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## Cost Effective Transportation

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### ABSTRACT

A study of 1999 physical distribution (outbound only) costs revealed that total logistics cost represented 7.34 % of sales and that the outbound transportation costs amounted to 3.24%, warehousing 1.84%, customer service 0.48%, administration 0.38%, and carrying cost 1.52%. of sales.

We may operate a private fleet of owned or rented vehicles (private transportation). Second, a carrier may be in charge of transporting materials through direct shipments regulated by a contract (contract transportation). Third, the company can resort to a carrier that uses common resources (vehicles, crews, terminals) to fulfill several client transportation needs (common transportation).

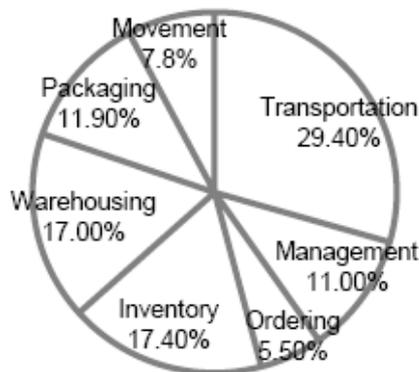
A common way to achieve considerable logistics cost savings is to take advantage of economies of scale in transportation by consolidating small shipments into larger ones. Consolidation can be achieved in three ways. First, small shipments that have to be transported over long distances may be consolidated so as to transport large shipments over long distances and small shipments over short distances (facility consolidation). Second, less-than-truckload pick-up and deliveries associated with different locations may be served by the same vehicle on a multi-stop route (multi-stop consolidation). Third, shipment schedules may be adjusted forward or backward so as to make a single large shipment rather than several small ones (temporal consolidation).

Logistics involves movement of products. A product produced will achieve its value after it has moved to the point where it will be consumed. Transportation does not only create utility, but creates time utility as well, since it determines how fast and how consistently products can move from one point to another. The transportation costs will also vary considerably with the mode of transportation chose. The particular mode chosen depends on the characteristics of the mode and the companies' need

**Keywords : cost effective transportation, transportation mode, freight consolidation, city logistics**

Transportation is the base of efficiency and economy in business logistics and expands other functions of logistics system. In addition, a good transport system performing in logistics activities brings benefits not only to service quality but also to company competitiveness. Therefore in the wake of rising freight costs and shrinking capacity, even the savviest of transportation professionals are struggling to reduce freight expenditures while keeping a keen eye on customer service. As transportation brings efficacy, also it builds a bridge between producers and consumers.

A study of 1999 physical distribution (outbound only) costs revealed that total logistics cost represented 7.34 % of sales



and that the outbound transportation costs amounted to 3.24%, warehousing 1.84%, customer service 0.48%, administration 0.38%, and carrying cost 1.52%. of sales. (Logistics cost and service 1999-N.J. Fort Lee, Herbert W. Davis And Company)

Also one analysis shows transportation is the highest cost, which occupies 29.4% of logistics costs, and then in order by inventory, warehousing cost, packing cost, management cost, movement cost and ordering cost. The ratio is almost one-third of the total logistics costs.

Cost ratio of logistics items (modified: Chang, 1998) Chang, Y.H. (1998) Logistical Management. Hwa-Tai Bookstore Ltd., Taiwan.

### Modes of Transportation.

Transportation services come in a large number of variants. There are five basic modes (ship, rail, truck, air and pipeline), which can be combined in several ways in order to obtain door-to-door services such as those provided, for example, by intermodal carriers and small shipment carriers. According to recent surveys, transportation by truck is approximately seven times more expensive than by train, which is four times more costly than by ship.

