Importance of Road Freight Transport to the Organization and Economy

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Freight Transport

- FT is the process of conveying different types of goods from one point to another using a variety of transport modes.

- Hence FT is NOT site specific as other logistic activities.

- Transportation create the place and time value (utility)

- High Transport Costs can off set manufacturing gains and reduce market size.
Po + rd

Where Pd is the cost at distance d where Po is the cost at point of pick up and r is the trucking rate per unit distance.

If production costs are similar and trucking costs are similar each producer and each trucker will have the same volumes.

The market area is $\Delta d^2$. 
\[
P_d = P_o + r_d
\]

- If one trucker is able to offer a 10% lower rate,
- Then the product is competitive at \(1.1 \times d\) distance from the point of production.
- The market area then increases to \(1 \times (1.1 \times d)^2\).
- This means that the market size has increased by 23%.
- This shows that when transport cost reduces by 10% then market size increases by 21% and when transport cost reduces by 20% then market size will increase by 36%.
FT cost impacts on Economies of Scale

- Wider markets can result in lower per unit production costs

- Higher FT costs lead to decoupling of markets and production sites.
Global Transport Costs as % of Logistics Costs is Increasing

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>Logistics Cost</th>
<th>% of GDP</th>
<th>Trans. Cost</th>
<th>% of Logistics Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>$2.88 trillion</td>
<td>$451 billion</td>
<td>15.7%</td>
<td>$214 billion</td>
<td>47.5%</td>
</tr>
<tr>
<td>1999</td>
<td>$9.26 trillion</td>
<td>$921 billion</td>
<td>9.9%</td>
<td>$554 billion</td>
<td>60.2%</td>
</tr>
<tr>
<td>2013</td>
<td>$74.5 trillion</td>
<td>$7,012 billion</td>
<td>9.3%</td>
<td>$3,500 billion</td>
<td>60%</td>
</tr>
<tr>
<td>2013 (Sri Lanka)</td>
<td>$70 million</td>
<td>$9 million</td>
<td>13%</td>
<td>$5 million</td>
<td>60%</td>
</tr>
</tbody>
</table>

Source: IMF, World Economic Outlook
Logistics Cost As A Percent of GDP

- Mexico
- Japan
- India
- Asia
- Europe
- China
- US

Percent of GDP
Logistics Cost As A Percent of GDP

Source: Rosalyn Wilson, CSCMP
Instances of Transport Cost addition
Transport as % of Logistics Costs
Network Paths

• One-stage system
  In a one-stage system, the movement and storage involve a direct flow of goods or services between the supply point, or origin, and the demand point, or destination. In this system, the goods or passengers are available at the supplier or generator end and need to be produced at the receiving point or attraction end. The strength of the one-stage system is that the flow of goods or passengers is not interrupted. No other warehousing, terminal or transport processes are required.

• Multi-stage system
  In a multi-stage system, the movement and storage involve an indirect flow of goods or passengers is between the supply and demand points. The flow of goods is interrupted at one or more stages. Here, additional storage or transport processes are performed. The objective of this work is to separate or consolidate the flow of goods or passengers.
    – Breakbulk point: Large quantities of goods or passengers from the supply point arrive at the “breakbulk point,” and small quantities of them leave it bound for various demand points.
    – Consolidation point: This is the reverse of breakbulk where goods or passengers from a supply point arrive in smaller quantities to be consolidated to larger quantities headed for the demand point.

• Combined system
  In combined systems, direct and indirect flows of goods or passengers can co-exist.
How do firms react to improvements in freight Transportation

- Firms reduce stocking points, increase JIT processes and increasing shipping distance.
- Firms react to reduced late-shipping-delays, values highly by shippers by investing more in logistics.
- Inter-industry trading partners are affected.
Structure of Transport Chain

Consolidate & Distribution

Break-bulk & Distribution

Producer
Central Logistics Centre
Regional Distribution Centres
Customers/Consumers
Structure of Transport Chain

Collection/Distribution → Consolidate & Distribution → Break-bulk & Distribution

Producers → Central Logistics Centre → Regional Centre → Customers/Consumers
One Central Warehouse serving customers directly. Number of smaller vehicles going to many customer destinations. Large fleet. High vehicle kms.
No Central warehouse. Large trucks collect and distribute to and from many plants. Smaller vehicles distribute to customers from each DC.
No warehouses or DCs. Each location is a cross docking where trucks bring and distribute after sorting out. (Lunch carrier operation or vegetable distribution).
Total Cost Trade off

• Factors Affecting the Total Logistics Cost
  – Inventory costs
  – Warehousing costs
  – Transportation costs
Network Planning Techniques for Managing Transport Operations Effectively
Representing a network

- Nodes/Hubs
- Links/Routes
- End Nodes
- Unimodal Hubs
- MultiModal Hubs
- Multimodal Corridors
• Higher order networks are built for speed (mobility) while lower order are built for access.

