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EVALUATING MARKETING STRATEGIES FOR THE INTERMODAL FIRM

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ABSTRACT

The Intermodal Strategy Evaluation (ISE) Model is a potential decision support tool for developing marketing strategies for intermodal carriers. The model predicts the motor carrier and shipper response to an intermodal company's marketing initiatives and indicates the circumstances under which cooperative and competitive strategies are advantageous to each party.

ISE defines the market to be a traffic lane. Profitability is evaluated for round trips and for the lane as a whole, not on a per box basis. Customers are modeled as being either "naive" (truck is better than intermodal) or "sophisticated" (carrier choice is based on total logistics costs). The user provides base case information on customer characteristics, traffic quantities and prices. This information is used in a linear optimization model that incorporates truck and intermodal costs, to predict the trucking and intermodal companies' behavior and estimate their profits.

The model is demonstrated for the Interstate 95 corridor. The intermodal marketing strategies evaluated include 1) cutting backhaul rates, 2) cooperating with the trucking firm, and 3) educating customers to consider their total logistics cost in selecting a carrier. These marketing strategies are examined in the current environment and in a hypothetical environment where fuel prices are doubled.

The model results demonstrate that intermodal profitability improves by shifting customers from naive to sophisticated and, in most cases, from higher fuel prices. The most attractive marketing strategy depends on the circumstances in the individual corridor.

INTRODUCTION

Historically, intermodal companies have viewed trucking firms as competitors, and have developed marketing strategies based on that perspective. In 1990, however, J.B. Hunt, one of the largest truckload (TL) carriers, began moving trailers between Chicago and the West

Coast under a joint service agreement with the Santa Fe Railway. J.B. Hunt has since expanded this network to seven U.S. and one Canadian railroad. Other major trucking firms, including Schneider National and May Trucking, have also established alliances with intermodal service providers. Thus the questions arise: "When will trucking and intermodal firms benefit more from a competitive strategy, and when from a cooperative strategy? Under what circumstances will a cooperative strategy be more advantageous to both parties, and therefore prevail over other approaches?"

The authors have created a model of the dynamics of the truck/intermodal marketplace as a potential decision support tool for developing marketing strategies for intermodal carriers. The model predicts the motor carrier and shipper response to an intermodal company's marketing initiatives and indicates the circumstances under which cooperative and competitive strategies are advantageous to each party. The intermodal marketing strategies evaluated include 1) cutting backhaul rates, 2) cooperating with the trucking firm, and 3) educating customers to consider their total logistics cost in selecting a carrier. These marketing strategies are examined in the current environment and in a hypothetical environment where fuel prices are doubled.

MODEL STRUCTURE & FORMULATION

The Intermodal Strategy Evaluation Model (ISE model) was designed to forecast the effects of different marketing strategies available to an intermodal company. As a planning tool, many of the inputs are at a summary level. The model defines the market to be a traffic lane with one intermodal company, one truck company, and a series of customers whose freight can be aggregated into several categories (high, medium, or low revenue; high or low density; high or low value). Other simplifying assumptions in the model include:

- ▶ All trucks and intermodal boxes are 45-foot generic dry vans. In this model, a "trailer"

or "TOFC box" is any dry van or container that can be moved by TOFC or truck.

- ▶ Costs are linear with volume. (If the model suggests a large swing in volume that would require the company to make major operational changes – add or subtract train starts or buy additional equipment – the user may want to tailor the cost parameters to the particular situation and rerun the model.)
- ▶ Each carrier's fronthaul trailer volume must equal its backhaul volume (including empties). This assumption of balance ignores any network trailers that are involved in triangular movements.

In a given scenario, the customers can be modeled as either "naive" or "sophisticated" in choosing a carrier. The "naive" customers share the common perspective that truck service is always superior to intermodal.¹ They respond to the perceived service difference between truck and intermodal by always preferring truck and using truck whenever it is available. The "sophisticated" customers, which make their carrier choices based on total logistics costs, are able to make informed tradeoffs between slower transit times or lower reliability and lower cost. The customers' modal choice is constrained by the intermodal and truck companies' willingness to carry the segment of freight at the available prices. That is, if a move is unprofitable and the carriers refuse to haul it, the model may reduce the total amount of freight carried in the lane.

