J. (2004), Rapid fire fulfillment, Harvard Business Review, November.
- [9] Fisher.M 1997, What is the right supply chain for your product, Harvard Business Review March April.
- [10] Forrester, J. (19568) Industrial dynamics: A Breakthrough for decision makers, Harvard Business review, July -August
- [11] Gattorna, J. (2010), Dynamic Supply Chains, (2nd Edition), Financial Times/Prentice Hall, London.
- [12] Godsell, J, Harison, A, Emberson, C. & Storey, J. (2006), Customer responsive supply chain strategy, an unnatural act? International Journal of Logistics: Research and Application, 9(1).47-56
- [13] Ho, J.K. (1997). What can contemporary systems be thinking offer to logistics management as a management discipline, European Journal of Purchasing and Supply Management, Vol. 3, No. 2, 77-81.
- [14] INCTAD review of Maritime transport 2009
- [15] Krumwiede, D.W. and Sheu, C. (2002) A model for reverse logistics entry by third-party providers, Science Direct, Vol. 30, 325-333.
- [16] Lalwani, C.s., Mason, R.J., A. T & Yang, B.(Eds) (2004), Transport in Supply Chain, Logistics and Operations Management section, Cardiff Business School, UK.
- [17] Mason, R.J, Lalwani, C.S & Boughton, R (2006), Alternative models for collaboration in transport optimization Management, Supply Chain management. An international Journal187-199
- [18] Potrol (2003) Inner freight transport and city logistics. Potrol transport teaching material.

- [19] Potter, A.T., Lalwani, C.S Disney, SM & Velho, H. (2003) Modelling in the impact of factory gate pricing on transport and logistics, proceedings of the 7th international symposium on Logistics, Seville,6-6 July.
- [20] Potter, AMason, R & Lalwani, C. (2007), Analysis of Factory Gate Pricing in the UK Grocery Supply Chain, *International Journal of Retail and distribution Management*,35(10,821-834
- [21] Reynolds-Leighann, A.J. (2001) Air freight logistics. In A.M. Brewer, K.J. Button and D.A. Hensher (eds.), *Handbook of Logistics and Supply-Chain Management*. Elsevier Science Ltd., UK, 431-439.
- [22] Rogers, D.S. and Tibben-Lembke, R.S. (1998) *Going backwards: reverse logistics trends and practices*. The University of Nevada, Reno.
- [23] Ross, D.F. (1998) *Competing through Supply Chain Management: Creating Market- winning Strategies through Supply Chain Partnerships*. Chapman and Hall, New York.
- [24] Rushton, A., Oxley, J.& Croucher, P. (2000), *Handbook of Logistics and distribution Management* ,2nd edition, Kogan Page, London.
- [25] Quinn, F (2004) People, Process, Technology, *Supply Chain Management Review* January/February 3.
- [26] Lee,H.(2004). The triple -A Supply Chain, *Harvard Business Review*, October
- [27] Lee, H., Padmanaghan, P.& Whang, S. (1997) The bullwhip effect in supply chains, *Sloan Management review*, July-August 37-66
- [28] Tang. (2006), Robust Strategies for Mitigating supply chain disruptions, *international journal for Logistics: Research and Application*, 9(1),33-45
- [29] Taniguchi, E., Thompson R.G., Yamada, T. and Duin R. (2001a) Introduction. In *City Logistics: Network Modelling and Intelligent Transport Systems*. Pergamon, 1-15.
- [30] Taniguchi, E., Thompson, R.G. and Yamada, T. (2001b) Recent advances in modelling City Logistics. In E. Taniguchi and R.G. Thompson (eds.), *City Logistics II*. Institute of Systems Science Research, Japan, 3-33.
- [31] Taniguchi, E., Thompson, R.G. and Yamada, T. (2003) Visions for city logistics. *Proceedings 3rd International Conference on City Logistics*, Institute for City Logistics, 3-17.
- [32] Thomas, D.J. and Griffin, P.M. (1996) Invited review coordinated supply chain management, *European Journal of Operational Research*, Vol. 94, 1-15.
- [33] Thompson, R.G. and Taniguchi, E. (2001) City logistics and freight transport. In A.M. Brewer, K.J. Button and D.A. Hens her (eds.), *Handbook of Logistics and Supply Chain Management*. Elsevier Science Ltd., UK, 393-405.
- [35] Tilanus, B. (1997) *Information Systems in Logistics and Transportation*. Elsevier Science Ltd., UK.