Impact of Lead Time on Truckload Transportation Rates

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Summary: This project developed a model to quantify the impact of business policy decisions, such as tender lead time, on truckload transportation costs. This model demonstrated that business policies have a substantial impact on companies' overall transportation spend and these policies can be quickly modified to reduce cost with little risk or capital investment.

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KEY INSIGHTS

1. Routing guide depth (the number of carriers to which a shipper tenders a load before it is accepted) drives transportation costs.
2. Business policy decisions, such as tender lead time, affect the likelihood preferred carriers will accept a tender.
3. Companies can modify business policies to increase carrier tender acceptance rates and therefore reduce transportation costs.

Introduction

Since companies in the United States spend over $150B annually on transportation, even slight improvements in pricing efficiencies can lead to substantial cost savings. This research analyzed over one million truckload transactions in partnership with C. H. Robinson's Transportation Management Center and determined that it is possible for shippers to modify their business processes to improve the likelihood tenders will be accepted by their preferred carriers at a lower cost. These business policy factors include tender lead time, tender and pick up day of the week, and carrier size preference.

Many companies seeking to reduce transportation costs concentrate on network design and carrier negotiation, which have both been well researched. Conversely, the transportation pricing impact of business policies, such as lead time, has been less explored. As a result companies likely fail to appreciate the impact their processes have on transportation costs. This research resolves this shortcoming by using statistical modeling to estimate the impact of each transportation factor and provide management insights to help companies improve business policies.

Routing Guide Depth

Since the price each carrier charges to haul a load is contractually fixed, the driving force in transportation

cost is related to how deep a shipper must tender in their routing guide until a carrier accepts their load. A routing guide is unique to each transportation corridor and lists all the potential carries on that corridor. Generally the least expensive carriers are at the top and have the first opportunity to accept the tender. The first carrier in the routing guide will on average accept 78% of tenders. The acceptance rate generally drops with each subsequent position in the routing guide, with tenders offered to the fifth carrier in the routing guide being accepted only 40% of the time.

The average routing guide depths for each day of lead time represented in Figure 1, show that the more time a carrier has between the tender and pick up day the more likely the first carriers in the routing guide are to accept the load.

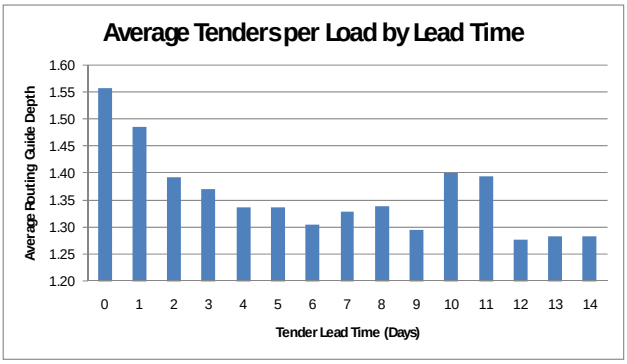

Figure 1: Average tenders per load

The decrease in routing guide depth then corresponds to a decrease in the cost per mile a shipper pays when providing longer lead times, as shown in Figure 2. From this observation one can conclude that the impact of business policy is actually measured by the effect it has on the likelihood a tender will be accepted, since multiple rejections result in increased cost.

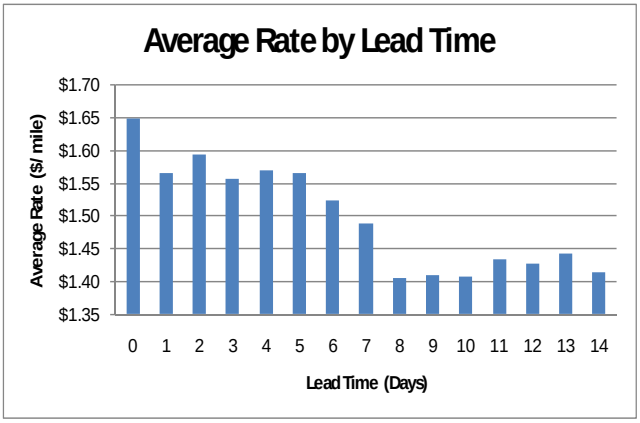

Figure 2: Average rate by lead time

A critical point to note is that the worst loads (those with multiple tender rejections) have the greatest affect on the average rate paid by a shipper. Figure 3 shows the average number of times a load had to be tendered compared to the average for the lane on which the load was travelling. From this graph, one can see that the 90th percentile of loads required 1.8 times the number of tenders compared to the average for the lane when lead time was zero. This helps demonstrate that even the small percentage of loads that are rejected repeatedly force the shipper much deeper into their routing guide and cause proportionately higher costs.