In the Intermodal Strategy Evaluation Model, a naive customer always prefers truck rather than intermodal if truck is available in that customer's revenue category. (The naive customer, however, is not willing to pay a premium for truck service, so the trucking company will have to match any rate reductions made by the intermodal company.) A naive, non-service sensitive customer will use intermodal, if a truck is unavailable. A naive, service sensitive customer will never use intermodal. All backhaul customers are assumed to be naive, non-service sensitive customers.

A sophisticated customer chooses its carrier based on total logistics cost. The component of the ISE model that calculates

total logistics cost is based on the formulation Sheffi, Eskandari and Koutsopoulos developed for Burlington Northern, which reflects the customer's service sensitivity and inventory holding costs of the product.² The model calculates the economic order quantity (EOQ) for each mode and category of freight (defined by revenue, density and value) and determines the safety stock required. With the EOQ and container capacity, the total logistics cost is calculated for each mode as the sum of the transportation costs, the stationary inventory carrying costs, the in-transit inventory carrying costs, and the safety stock carrying costs. In this way, the EOQ model takes into account service differences between modes.³

The user provides the base case input to the ISE model, including customer characteristics, the amount of traffic and the price for each traffic category and direction. The model estimates the total revenue, cost, and contribution for both firms, as well as the total logistics cost for each category of traffic.⁴ These parameters, along with the strategy that the user wishes to test, become the basis of a linear optimization program (LP). The LP reassigns the traffic to the truck and intermodal companies in the combination that maximizes the dominant player's profit,⁵ subject to the customer choice constraints described above. Once traffic is reassigned, the ISE model quantifies the potential impact on the intermodal and truck companies of the strategy selected. The model can analyze three basic marketing strategies: price competition, cooperation, and educating consumers to evaluate total logistics costs. It can also evaluate combinations of those strategies. The next sections describe how these strategies are incorporated into the model.

Strategy 1 - Cut Backhaul Rate

In the first strategy, the model represents the market as competitive and the trucking company as the dominant player. That is, the intermodal company has enough power in the market to influence rates, but customers are naive decision makers who will choose truck whenever that option is available. In Strategy 1, the intermodal company cuts its price in the back haul direction. This forces the truck company to also lower its price. The trucking company reevaluates its traffic on a "round trip"

basis and sheds any fronthaul/backhaul combinations that are not profitable.

The objective function maximizes the trucking company's profit, because the trucking company would respond to the lowered backhaul rate by adjusting its traffic base to maximize profits. The element in the objective function for projected intermodal volume insures that among the feasible solutions maximizing the truck company profit, the LP selects the solution that shifts the most traffic to intermodal. The LP formulation for this case is contained in Table 1.

Strategy 2 - Cooperation

In the second strategy, the truck company uses the intermodal company to perform the line-haul portion for some of its moves. The agreements Schneider and J.B. Hunt have reached with major railroads are examples of this strategy. Cooperation might occur because of a driver or an equipment shortage, or simply because the trucking firm can save money by getting the intermodal company to perform its line-haul. Both of these factors were significant for J.B. Hunt:

A J.B. Hunt official told us that the use of intermodal service has enabled the company to increase its ratio of trailers to tractors, thus increasing the leverage of its tractor fleet.... [T]ruckload companies have had difficulty in retaining qualified drivers....[because of] the truckload companies' practice of keeping the drivers on the road 3 or 4 weeks at a time.... A J.B. Hunt official told us that the drivers involved in intermodal service have been averaging about 3 days on the road per trip and that turnover among them has virtually disappeared. [GAO, 1992]

The trucking firm often continues to be the customer contact and perform the pick-up and delivery function for all of its traffic, including the traffic transported via the intermodal company.

In the cooperation strategy, the model assumes that customers are naive and choose truck service when it is available in the customers' revenue category. For this strategy,

the intermodal company's profit is the objective function to be maximized. (The LP formulation for this case is shown in Table 2.) This objective function and set of constraints cause all the shipments where the cost of intermodal is less than the cost savings to the trucking firm to be shifted to the intermodal company. A transfer payment that represents the trucking firm's lost profit from these movements is calculated and included in the trucking firm's profit.

In reality, the intermodal company is not the dominant player in this market and will not be able to compel the traffic to shift to intermodal. The objective function, which maximizes the intermodal company's profit, simply causes the model to identify all the traffic and revenue the intermodal company may hope to gain. The intermodal company can use this knowledge in negotiations with the truck company.

