RESEARCH PAPER | Management | Volume : 5 | Issue : 12 | December 2015 | ISSN - 2249-555X

Logistics Cost Minimization, An approach with Operations Research Models

KEYWORDS: Logistics, Operations Research, Transportation Management, Warehouse Management & Inventory Management

Dr.D.Ghosh

Associate Professor, Department of Business Administration, Assam University, Silchar

ABSTRACT

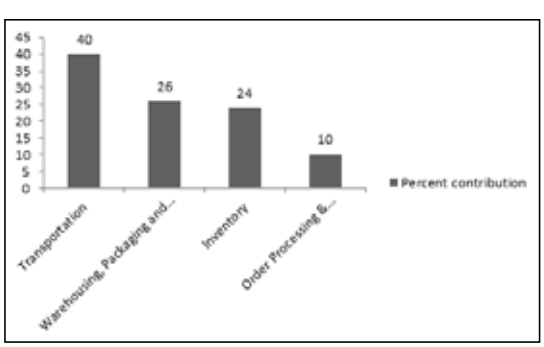
Logistics functions are very important for successful business operations. Without logistics the business will not be able to compete in the market. The important components of logistics are transportation, inventory management and warehouse management. The operations managers need to know the cost associated with the business logistics. For successful business functions the managers need to minimize cost of every activity. The Operations Research is very interesting field of study where the models of business can have good solution. The current paper will make an attempt to apply Operations Research tools in business logistics, so that operations managers can minimize the total logistics cost and thereby the competitiveness in business logistics can be achieved. The paper thus applied the operations research techniques in the areas of transportation management, inventory management and warehouse management issues.

I.INTRODUCTION:

Business operations need to arrange in a way so as to provide goods at right time, to the right people at the right price. In order to facilitate manufacturing, trading and retail operations business firms need to design their supply chain and logistics activities. The designing of proper supply chain and logistics operations are really important in business. Due to the logistics activities the products can be tracked, stored at suitable locations, can be moved from one geographical location to another. Organizations are designing their logistical functions so as to compete with their competitors.

In the competitive business environment the success of every business depends on the way they design the logistics functions. The issues of logistics are not really confined to only in business operations but it has really become a critical issue in international level as well as national level. The different logistics functions are transportation management, inventory management, warehouse management, packaging & order processing. The main issues from the organization's side remain the logistics cost minimization. In order to perform different activities like transportation, inventory management, warehouse functioning, packaging & order processing, the business organization generally incurs huge cost. The approach of every organization is to minimize the cost in logistics functions.

FIGURE 1: ELEMENTS OF LOGISTICS COST IN INDIA



Source: Adapted from Sanyal (2006a)

From figure 1 we can observe that the transportation cost is very high in the logistics functions followed by warehousing and inventory. The operations research is basically the applications of mathematical models which can be applied in wide range of business function so as to develop good numbers of models.

II.NEED OF THE STUDY:

The logistics sector is very fundamental to the development of a country. From 1990's onward the logistics and transport sector has gone for a wide shift. The recent study by McKinsey pointed out that transport is the most capital intensive sector in India. Since freight forms an important part of transport, thus role of logistics is very important.

Operations research generally formulate a model of the situation, apply different optimization techniques, generate alternative solutions and it is up to the managers to select the best possible solution for the model. The most commonly used operations research techniques are the linear programming problem, which is applied in logistics activities.

The different growth drivers of logistics are basically are presented in the following table:

TABLE 1: DRIVERS OF INDIAN LOGISTICS

Sl No	Growth Drivers of Logistics	Components
1	Consumption issues	Growth of per capita income
		E commerce rise
		FMCG sales
2	Manufacturing issues	Indian Manufacturing GDP increased INR 8.6 trillion in 2013-2014
		Make in India initiative
3	Agricultural issues	India is the second largest producer of vegetables and fruits after china
4	EXIM issues	EXIM cargo is expected to increase to 2800 MMT by 2020

Source: Adapted from JLL 2015

Volume : 5 | Issue : 12 | December 2015 | ISSN - 2249-555X

Thus the logistics cost minimization is very important in the current business operations.