Basic Modes of Transportation wrt cost and nature of consignments

	Fixed Costs	Variable costs	Traffic composition
Rail	high	low	bulk food, mining, Heavy mfg
Motor	low	medium	consumer goods, Medium/light mfg
Water	medium	low	bulk food, mining, Chemicals
Air	low	high	high-value goods, Rush shipments
Pipe	high	low	petroleum, chemicals, Mineral slurry

Source :Michigan State University

**Relative Operating Characteristics**

Relative characteristics	Rail	Motor	Water	Air	Pipe
Speed	3	2	4	1	5
Availability	2	1	4	3	5
Dependability	3	2	4	5	1
Capability	2	3	1	4	5
Frequency	4	2	5	3	1
<b>Composite</b>	<b>14</b>	<b>10</b>	<b>18</b>	<b>16</b>	<b>17</b>

1 = best, 5=worst

Source:Michigan State University

**Transportation Mode Selection**

Mode selection is another fundamental concept in transportation planning. Common transportation modes include overnight package, parcel, less-than-truckload (LTL), truckload (TL), and rail carload (CL), for example. Each mode offers different cost and service advantages and disadvantages

Transportation mode impacts inventory costs in three different ways. First, slower transportation modes create more in-transit or pipeline inventory. Second, larger shipment sizes may create order quantity inventory, which arises if the batch shipment size is more than the amount of current demand. Third, slower transportation modes may raise safety stock inventories needed to protect uncertainties in supply and demand. A slower transportation mode increases the order lead time (the time between placing an order and actually receiving the shipment), so more safety stock may be needed to protect against the lack of knowledge about demand during the lead time. Thus smaller shipments via faster modes reduces all three types of inventories, but associated transportation costs increase.

**Transportation selection determinants**

According to transportation selection literature, the salient selection determinants are: transportation costs and service performance, which can be categorized as transit time, reliability, accessibility, capability and security/safety.

Coyle, Bardi and Langley have demonstrated the user implication for each determinant.

**Selection Determinant User Implication**

Transport cost	landed cost
Transit time	inventory, stock out costs, marketing
Reliability	inventory, stock out costs, marketing
Accessibility	transit time, freight costs
Capability	meet physical/marketing needs
Security/safety	inventory, stock out cost

**Transportation Selection Decision**

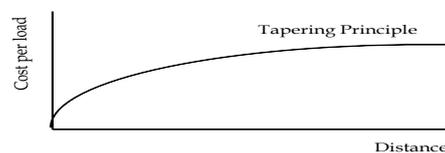
Here we can carry out the selection process in twofold: the choice of mode (rail, water, truck, air and pipe line or mixing of any two mode) and selection of specific transport provider (private, contract, common)

We may operate a private fleet of owned or rented vehicles (private transportation). Second, a carrier may be in charge of transporting materials through direct shipments regulated by a contract (contract transportation). Third, the company can resort to a carrier that uses common resources (vehicles, crews, terminals) to fulfill several client transportation needs (common transportation).

**Factors affecting transport cost**

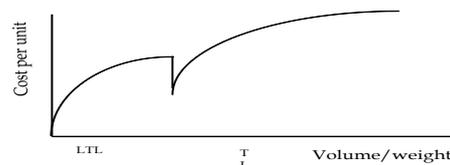
Outbound transportation being the largest component of total physical distribution is required to be cost effective. There are seven factors that affect the pricing aspects of transportation. They are: Distance, Volume, Density, Stowability, Handling, Liability,Market Factors,

Distance is directly influencing transportation cost as it contributes to all variable cost such as labour, fuel and maintenance but is independent of fixed cost which is fixed for no distance also.



Transportation cost per unit of weight decreases as load volume increases and hence small load should be consolidated in to larger loads to take advantage of cost effectiveness.

Transportation cost per weight is indirectly proportional to the density of product and hence effort should be to increase product density to decrease transportation cost.



Items with standard rectangular shapes are much easier to stow than odd shaped items.

Handling of sophisticated items or many numbers of small items involves more cost in transportation process.

Six characteristics of products create liability and results in incidence of claim. They are: susceptibility to damage, property damage to freight, perishability, and susceptibility to theft, susceptibility to spontaneous combustion or explosion, and value per rupee.