Strategy 3 - Educate the Customers

In the third strategy, the intermodal company tries to convert customers from naive customers to sophisticated customers. It might undertake a marketing and sales blitz to inform the customer about intermodal's performance record, or help customers evaluate their modal choices based on total logistics cost. The Burlington Northern, for example, used its total logistics cost model for this purpose:

The second use of the model is marketing. Here it is expected that marketing representatives will use the model as a tool for conducting logistics analysis at the customer site. The model can be used to quantify cases in which a rail option should be used even if it is slower or less reliable. [Sheffi, Eskandari and Koutsopoulos]

In this strategy, the model assumes that a customer will choose to use intermodal for any category of freight where intermodal has a lower total logistics cost. If truck service provides the lower total logistics cost, the customer will choose truck.⁶ In this scenario, the objective function maximizes the truck company's profit subject to a customer's choice. (See the LP formulation in Table 3.) This formulation represents a competitive

Table 1
LP Formulation for Strategy 1
Cut Backhaul Rate

Maximize:

$$\sum_r V_{prif}(R_{prif}-C_{prif}) + \sum_r V_{prtb}(R_{prtb}-C_{prtb}) + \sum_r V_{prif} + \sum_r V_{prtb}$$

Projected truck profit + projected intermodal volume

Subject To:

$$\forall_r \frac{V_{prif}(R_{prif}-C_{prif}) + V_{prtb}(R_{prtb}-C_{prtb})}{V_{orif}(R_{orif}-C_{orif}) + V_{orib}(R_{orib}-C_{orib})} \geq$$

Intermodal profit cannot be reduced

$$\forall_r \frac{V_{prif} + V_{prtb}}{V_{prif} + V_{prtb}} \leq \frac{V_{orif} + V_{orib}}{V_{orib} + V_{orib}}$$

Number of loads cannot increase

$$\sum_r V_{prif} - \sum_r V_{prtb} = 0$$

$$\sum_r V_{prif} - \sum_r V_{prtb} = 0$$

Fronthaul volumes for each mode must equal the backhaul volumes (including empties)

$$\forall_r V_{prif} \geq 0$$

$$\forall_r V_{prtb} \geq 0$$

$$\forall_r V_{prif} \geq 0$$

$$\forall_r V_{prtb} \geq 0$$

Volumes must be non-negative

Where:

V - Volume of trailers

subscript o - base case

R - Revenue per Trailer

subscript p - projected case

subscript r - revenue category

C - Cost per Trailer

subscript i - intermodal company

subscript t - truck company

subscript f - fronthaul direction

subscript b - backhaul direction

Table 2
LP Formulation for Strategy 2
Cooperation

Maximize:

$$\sum_r V_{prif}(R_{prif}-C_{prif}) + \sum_r V_{prib}(R_{prib}-C_{prib}) + \sum_r V_{prtf} + \sum_r V_{prtb}$$

Projected intermodal profit + projected truck volume

Subject To:

$$V_r \frac{V_{prif}(R_{prif}-C_{prif}) + V_{prib}(R_{prib}-C_{prib})}{V_{ortf}(R_{ortf}-C_{ortf}) + V_{ortb}(R_{ortb}-C_{ortb})} \geq$$

Truck profit cannot be reduced

$$V_r \frac{V_{prif} + V_{prtf}}{V_{prib} + V_{prtb}} \leq \frac{V_{orif} + V_{ortf}}{V_{orib} + V_{ortb}}$$

Number of loads cannot increase

$$\sum_r V_{prif} - \sum_r V_{prib} = 0$$

$$\sum_r V_{prtf} - \sum_r V_{prtb} = 0$$

Fronthaul volumes for each mode must equal the backhaul volumes (including empties)

$$V_r V_{prif} \geq 0$$

$$V_r V_{prib} \geq 0$$

$$V_r V_{prtf} \geq 0$$

$$V_r V_{prtb} \geq 0$$

Volumes must be non-negative

Where:

V - Volume of trailers

subscript o - base case

subscript p - projected case

R - Revenue per Trailer

subscript r - revenue category

subscript i - intermodal company

C - Cost per Trailer

subscript t - truck company

subscript f - fronthaul direction

subscript b - backhaul direction

Table 3
LP Formulation for Strategy 3: Educate the Customers
and Strategy 4: Educate the Customers & Cut Backhaul Prices

Maximize:

$$\sum_r V_{prt}(R_{prt}-C_{prt}) + \sum_r V_{prtb}(R_{prtb}-C_{prtb}) + \sum_r V_{prif} + \sum_r V_{prib}$$