For loads with six or more days of lead time, the impact of the worst percentile of loads is mitigated, helping explain the improvement in cost per mile after five days of lead time in Figure 2.

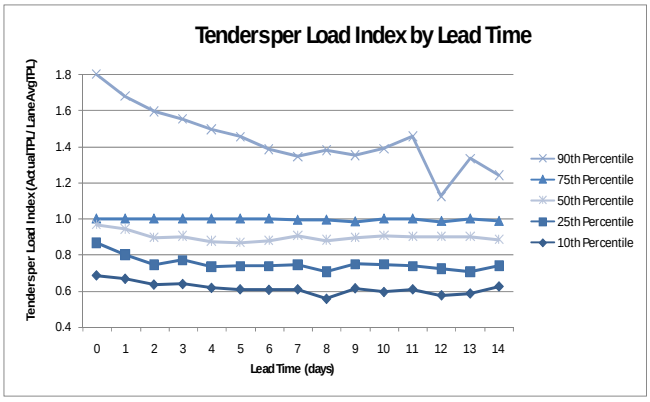

Figure 3: Tenders per load index by lead time

Transportation Model Results

Using multiple linear regression it was possible to quantify the impact of the different factors in a transportation model. All factors in Table 1 except mileage are binary and result in either a cost bonus or penalty for the predicted cost of each load. Distance cost is calculated by multiplying the mileage of the load by the per mile charge.

Transportation Model			
Variable	Criteria	Impact	P Value
Constant	$ per load	$ 149.90	0.000
Distance	$ per mile	$ 1.17	0.000
Origin	Origin State ($ per load)	Various	
Destination	Destination State ($ per load)	Various	
Corrider Volume (per year)	Daily >150 loads ($ per load)	Base Case	
	Weekly = 52-149 loads ($ per load)	$ 1.69	0.063
	Monthly = 24-51 loads ($ per load)	$ 21.27	0.000
	Annual <24 loads ($ per load)	$ 61.51	0.000
Carrier Size	Small/Medium	Base Case	
	Large	$ 22.12	0.000
	Extra Large	$ 77.91	0.000
Tender Day	Sunday	N/A	
	Monday	$ (0.38)	0.000
	Tuesday	Base Case	
	Wednesday	$ (2.07)	0.045
	Thursday	$ 4.05	0.000
	Friday	$ 5.94	0.000
	Saturday	$ 49.23	0.000
Pick Up Day	Sunday	$ 16.55	0.000
	Monday	$ 0.61	0.586
	Tuesday	Base Case	
	Wednesday	$ (1.00)	0.366
	Thursday	$ 2.29	0.050
	Friday	$ (1.54)	0.153
	Saturday	$ 22.98	0.000
Lead Time	0 to 8 hours	$ 24.26	0.009
	9 to 16 hours	$ 17.48	0.007
	17 to 59 hours	Base Case	
	3 to 5 days	$ (15.34)	0.000
	6 to 8 days	$ (24.51)	0.000
	9 to 11 days	$ (38.68)	0.000
	12 or more days	$ (47.10)	0.000
Adjusted R^2 Goodness of Fit		0.905	

Table 1: Transportation model details

The origin and destination were represented with a variable for each state. Corridor volume reflects economies of scale with the number of annual loads travelling between a pair of 3-digit origin and destination zip codes. Carrier size was derived using industry rankings.

Lead Time Impact

Although they all used the same tendering platform, average lead time for the nine customers included in the study ranged from less than one day to over five days, as shown in Figure 4.

