



MIT SCALE RESEARCH REPORT

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The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

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Research Report: ZLC-2006-6
Transportation Cost Volatility and Mode Choice
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Transportation Cost Volatility and Mode Choice

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EXECUTIVE SUMMARY

Coordinating supply chains globally is very complicated and costly. After setting the network of facilities, managers struggle to optimize capacity allocation and product flow between these nodes. Taking into account dynamic market conditions and prices is especially challenging in an environment where fuel prices are increasingly volatile.

These problems affect multinationals as well as managers of companies in the US that have operations nationwide. A supply chain manager must choose which mode of transportation to use between production and storage locations, given the value density of his products, transportation costs and total logistics costs. Furthermore, if the product mix allows, he has to choose whether to operate dedicated facilities for single family-groups of products, or to invest in flexible production. The goal is clear: to minimize total logistics costs. In the longer term, managers have to determine the optimal sourcing structure and network design for the supply chain, given current and expected market trends.

Scenario analysis of total logistics costs of truckload and intermodal transportation for products of different value densities over distances of 500, 1000 and 1500 miles, with some assumptions about fuel costs, inventory holding costs and lead times, gives some interesting results:

- **Truck driver labor:** This represents almost half the cost of truck load transportation and only about a quarter the cost of intermodal transportation. A study sponsored by the American Trucking Association indicates that truck driver wages will increase 6-7% over the next three years. Hence a 10% increase in the cost per mile in truck load transportation can be caused by a 23% increase in driver costs. This shifts the range of value densities of products for which intermodal is more efficient by as much as 33%.
- **Increase in diesel price:** A price jump from \$2.50 per gallon to \$4.20 per gallon, which is a 68% increase, will cause the cost per mile of truckload and intermodal transportation to increase by only about 20% and 13%, respectively. This will cause intermodal to be more attractive than truckload over a range of value densities that is 27-33% larger, which is similar to the effect of a 23% increase in truck driver labor.
- **Equipment maintenance and other:** This category represents about 44% of the total cost of transportation for truckload and 60% for intermodal. New environmental regulations require cleaner truck engines that are more expensive to maintain. This will cause truckload transportation to become less attractive but the effect is not likely to be very significant since this category is composed of many factors, none of which are a very big component of transportation costs.

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- **Inventory holding:** Due to the longer lead time of intermodal transportation, an increase in the cost of holding inventory causes truckload to become relatively more attractive in terms of total logistics costs.
- **Lead Time:** A one day increment in lead time of intermodal increases the range of value densities over which truckload is cheaper by 33% due to the larger safety stock requirement for intermodal.

The analysis shows that the relevant logistics costs depend upon the cost of labor, fuel, equipment, inventory holding and relative lead times to different degrees. The most interesting fact is that truck driver wages have a much stronger positive correlation with total cost per mile than most people realize. This is exacerbated by the current shortage of qualified truck drivers that will continue to increase over the next ten years. Contrary to popular belief, fuel cost is not the largest component of transportation cost.

We recommend that supply chain managers take the following steps to aid them in making the correct mode choice and capacity allocation decisions:

- Determine the value densities of their product families.
- Tabulate the relevant distance ranges between production, storage and customer locations over which there is a choice of mode.
- Verify the lead times for these modes for the relevant source-destination pairs.
- Calculate the tradeoff between transportation versus inventory holding costs for these modes at current lane rates.
- Evaluate how much of a change in cost per mile would justify switching modes and simultaneously determine how likely these scenarios are in six to twelve months.
- Create a watch list of scenarios that are most likely and of those products for which these scenarios are relevant and monitor them regularly.
- Document and approve a pre-determined action plan so that relevant contacts and procedures are known beforehand in case a mode switch or capacity reallocation is justified.

This process will ensure swift action and minimize the chance of a lost opportunity to save money. Our research determined that such a plan could save over \$300 in total logistics spend per load in a scenario where truck load costs increased by 10%. The annual savings of instituting such a plan run into hundreds of thousands of dollars.