Projected truck profit + projected intermodal volume

Subject To:

$$V_r \frac{V_{prif}(R_{prif}-C_{prif}) + V_{prib}(R_{prib}-C_{prib})}{V_{orif}(R_{orif}-C_{orif}) + V_{orib}(R_{orib}-C_{orib})} \geq$$

Intermodal profit cannot be reduced

$$V_r \frac{V_{prif} + V_{prt}}{V_{prib} + V_{prtb}} \leq \frac{V_{orif} + V_{ort}}{V_{orib} + V_{ort}}$$

Number of loads cannot increase

$$\sum_r V_{prif} - \sum_r V_{prib} = 0$$

$$\sum_r V_{prt} - \sum_r V_{prtb} = 0$$

Fronthaul volumes for each mode must equal the backhaul volumes (including empties)

$$V_r V_{prif} \geq 0$$

$$V_r V_{prib} \geq 0$$

$$V_r V_{prt} \geq 0$$

$$V_r V_{prtb} \geq 0$$

Volumes must be non-negative

$$V_r V_{prt} \leq V_{ort} + V_{orif} - X_{prif}$$

Some customers choose intermodal

Where:

V - Volume of trailers

subscript o - base case

subscript p - projected case

R - Revenue per Trailer

subscript r - revenue category

subscript i - intermodal company

C - Cost per Trailer

subscript t - truck company

subscript f - fronthaul direction

subscript b - backhaul direction

X - Volume of trailers with lower total logistics cost using intermodal (calculated outside the LP)

environment, with the customer as the dominant player. The customer choice model is run outside the linear optimization program with the results being used in the LP as constraints.

Strategy 4 - Combination

The intermodal company may also initiate a combination of the other strategies. An example of a combination strategy – educating the customers to shift them from naive to sophisticated and cutting the backhaul price – is discussed in greater detail later. In this scenario, the LP used is the same as strategy 3. However, the projected profit is calculated using the new, lower backhaul price.

EXAMPLE CORRIDOR INVESTIGATION

The Interstate 95 corridor between northeastern states (MA, RI, CT, NY, NJ, PA and MD) and southeastern states (FL, GA, and SC) was selected for model testing. This is a high density, long haul corridor where most moves stay on the corridor. The fronthaul is southbound and the backhaul is northbound.⁷ Most sources indicate that traffic in this lane is unbalanced and heavier in the southbound direction. For example, the GAO report indicates "some LTL markets, such as Florida receive more goods than they send out." TRANSEARCH data did not support this, revealing essentially balanced traffic. The NMTDB data did show higher rates in the southbound direction, which would suggest a direction imbalance in traffic demand.

To prepare the base case for this corridor, truck and TOFC tons were selected by 2-digit STCC from the TRANSEARCH database. Only commodities that would reasonably be carried by TOFC boxes were used.⁸ The tons were converted to estimated trailer equivalents based on average density of each commodity group⁹ and cube out/weight out limits, adjusted for a typical trailer capacity utilization.

To identify reasonable high, medium and low prices for the corridor, the average and standard deviation of TOFC revenue per box per mile was calculated using the ICC Public Use Waybill File for each direction on the corridor.¹⁰ The average and standard deviation of truck revenues per box per mile was calculated using the National Motor

Transportation Data Base.¹¹ A representative revenue per trip for each revenue category in the fronthaul direction was derived using the average rate plus one standard deviation for high revenue, the average rate for medium revenue, and the average rate less one standard deviation for the low revenue category. The high revenue in the back haul direction equals the average backhaul rate plus one standard deviation while the low revenue category was set equal to the average backhaul rate. The ISE model is limited by assuming the two modes have the same rates (except in the EOQ calculation where mode-specific rates are applied). Thus a weighted average "market rate" was calculated for each revenue category (see Table 4).

Twenty percent of the truckloads and boxes were assigned to the high revenue category, sixty percent to the medium revenue category and twenty percent to the low revenue category in the fronthaul direction. In the backhaul direction, sixty percent were assigned to the high revenue category and the remainder to the low category.

Truck costs are derived from the AAR/Policy and Special Projects Truck Cost Model. (This is a proprietary model, although the results are regularly used by AAR in public forums.) The costs are for a complete truck trip, with a 90% loaded utilization rate. The AAR truck cost model assumes that the differential in truck costs between a loaded and empty backhaul is very small. (A loaded backhaul may consume more fuel or cause a bit more wear and tear on the vehicle.) This is significant to our model, because it means that the costs the trucking firm must cover for the backhaul are substantial.¹² The truck costs used in the model under current fuel prices and doubled fuel prices are presented in Table 5.