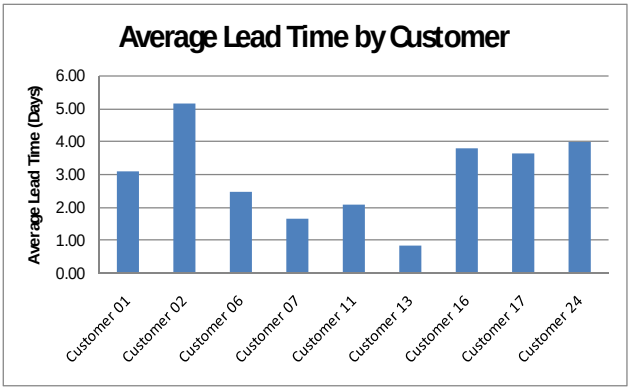

Figure 4: Average lead time by customer

This four-day difference in average lead time results in the customer with the shortest lead time paying an expected cost penalty of $42 per load, or 4.2% of that customer's annual transportation spend. It is likely that these costs could have been reduced if the customer had been able to provide carriers additional lead time.

Carrier Availability Impact on Lead Time

The research also reviewed how different periods of carrier availability would impact the transportation factors. The Morgan Stanley Freight Index compares the demand for trucks against the availability of trucks in a given week. A higher index number indicates tight capacity and a lower index number indicates looser capacity. The graph below shows a strong correlation between the freight index and the average routing guide depth.

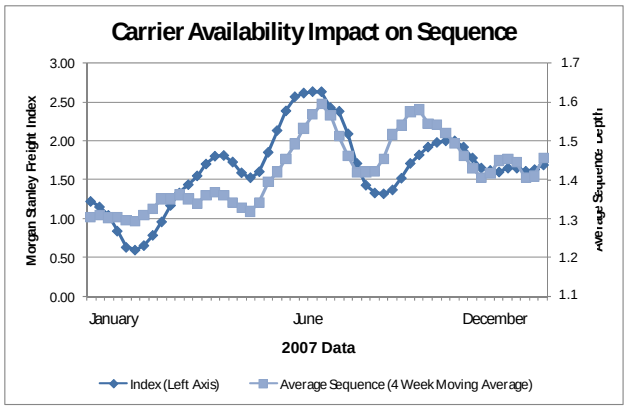

Figure 5: Freight index and average tender sequence number

After isolating the dataset for periods of tight and loose capacity (loads tendered when the freight index was above 2.20 and below 1.20) the transportation model was rebuilt to better understand the macroeconomic effects. The models have adjusted R^2 values of .910 and .904 respectively.

In the tight-capacity variation of the model, the impact of short lead time became more sensitive and carrier size became less important. The penalty for short lead time increased 40% and the penalty for using larger carriers decreased 50% compared to the original model. In the loose-capacity model, the short lead time penalty dropped 50% and the larger carrier penalty increase 40%.

These changes make sense with smaller carriers being more sensitive to idle tractors in the times of reduced demand and either discounting rates or increasing their acceptance frequency while the larger carriers are more prone to maintain the status

quo. This would explain the widening gap between the different sized carriers as large carriers become even more expensive in relation to the smaller carriers in times of reduced demand and excess capacity.

Day of the Week Activity

The results of the model highlight that tendering at the end of the week becomes slightly more expensive. Tender and pick up activity on the weekends incurs an average cost penalty of over $23 per load.

Management Insights

We expect that increasing average lead time to five or more days will markedly reduce transportation costs. Companies can increase lead time by contacting carriers when shipments are planned before actual loading or even forecasting future transportation needs with carriers well in advance.

The average corridor volume was 350 loads per year and the highest volume corridors were substantially above the median. This creates a situation where it is possible to forecast fixed transportation requirements weeks in advance to allow carriers time to better plan their capacity and increase the tender acceptance rate. Any additional loads can then be secured for the variable portion of the corridor volume closer to the pick up date.

Companies can also improve their transportation costs by focusing on loads responsible for the most expensive cost variances. By maintaining a private fleet capable of handling 10% of the volume it would provide the strategic ability for managers to handle loads with multiple rejections with fixed cost assets.

Human behavior tends to be impacted by metrics and deadlines. When companies use a Monday-Friday schedule they unwittingly cause an increase in more costly end of week activity and weekend penalties. By changing the work week metrics to a Wednesday-Tuesday schedule companies can avoid these impacts by changing their volume patterns. This also provides three days following the modified “end of week” in order to handle exceptions before the more expensive weekend.

Finally, the research shows that cost savings do not end with network design and carrier negotiation. Shippers can significantly reduce their transportation costs by optimizing their business policies with regard to the factors discussed in this research.