III.REVIEW OF LITERATURE:

Supply Chain Management and Logistics Management are very important in business process. There is need of great cooperation and coordination within and between organizations in the supply chain (Cooper, Lambert & Pagh, 1997). The authors also proposed a conceptual model which provides guidance for decision making in supply chain.

Different companies continuously try to bring down their distribution cost as well as warehouse cost. A physical programming (PP) developed to re-configure a warehouse network. The model helps the managers to consider multiple criteria (Melachrinoudis, Messac & Min, 2005).

The detail study was carried to review the strategic production distribution model. The four sections in the review were previous reviews, optimization models, additional issues for modeling and case studies and applications. Mixed integer programming was applied in the problem (Vidal & Goetschalckx, 1997).

To improve the overall performance of the total logistics chain, logistics chain modeling is very important. OR model is also very important to analyze the local performance of logistic sub-chain and processes (Slats, Bhola, Evers & Dijkhuizen, 1995).

In any business firm the logistics system is evaluated on the basis of three primary levels: the organizational/ supply chain relationship, principles of logistics and attributes of these principles. Analytic network process and systematic analytical model was used to evaluate logistics strategies (Meade & Sarkis, 1998).

Increasing attention was placed on the performance, design and analysis of the supply chain. The main emphasis was placed on review of literature in multi-stage supply chain and modeling. The study was carried due to rising cost of manufacturing, shrinking resources, shortened product life cycles, etc (Beamon, 1998).

The mathematical model -Path selection was used in emergency logistics management. The objective of the model was to minimize the total travel time along a path (Yuan & Wang, 2009).

To choose appropriate supply chain performance measure is difficult. The performance measures are identified as necessary components in any supply chain performance measurement system (Beamon, 1999).

IV. RESEARCH GAP: The above reviewed literature mentioned about few Operations Research models for Logistics. Thus, here none of the review was pointing towards an effective model for combine approach in Transportation, Warehouse and Inventory, which are essential root of logistics.

V.OBJECTIVES OF THE STUDY: The objective of the study is as follows:

To propose an Integrated Operations Research Model for Logistics cost.

VI.SCOPE OF THE STUDY: The study will try to conceptualize an integrated Operations Research Model for logistics cost. Thus the study will concentrate on transportation cost, warehouse cost as well as Inventory cost.

VII. LIMITATIONS OF THE STUDY: The study has focused on limited route and network paths to develop the logistics cost. The study also focused on three zones of logistics functions as-transportation cost, inventory cost and warehouse cost.

VIII. RESEARCH METHODOLOGY: The study is of the type of exploratory, where every attempt has made to further explore the linkages. The study has inducted numbers of parameters to develop through understanding of the total integrated cost in logistics.

IX.CONCEPTUAL FRAMEWORK AND MODEL: The logistics cost mainly consists of transportation cost, warehouse cost as well as Inventory cost.

Model developed for the study purpose.

Transportation Cost:

		Warehouse				
		1	2	3	4	Supply
Factory	1	C11	C12	C13	C14	S1
	2	C21	C22	C23	C24	S2
	3	C31	C32	C33	C34	S3
	Demand	D1	D2	D3	D4	

The above matrix shows a hypothetical transportation matrix with three factories and four warehouses, having C_{ij} is the cost per unit of transportation from factory to the warehouse and X_{ij} be the unit load transported from each factory to each warehouses. Where i is the source (factory) and j is the destination (warehouse). Thus, the linear programming problem applied here gives the transportation cost function as:

Minimize $Z= C_{11}X_{11}+C_{12}X_{12}+C_{13}X_{13}+C_{14}X_{14}+C_{21}X_{21}+C_{22}X_{22}+C_{23}X_{23}+C_{24}X_{24}+C_{31}X_{31}+C_{32}X_{32}+C_{33}X_{33}+C_{34}X_{34}$