Intermodal costs were developed from Mercer Management Consulting's intermodal cost model. This model calculates costs for traditional TOFC as well as double stack and RoadRailer. The model can also calculate drayage costs. In the model runs used here, we assumed traditional TOFC technology and a standard train consist of 50 flat cars carrying 74 loaded boxes and 13 empty boxes. Only the line haul costs were considered. The difference in intermodal costs between a loaded and an empty haul is negligible. Overall, the intermodal company's costs are significantly

Table 4
I-95 Corridor, Base Case

	Percent of Boxes Allocated	No. of Truck Loads per Week	No. of Inter-modal Boxes per Week	Truck Revenue (\$/750 mile trip)	Inter-modal Revenue (\$/750 mile trip)	Weighted Average Revenue (\$/750 mile trip)
Fronthaul						
High Revenue	20	667	86	1,368	977	1,324
Medium Revenue	60	2,001	259	969	737	942
Low Revenue	20	667	86	570	497	561
Backhaul						
High Revenue	60	2,001	239	1,242	1,037	1,221
Low Revenue	40	1,334	160	900	614	871
Empty		0	32	0	0	0

Table 5
Truck and Intermodal Costs Used in Model

<u>Mode</u>	<u>Fuel Cost</u>	<u>Total Cost \$/mile</u>
TOFC	\$0.80	\$0.57
TOFC	\$1.60	\$0.64
Truck	\$0.80	\$0.96
Truck	\$1.60	\$1.17

lower than the trucking firm's costs on a per ton-miles basis. The intermodal costs used in the model under current fuel prices and doubled fuel prices are also presented in Table 5.

RESULTS

Before testing the marketing strategies, an equilibrium run was performed to isolate results related to the base case model inputs from results related to the change in business strategy. To do this, the LP formulation from Strategy 1 was run, but without any change in backhaul price. Changes occurring in the

equilibrium run may indicate that the market is not in equilibrium or (more likely) that the base case is only approximate representation of the market in the corridor. After this initial run, the four strategies were tested assuming current fuel prices and assuming a doubling of fuel prices.

The initial equilibrium run resulted in the trucking firm capturing all of the intermodal firm's high revenue fronthaul boxes and most of its medium revenue fronthaul boxes. (See Table 6.) The intermodal company captures most of the trucking firm's low revenue fronthaul boxes, and a few low revenue fronthaul boxes and empty backhaul boxes are shed as both carriers directionally balance their loads to maximize profits. The trucking firm's profits increase 12 percent and the intermodal firm's profits decrease by 0.2 percent as a result of these changes.

The results of Strategy 1, when backhaul prices were cut by about 50 percent, are contained in Table 6. The trucking company drops most of its low revenue backhaul moves and a comparable number of front hauls. The intermodal company captures those moves, and 64 boxes are shed as both carriers directionally

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Table 6 No Change in Fuel Prices		
	Truck Company	Intermodal Company
Equilibrium		
Old No. of Boxes	6,670	862
New No. of Boxes	5,918	1,550
Change	(752)	688
Old Profit	1,944,972	468,762
New Profit	2,175,260	467,987
Change	230,288	(775)
Strategy 1: Cut Backhaul Rate		
Old No. of Boxes	6,670	862
New No. of Boxes	4,670	2,798
Change	(2,000)	1,936
Old Profit	1,944,972	468,762
New Profit	1,870,380	1,137,762
Change	(74,592)	669,000
Strategy 2: Cooperation		
Old No. of Boxes	6,670	862
New No. of Boxes	0	7,468
Change	(6,670)	6,606
Old Profit	1,944,972	468,762
New Profit	0	2,429,145
Change	(1,944,972)	1,960,383
Transfer Price	1,944,972	(1,944,972)
Strategy 3: Educate the Customers		
Old No. of Boxes	6,670	862
New No. of Boxes	4,480	3,052
Change	(2,190)	2,190
Old Profit	1,944,972	468,762

Table 6 No Change in Fuel Prices		
	Truck Company	Intermodal Company
New Profit	1,484,261	1,570,048
Change	(460,711)	1,101,286
Strategy 4: Drop Backhaul Prices & Educate the Customers		
Old No. of Boxes	6,670	862
New No. of Boxes	3,014	4,518
Change	(3,656)	3,656
Old Profit	1,944,972	468,762
New Profit	1,233,575	2,249,539
Change	(711,397)	1,780,777

balance their loads. These changes cause the trucking company's profits to drop \$74,592 per week and the intermodal company's profits to increase \$669,000 per week. The intermodal company's gain is greater than the trucking firm's loss, because the intermodal company has lower movement costs.