• Higher order networks are efficient for long trip lengths while lower order networks are efficient for shorter trip lengths.

• Higher order networks have larger capacities and lower networks are designed for lower capacities but possibly higher frequencies.
Network Integration

Types of Networks

• Collection Networks (Many collect points → one distribution point)
  Examples
  – Tea/Milk Collection

• Distribution Networks (One collect point → many distribution points)
  Examples
  – Cement/Coca Cola
  – Choon Paan/Newspaper

• Collector-Distributor Networks (many collect points → many distribution points)
  Examples
  – Courier
  – School Vans/Office Vans
  – Local route bus

• Point to Point Networks (one collect point → one distribution point)
  – Non-stop airline
  – Dedicated Home delivery (Pizza)
  – Chartered Services
Routing

• Fixed Route and Stops
  – Airlines
  – Trains
  – Milk Runs

• Fixed Route with Variable Stop
  – Buses
  – Vegetable/Tea Leaf Pick up

• Route and Stops varied on demand
  – Courier service
  – Office/School Van Service

• Point to Point
Milk Run
Strategic Network Planning

- At strategic level or long term level we consider the planning of the underlying physical network or infrastructure.

- The questions at Strategic Level are:
  - Where the facilities should be located? (e.g. where depots, warehouses should be built?)
  - What resources should be acquired (e.g. what type of truck to operate)?
  - What type of services should be offered?
When Networks should be redesigned?

**Frequency of review for network design**

- On an annual basis: 27.9%
- Only when a significant change occurs: 20.3%
- Between 2 to 5 years: 15.5%
- Between 1 to 2 years: 14.2%
- Every 6 months or less: 13.0%
- Have not reviewed the network design: 7.3%
- More than 5 years: 1.8%

*Source: 2011 Masters of Logistics Study*
Network Planning at Tactical Level

• At tactical level (medium term) we do not consider the day-to-day operation of the network or facility, but aggregate information to determine an efficient and rational allocation of existing resources.

• Network planning and design problems at this level are:
  – Which customers to service?
  – The capacity and frequency for each customer
  – The positioning of empty vehicles? (what do I do with off peak or off season capacity)
Operational Level

- Network planning and design problems at operational level are mostly involved in service delivery.

- For example, a courier company needs to each day plan its routing, vehicles, personnel to use the underlying transportation network as cost efficiently as possible, at the same time ensuring that all deliveries are made on time.
Issues in Network Operational Planning

- Scheduling fleet, staff to meet anticipated demand.
- Planning to meet demand variations
- Recovering from events and incidents
- Determining service-cut off levels vs minimum service levels
Network Operational Planning

• A network can be understood by its key operational features. Some of the important features are:

• **Time** – from the user perspective door to door time is important. For passenger travel, waiting time, transfer time are more important. Overall journey speed determines the journey time which includes stops, delays, transfers etc.

• **Distance** – determining minimum distance is important since cost and speed are often associated with distance. It can also mean higher costs.

• **Capacity** – the capacity determines the volume that can be transported. Less volumes mean lower frequencies and lower speeds. Capacity can be measured in terms of passengers, vehicles or by weight or size.
Network Operational Planning

• **Costs** - The above translates to cost of carriage both in terms of out of pocket cost and perceived cost. It also includes external social costs for which the user may or may not pay.

• **Reliability** - the ability to deliver on time repeatedly, measure as on time arrival.

• **Transferability** – the ability to transfer to other modes that are faster or cheaper at key points defined also as inter-modality.