Subject to,

$X_{11}+X_{12}+X_{13}+X_{14}=S_1$
$X_{21}+X_{22}+X_{23}+X_{24}=S_2$
$X_{31}+X_{32}+X_{33}+X_{34}=S_3$
$X_{11}+X_{21}+X_{31}=D_1$
$X_{12}+X_{22}+X_{32}=D_2$
$X_{13}+X_{23}+X_{33}=D_3$
$X_{14}+X_{24}+X_{34}=D_4$
and $X_{ij}>=0$ (i=1,2,3; j=1,2,3.4)

Inventory Cost: Under Deterministic Model with Planned Shortages (Hillier, Lieberman,Nag & Basu,2013) -

Production or Ordering cost per cycle = K+cQ

Carrying Cost per cycle = $hS^2/ 2d$

Shortage Cost per cycle = $p(Q-S)^2 / 2d$

Thus, Total inventory cost per cycle = $K+cQ+ hS^2/ 2d+ p(Q-S)^2 / 2d$

Volume : 5 | Issue : 12 | December 2015 | ISSN - 2249-555X

Where,

K= setup cost for ordering one batch
c= unit cost of producing or purchasing each unit
h= holding cost per unit of time held in inventory
p=shortage cost per unit short per unit of time
S=inventory level just after a batch of Q units is added to inventory
Q-S=shortage in inventory just before a batch of Q unit is added

Warehouse Cost: It is generally consisting of handling cost (C_H), storage cost(C_S), operations administrations(C_O) and general administrative expenses(C_{GA}) (Speh, 2009).

Thus warehouse cost = $C_H+C_S+C_O+C_{GA}$

X.INTERPRETATION: Thus the above models can be taken together to minimize the overall logistics cost of an organization. The different parameters used in the study need to be defined before starting the calculation.

XI.CONCLUSION: Thus, Logistics functions are very important for successful business operations. The important components of logistics are transportation, inventory management and warehouse management. The operations managers need to know the cost associated with the business logistics. For successful business functions the managers need to minimize cost of every activity. With the application of Operations Research models the different cost can be calculated and thus it is quite helpful for the managers to visualize the problem.

REFERENCE

Beamon B M (1998). Supply Chain Design and Analysis: Models and Methods, International Journal of Production Economics, 55(3), 281-294. Beamon B M (1999), Measuring Supply Chain Performance, International Journal of Operations & Production Management, 19(3), 275-292. Cooper M C, Lambert D M & Pagh J D (1997). Supply Chain Management: More Than a New Name for Logistics, The International Journal of Logistics Management, 8(1),1-14. Hillier F S, Lieberman G J, Nag B & Basu P (2013). Operations Research. Delhi, India: McGraw Hill. Meade L & Sarkis J (1998). Strategic analysis of logistics and supply chain management systems using the analytical network process, Transportation Research Part E: Logistics and Transportation Review, 34(3), 201-215. Melachrinoudis E, Messac A & Min H (2005). Consolidating a Warehouse network: A physical programming approach, International Journal of Production Economics, 97(1),1-17. Sanyal S (2006 a). A guide to global logistics and freight forwarding, Hindu Business Line , 11 December. Slats P A ,Bhola B ,Evers J J & Dijkhuizen G (1995). Logistic Chain Modelling, European Journal of Operational Research, 87(1), 1-20. Speh T W (2009). Understanding Warehouse Costs and Risks, Ackerman Warehousing Forum, 24(7.) Vidal C J & Goetschalckx M, (1997). Strategic production-distribution models: A critical review with emphasis on global supply chain models, European Journal of Operational Research, 98(1),1-18. Yuan Y & Wang D (2009). Path selection model and algorithm for emergency logistics management, Computers & Industrial Engineering, 56(3), 1081-1094. REPORTS: E Commerce Boom triggers transformation in retail logistics- Driving a global wave of demand for new logistics facilities –JLL Report.