If the intermodal company pursues Strategy 2 (Cooperation), all the boxes would be transferred to the intermodal company for line-haul. It would pay \$1,944,972 per week to the truck company to compensate for the profit the trucking company loses by cooperating. The intermodal company's profit increases by \$1,960,383, which is only slightly greater than the transfer payment.

The transfer payment is the model's representation of the parties' room for negotiating a cooperative arrangement, such as a drayage agreement. It should be noted that the intermodal company nets more profit in the competition strategy than it does after making the transfer payment in the cooperation strategy. (New profit of \$2,429,145 less maximum transfer payment of \$1,944,972 equals \$484,173, which is less than intermodal company's profit of \$1,137,762 from Strategy 1.)

A transfer price of \$1,870,380 is the lower boundary of what the trucking company is

likely to accept, since it could make that much by Strategy 1. However, the upper boundary of what the intermodal company is likely to offer is only \$1,291,383 (\$2,429,145-\$1,137,762), since that is how much more profit it makes by choosing strategy 2 rather than strategy 1. Thus, the parties are unlikely to come to an agreement in this case.

If the intermodal company successfully pursues Strategy 3, and changes the customers from naive to sophisticated, the trucking company suffers significantly and the intermodal company benefits. A little over forty percent of the trucking company's high revenue boxes and medium revenue fronthaul boxes are captured by the intermodal company. The trucking company gains the intermodal company's high revenue backhaul boxes, but sheds all its low revenue backhaul boxes, which are picked up by the intermodal company. The intermodal company's profit increases by \$1,101,286, which is 65 percent more than its gain from Strategy 1.

This result is amplified if the intermodal company adopts Strategy 4, combining customer education with lower backhaul rates. In that case, the trucking company loses all boxes that are low revenue on the fronthaul/high revenue on the backhaul. The intermodal company's profit increases

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\$1,780,777 over the base case and \$679,491 over Strategy 3. The trucking company's profits deteriorate another \$250,686 from Strategy 3.

These four strategies were also examined in the context of a doubling in fuel prices. The equilibrium run resulted in the trucking firm capturing all of the intermodal firm's high revenue fronthaul boxes and most of its medium revenue fronthaul boxes. The intermodal firm does retain more of its medium revenue fronthaul boxes than when no change in fuel prices occurred (see Table 7). The intermodal company captures most of the trucking firm's low revenue fronthaul boxes, and 32 low revenue fronthaul/empty backhaul boxes are shed as both carriers directionally balance their loads. The trucking firm's profits increase \$346,296 per week relative to the "Old Profit" and the intermodal firm's profits stay the same as a result of these changes. Note that each firm's "Old Profit" is lower to start with, because fuel prices are higher. The change for the intermodal company is relatively modest (\$45,255 per week less), but the impact of higher prices on the trucking firm is very serious (\$1,050,525).

If the intermodal company pursues Strategy 1, (cut backhaul rates) the impact is less dramatic than when fuel prices were unchanged. The trucking company drops some low revenue backhaul moves and the associated high and medium revenue front hauls. The intermodal company captures those moves, and 64 boxes are shed as the carriers directionally balance their loads. The trucking company's profits increase over the modest "Old Profit" by \$60,090 per week. The intermodal company's profits increase \$747,678 per week as a result of traffic gains.

If Strategy 2 is adopted, all the boxes shift to the intermodal company for the line-haul. It must pay \$894,444 per week to the truck company to compensate it for lost profits. This is less than half the transfer price required when fuel prices were unchanged. The intermodal company's profit increases by \$2,664,093, which is significantly greater than the transfer payment in every case. Thus, when fuel prices double, the intermodal company nets more profit by cooperating, even if it pays the entire transfer amount to the trucking company.¹³ In this case, both the intermodal company and the trucking firm will benefit from cooperating.