When a transport driver returns to origin point, he either comes with load (back-haul), or with empty vehicle (dead-head). This is called market factors, which influence transport cost effectiveness. (Donald J. Bowersox, & David J. Closs)

**Transportation Cost Structures**

- Variable: costs vary with services or volume:
  - o line-haul costs of fuel, labor and maintenance
  - o handling
  - o pickup and delivery
- Fixed: constant regardless of activity

- o Facilities, equipment and administration
- Joint: "hand-in-hand" costs -- unavoidable
  - o Example: the backhaul move
- Common: shared costs ("overhead")
  - o need for Activity-based costing

#### Consolidation of transportation for cost savings

A common way to achieve considerable logistics cost savings is to take advantage of economies of scale in transportation by consolidating small shipments into larger ones. Consolidation can be achieved in three ways. First, small shipments that have to be transported over long distances may be consolidated so as to transport large shipments over long distances and small shipments over short distances (facility consolidation). Second, less-than-truckload pick-up and deliveries associated with different locations may be served by the same vehicle on a multi-stop route (multi-stop consolidation). Third, shipment schedules may be adjusted forward or backward so as to make a single large shipment rather than several small ones (temporal consolidation).

#### Freight Consolidation

In freight transport, decisions on the transport network settings have a direct impact on the service quality but also on their costs. It is then important to adapt the transport network to the economical, geographical, organisational and quality constraints (Deflorio et al. 2009).

H. Donald Ratliff, and William G. Nulty of Georgia Institute of Technology state that strategies for consolidating freight are fundamental to shipment planning decisions. Shipments in the logistics system can be routed and scheduled independently of each other or can be combined to try and achieve transportation economies-of-scale. There are many ways to consolidate freight, including:

- Vehicle routing. Individual shipments can be combined to share a transportation asset making pickup or delivery stops at different facilities. This type of consolidation is called multi-stop vehicle routing
- Pooling. Individual shipments can be brought to a central location or pooled, creating large shipments suitable for economy-of-scale transportation modes such as truckload or rail carload
- Scheduling. Sometimes shipment schedules can be adjusted forward or backward in time so they
- can be combined with other shipments

#### Routing and Scheduling

##### Goals:

- find best path a vehicle should follow through networks of roads, rail lines, shipping lanes, and air routes
- determine best pattern for stops, multi-vehicle use, driver layovers, time of day restrictions

##### Benefits:

- greater vehicle utilization
- improved and more responsive customer service
- reduced transportation expenses reduced capital investment in equipment

#### Principles for Good Routing/Scheduling

- load trucks with deliveries for customers closest to each other
- stops on individual days arranged together

- start routes with farthest stops first
- circular routes - don't cross paths
- use largest vehicles first if can be filled
- mix pickups in with deliveries, not at end
- if one stop far from other, use other truck
- avoid narrow stop time windows, or handle separately

#### Continuous Move Routing

Some trucking companies offer discounts for continuous move routes, where drivers and tractors are kept highly utilized by coordinating the dropoff of an inbound trailer with the pickup of an outbound trailer.

#### Single Sourcing

Single sourcing refers to satisfying all product demand at a location from one supplier - in contrast, split sourcing refers to multiple suppliers satisfying the same demand location. The most common form of single sourcing is between distribution centers and customers or markets, with each customer assigned a single distribution center

Single sourcing simplifies the logistics supply chain which can reduce management and operational costs. Single sourcing also creates larger volume shipments along lanes, which may reduce transportation costs. However, single sourcing requires each supplier to stock all products - split sourcing allows each product to be shipped via the cheapest shipping route to a customer. Split sourcing can also reduce costs if the supply points are capacitated, as the least cost allocation of supply may require split shipments.