• **Quality** – this refers to the quality that the user may require. Different services are provided with different qualitative aspects such as comfort, convenience, reliability, customer service, choice of service class etc.
KPI: Service Supply Attributes

• Reduce Operational distance/time
• Improve fleet utilization (km/vehicle/day)
• Reduce operating cost per unit km/hr
• Reduce operating cost per ton km
• Improve yield per vehicle km operated
• Improve yield per ton km provided
• Improve yield per vehicle/facility
• Improve load factors (tons/capacity)
• Reduced time
• Reduced rate
• Eliminate double handling /have direct services
• Improved customer service (personal attention)
Approach to Dynamic Routing & Scheduling

1. Build on historical data feeds for different inventory items.
2. Build routes so that load factors are reasonably high but do not exceed that of the truck capacity say 95% of time.
3. If desired frequency is achieved or if transport cost per unit need to be reduced then get larger truck.
4. If GPS is fitted to trucks then routing can be dynamically changed to add/drop scheduled stops or routing order depending on developments after truck is dispatched.
5. The sequence of stops to be designed so that veh kms are minimised.
6. Pickups mixed into delivery routes rather than assigned to the end of routes after checking for capacity of truck at all points of delivery route.
7. Improving turn around time, higher vehicle utilisation, crew assignment will decrease per unit cost further.
Principles for Good Routing and Scheduling

1. Load Trucks with stop volumes that are in the close proximity to each other
2. Stops on different days should be arranged to produce tight clusters
3. Build routes beginning with the farthest stop from the depot
4. The sequence of stops on a truck should form a teardrop pattern
5. The most efficient routes are built using the largest vehicle available
6. A stop that is greatly removed from a route cluster is a good candidate for an alternate means of delivery
Conclusions

• Transport costs make up a significant part of total logistics cost.

• Higher quality of service requirements such as JIT and D2D results in higher transport costs.

• Distribution Centres will reduce transport costs but increase other costs.

• Consolidation, Routing and Scheduling can further reduce transport costs without increasing total logistics costs.
Understanding the Cost Profiles of Road Freight Transport Services
Profit Maximization for trucking

- Increase volume
  - Same customer (better service)
  - More customers (better marketing)

- Same volume
  - Better margin (better efficiency)

- Better Margin
  - Lower cost per km (efficient operations)
  - Lower kms (higher payloads/better scheduling)
  - Better prices (better service)
  - Better (new) customer

- Success if usually a combination of all above
Higher Profits through better service quality

- Time-in-transit (journey time)
- Reliability (on time delivery- JIT)
- Door to Door Delivery (D2D, no double handling)
- Damage-in-transit and Insurance
- Collection Time (frequency)
- Shipment Tracking
- Quantity flexibility (LTL/ truck size variations)
- Customer Service
Higher profits through Lower Cost per km

The process

• Identify cost inputs
• Identify how input costs vary
• Reduce input volumes
• Reduce input unit costs
Variants of Truck Operation Costs

- Type of Route (urban, low country, up country)
- Type of Service (general cargo, flat bed, bowser)
- Tare (maximum carrying capacity, tonnes, litres)
- Age of Truck
- Country of Origin (Technology) – Indian, Chinese, Japanese, European
- Trip Type (short haul, long haul)
- Working Hours (regular, single shift with OT, double shift)
- Truck availability for operation (days/month)
- Average kms operated/month
- Percentage empty running
- Percentage dead running
- Average Load Occupancy
- ICT applications
Cost Components

1. Fuel (tare of truck, type of operation, manufacturer, cost of diesel, overloading)
2. Crew (hours of work, wage rate, EPF/ETF/Gratuity)
3. Oil & Lubricants (cost of oil, servicing cost, age of truck)
4. Tires & Tubes (tyre wastage, cost of tires and tubes, loading levels)
5. Repairs (engine/body work, minor repairs- labour and parts, load levels)
6. Daily Overhead (parking fees)
7. Monthly Overheads (management fees)
8. Annual Overheads (license, insurance, fitness)
9. Depreciation (value of truck, depreciation rate)
10. Interest on Capital (Prime Lending Rate, Treasury Bill Rate)
11. Risk on Enterprise (value of bus, risk rate)
Factors for Fuel Efficiency of Trucks

Source: Kenworthy- Trucking
Fuel Consumption Euro III 17 tonne truck

\[ y = -4E-05x^3 + 0.009x^2 - 0.6665x + 20.652 \]

\[ R^2 = 0.8574 \]

Source: Transport Research Laboratory, - www.trl.co.uk
Optimum Operating Cost and Age of Vehicle
Improving operational efficiency (lower kms and higher load factors)

• Better scheduling (AVU?, data-fed delivery systems, routes, paths, tracking, Dead Running)

• Improve On-Time Delivery (breakdowns (what is cost of breakdown?, age of trucks, safe drivers, GPS)

• Consolidation of Loads (load factors, vehicle mix)

• Return Loads (truck pooling)
Some key solutions- and take home lessons

- Reducing cost and improving output quality the most important factors for profitability

- To reduce costs you should identify cost factors and know what causes them to vary

- The mix at which the lowest cost is achieved with the best output of quality will provide the best profitability in the long run.