If Strategy 3 is pursued, the same shifts in traffic take place as in the low fuel price case. The profits earned, however, do change. (Compare Table 6 and Table 7.) The trucking company, starting from a much lower "Old Profit" amount, loses \$115,786 per week. Again, the trucking company loses more from the customer reevaluating its logistics function than from the intermodal company cutting its backhaul price. The intermodal company, starting from a slightly reduced "Old Profit", gains \$986,311. The profit level for the intermodal company is almost as high with fuel prices double as when they are unchanged.

With Strategy 4, and high fuel prices, the trucking company abandons all movements other than high revenue fronthaul/high revenue backhaul movements because they are unprofitable. The intermodal company picks up all the abandoned movements. The intermodal firm's profit increases to \$2,948,227 and the trucking firm's profit drops to \$297,830.

NEXT STEPS

The results discussed for the example corridor in this paper indicate that the model formulation is reasonable and suggests that testing on corridors with different characteristics is warranted. For example, the cost difference between truck and rail would be much smaller on a shorter corridor. How would this affect the relative attractiveness of strategies? Other corridors exhibit tighter operating margins than shown in the I-95 example. Would the ISE model suggest TOFC could benefit from entering a corridor where a truck price war had already eroded rates?

Although this study used a linear cost function, the model could be enhanced to support non-linear costs that reflect train utilization, equipment type or other situation specific factors. In a corridor with significant traffic imbalance, using the ISE model in conjunction with a network model or yield management pricing model could clarify the tradeoffs between empty re-positioning costs, lost revenue, opportunity costs, and excess capacity costs.

CONCLUSIONS

The real world contains a mixture of naive and sophisticated customers. The

<p align="center">Table 7 Fuel Prices Double</p>		
	Truck Company	Intermodal Company
Equilibrium		
Old No. of Boxes	6,670	862
New No. of Boxes	5,831	1,637
Change	(839)	775
Old Profit	894,447	423,507
New Profit	1,240,743	423,507
Change	346,296	0
Strategy 1: Cut Backhaul Rate		
Old No. of Boxes	6,670	862
New No. of Boxes	4,670	2,798
Change	(2,000)	1,936
Old Profit	894,447	423,507
New Profit	954,537	1,171,185
Change	60,090	747,678
Strategy 2: Cooperation		
Old No. of Boxes	6,670	862
New No. of Boxes	0	7,468
Change	(6,670)	6,606
Old Profit	894,447	423,507
New Profit	0	3,087,600
Change	(894,447)	2,664,093
Transfer Price	894,447	(894,447)
Strategy 3: Educate the Customers		
Old No. of Boxes	6,670	862
New No. of Boxes	4,480	3,052
Change	(2,190)	2,190
Old Profit	894,447	423,507

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	Truck Company	Intermodal Company
New Profit	778,661	1,409,818
Change	(115,786)	986,311
Strategy 4: Drop Backhaul Prices & Educate the Customers		
Old No. of Boxes	6,670	862
New No. of Boxes	754	6,778
Change	(5,916)	5,916
Old Profit	894,447	423,507
New Profit	297,830	3,371,734
Change	(596,617)	2,948,227

intermodal company benefits when it can increase the proportion of sophisticated buyers. Even when the intermodal's primary marketing strategy is to cut prices, it gains from having customers that can evaluate the price cut in the context of total logistics costs. The model results show that the intermodal firm unequivocally benefits from having sophisticated customers.

The intermodal company makes higher profit in most cases when fuel prices are doubled, indicating that the higher fuel costs are more than offset by gains in traffic. The only higher fuel price case that does not produce a traffic benefit to the intermodal company is Strategy 3 – shifting customers from naive to sophisticated. In this case, traffic is shifted based on the customers' total logistics cost. Thus the increase in fuel price produces no additional traffic, but does increase the intermodal carrier's costs. The major increase in intermodal profit from higher fuel prices in Strategy 4 stems from the trucking company's behavior. With higher fuel prices and a steep cut in backhaul rates, most of the truck company's fronthaul/backhaul combinations become unprofitable and are abandoned, forcing the customers to use intermodal as the only available option.

The incentive to cooperate occurs for both companies only in the high fuel price case. It arises because the hike in fuel price puts pressure on the trucking firm's margins, while increasing the cost differential between intermodal and truck. This would suggest that an energy tax would have the effect of increasing cooperation between truck and intermodal companies. Other cost factors that differently affected the two modes – such as driver shortages, traffic congestion or increased pollution taxes – could have the same effect. As noted earlier, the issue of truck driver availability and turnover was an important factor for J.B. Hunt's joint efforts with intermodal providers. With tougher licensing standards for drivers and changing U.S. demographics expected to exacerbate the industry driver shortage,¹⁴ opportunities for cooperative strategies should continue.