#### Approach to Analysis

- 1 we should analyze lane densities/frequencies:
  - What opportunities emerge for?
    - inbound/outbound consolidation
    - vehicle consolidation
    - temporal consolidation
    - network consolidation - cross dock potential (hub and spoke systems)
- 2 Once opportunities for consolidation are visible, we should make mode/carrier selection based on service/cost mix
  - Given similar service, are rates better on 1 mode/carrier than another?
  - Does any mode/carrier have relative strengths in a particular lane?
  - Any backhaul opportunities?
3. If so, we look to consolidate loads on mode/carrier with best cost structure - assign private fleet to most costly routes.

#### Consolidation Opportunities

- Inbound-Outbound flow consolidation: looking for opportunities to combine inbound/outbound freight
- Vehicle consolidation: using one vehicle/multi stops for LTL volumes vs. one shipment to each
- Temporal consolidation: holding orders until large volume shipment possible

#### City Logistics- an optimized transportation service technique

City Logistics is the process for totally optimising the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy.

Common techniques integrated in the procedures of City Logistics include cooperative freight systems, freight villages (terminals), controlling transport load factors, new freight transport systems, and intelligent transport systems (ITS).

#### Cooperative freight systems

The traditional delivery pattern of freight is fewer trips and more loads. The delivery companies usually maintained their business independently by two different carriers where the transport costs will increase hugely to satisfy the customer's requirements.

Cooperative freight systems are the ways which could be expected to solve this problem.

Cooperative freight systems integrate the resources of the co-operating companies to optimize the economic benefits. The main benefits of the techniques are (1) properly increasing delivery trip loads; (2) reducing unnecessary trips, as well as pollution and costs; (3) reducing service area overlaps; (4) increasing service quality and company profits.

#### Freight villages (terminals)

The concept of freight villages (terminals) has been applied in several cities, such as Monaco.

The goods are reorganized in the freight village before being delivered to the urban areas.

This system can reduce the required number of trucks used for delivery and handling.

#### Controlling transport load factors

In Europe, some cities implement the limitation of load factors in urban freight transport.

Companies allowed to deliver freight in urban area must have high loading rates, and the vehicles have to conform to the environmental standards. The method of regulation is through publishing special certificates and giving the right for the companies to use particular transport infrastructure in the urban area, so reducing the complexity of urban transport.

#### New freight transport systems

New freight transport systems range from the design of new vehicles to the underground freight transport systems. The

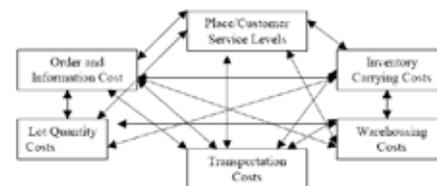
former can be used to adjust the current resource to satisfy the short-term requirements. The latter is for the long term, bringing a new era to city freight transport.

#### Transport Systems (ITS)

Applications of ITS in transport systems involves the techniques like Global Positioning System (GPS), Geographic Information Systems (GIS) and advanced information systems. GPS provides the service of vehicles positioning and helps to control centres to monitor and dispatch trucks. GIS provides the basic geographic database for the deliverers to enable to organise their routes easier and faster. Advanced information systems provide the real-time information for both managers and deliverymen to adjust their paths as new demands occur. The integration of GPS, GIS and advanced information systems are providing better service quality, reduced unnecessary trips, and increased loading rate thus decreasing overall transportation cost.

#### Conclusion

The Total Cost Model by Lambert and Stock (2001) presented six major logistics cost categories that are driven by a number of key logistics activities required to facilitate the flow of a product from the point of origin to the point of consumption (Fig.)



Source: Adapted from Lambert and Stock (2001)

According to Lambert and Stock (2001) Logistics involves movement of products. A product produced will achieve its value after it has moved to the point where it will be consumed. Transportation does not only create utility, but creates time utility as well, since it determines how fast and how consistently products can move from one point to another. The transportation costs will also vary considerably with the mode of transportation chose. The particular mode chosen depends on the characteristics of the mode and the companies' need.

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