The big traffic and profit shifts that the Intermodal Strategy Evaluation Model produces when naive customers become sophisticated suggests that either (1) most customers are not sophisticated, or (2) customers do not accurately perceive the value parameters for intermodal. This latter explanation is consistent with the findings of the IANA/NITL surveys that intermodal service faces an "image problem"

with customers. The model results would suggest that intermodal companies would benefit from educational contacts with customers. The model also demonstrates that small improvements in intermodal service level produce significant changes in intermodal traffic level and profit. Changing these parameters, singly or in combination with selective price cuts, was far more effective than simply cutting prices.

Intermodal service has historically been sold on an "wholesale" basis through shipper agents and third parties. Markets were constructed very broadly and price was viewed as the primary tool for competing with trucks. The Intermodal Strategy Evaluation Model approaches the market much more like a trucking company, segmenting it into traffic lanes. Profitability is evaluated for round trips and for the lane as a whole, rather than on a per box basis. This traffic lane approach to analyzing markets allowed the authors to define marketing strategies that were far more profitable to the intermodal company than an undifferentiated price competition strategy.

The potential markets for intermodal service are rapidly expanding. The next round of labor negotiations for LTL carriers, for example, is expected to greatly increase their ability to employ intermodal service between hubs. As new technologies, such as Road Railer and Iron Highway offer alternatives to traditional TOFC, intermodal will become an option for an increasing number of customers and trucking companies. Tools such as the Intermodal Strategy Evaluation Model can help the railroad to develop more sophisticated product lines and proactive business strategies. Such an approach is needed if intermodal companies are to fully capitalize on the opportunities present in the commercial environment of the 1990s.

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ENDNOTES

- * Transport & Management Consultants, Inc. Arlington, Virginia 22201
- ** CSX Transportation Jacksonville, Florida 32202

1. "Although intermodal rail service improved in the 1980s, it continued to suffer from a perception among many shippers that it was inferior to trucking service and unsuitable for shipments that were time-sensitive or susceptible to damage." [GAO, 1992.]
2. Because customers often perceive intermodal loss and damage costs to be much higher than truck loss & damage, we added a loss and damage

- component into our total logistics cost formulation. Model runs displayed in this report use a modest loss and damage amount; the model demonstrates that even with relatively high loss and damage costs, the intermodal company is competitive from a total logistics cost perspective.
3. We used representative levels of transit time and service reliability for intermodal and truck service in the Interstate 95 corridor. Different service assumptions would obviously alter modal preferences for sophisticated customers.
 4. The model is written in the C computer language. User input is accommodated through menu driven screens.
 5. In this model, "profit" is defined as total revenue less long term variable cost (including a cost component for the truck, trailer, and rail car).
 6. If the customer chooses truck service, but the truck carrier rejects the move as unprofitable, the traffic will shift to intermodal.
 7. Although Beilock and Freeman treated the outbound movement from Florida as the fronthaul in their study of produce/plant movements, they recognized that Florida is a "net importer of freight" [Beilock and Freeman, 1991].
 8. Farm products, food and kindred products, primary metal products, machinery, transportation equipment, chemicals, petroleum and petroleum products were eliminated. Although some commodities in STCC 20 (food and kindred products) can move by TOFC, the restrictions on what products can be backhauled in food containers has limited its use.
 9. This calculation was made on a 2-digit STCC basis using the AAR/P&SP Commodity Attributed File.
 10. We assumed the TOFC revenue was for the rail portion only, although some of the records may also include revenue for the dray portion of the trip.
 11. These data are quite sparse, and do not have a sufficient number of revenue observations to statistically represent this corridor's population. However, the observations did offer some insight to the variability of the revenues and the relative difference by direction. The observed revenue numbers from NMTDB were adjusted, using a nationwide average truck revenue estimate offered by several experts as the index. The result was that the corridor had the same average revenue as the national system with the same relative distribution by direction as the observed data.
 12. Combination of front haul and back haul must be profitable. If the truck must run empty on the backhaul, the whole round trip may become unprofitable, causing the truck to abandon the front haul.
 13. New profit of \$2,664,093 less maximum transfer requirement of \$894,447 equals \$1,769,646, which is higher than intermodal company's profit in any other case except Strategy 4.
 14. "Watching Washington," Railway Age (June 1992).