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***JOURNAL OF THE  
TRANSPORTATION  
RESEARCH FORUM***

Volume XXVIII Number 1

1987

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**TRANSPORTATION RESEARCH FORUM**  
In conjunction with



**CANADIAN TRANSPORTATION  
RESEARCH FORUM**

**PROCEEDINGS—  
TWENTY-SECOND  
ANNUAL MEETING**

**Canadian  
Transportation Research Forum**

**St. John's, Newfoundland**

**June 1987**

# The Economic Cost of Transporting Grains From Farm to Market

by *N. Meyer and G. Sparks\**

## I. ABSTRACT

The impact on producers of adjustments in the Canadian grain collection system depends heavily on how the system evolves. If the system maintains the numerous delivery points which presently exist, producer transport distances will be relatively short but the benefits of system rationalization will elude them. However fewer assembly points mean generally longer hauls, although not necessarily higher transport costs for producers. Economies of size and scale in grain delivery can actually reduce total and variable transport costs for producers assembling their grain. The net result could be higher net margins to producers for grains.

Modifying the grain assembly system can bring about a number of changes which are beneficial to producers. First, because they have adequate on farm storage, they can deliver their grains to market throughout the year. Using larger trucks, producers can actually reduce the per unit cost of moving grains to the assembly points even if the distance is up to four times farther. This is because more use of transport capacity reduces per unit fixed costs. In cases where custom or commercial trucking is used costs per unit decline even more because equipment has more annual use.

## II. INTRODUCTION

Many of the most recent innovations in grain handling have not been incorporated into the Canadian grain handling system. Rationalization of the Canadian grain handling system would be very likely to incorporate many of these innovations. That action has important implications for several different groups in Canadian society. These changes are likely to bring some costs and some changes in rural lifestyles to different segments of society. Therefore, there are strong vested interests in any change of the system.

**Producer's perspective:** Producers often envision two different aspects from the rationalization of the grain handling system. The first thought in many producer's mind is the additional distance to haul grains if local elevators are closed. That means additional expenses and time to transport grain. It may mean upgrading and resizing a truck or it may mean constructing additional on-farm storage to be able to keep combines running during harvest. Additional traffic on rural roads may also mean higher maintenance costs to rural municipalities and thus higher taxes. All of these imply additional costs. Producers want to know specifically what are the benefits to the individual producer of the proposed changes in the system? If producers receive some of the grains from efficiency, they may support changes in the system, if not they will oppose changes.

**Grain firms perspective:** The grain firms also have potential gains and costs associated with changes in the system. Presently they have a system setup for collection, processing and storage of grains. To change the system renders some of the facilities obsolete with few alternative uses. In addition, what about labor contracts and the need for fewer managers of a smaller number of high thru-put facilities. These firms have the potential of greatly increasing efficiency but at a cost of reduced facility values and labor contract settlements. Both can have a significant impact on the firm's profitability in the short run.

**Rural municipalities perspective:** A major concern of rural municipalities in system rationalization is abandoning branch lines. The concern is for additional traffic on roads causing increased maintenance costs. Abandoning rail lines could reduce the property tax base in some rural municipalities while increasing the tax base in communities where the assembly facilities are maintained or expanded. Reducing the service levels at elevators on lines to be abandoned could result in the transfer of visits to town by rural residents to the community retaining the assembly point. Rural municipalities are concerned that revenue to support additional road maintenance demands will not be available from the tax base. The net result could be inadequate revenue to meet additional expenses.

**Province's perspective:** Research has shown that the majority of the additional traffic resulting from hauling grain additional distance will be on the provincial highways leading to the rail sites where rapid loading of grains is possible (Calkins and Meyer). Maintenance and improvement of these roads is the responsibility of the province. Their concern is: will they end up with additional costs and no additional revenues?

**National perspective:** Grains are an important earner of foreign exchange for Canada. With the depressed grain prices each extra dollar of cost to get grains to tidewater inhibits Canada's ability to compete in world markets without government subsidies. Extra costs in the system reduce the price which can be paid to producers, shifts production out of these crops and puts additional financial pressure on them. A related national question is: could the funds being put into the grain handling system be used in another manner and improve the overall economy of Canada?

## III. LITERATURE REVIEW

Sparks, G. "Investment Options Related to Rail Line Rehabilitation", CANADIAN TRANSPORTATION RESEARCH FORUM, 1985 pp. 334-358. First, rehabilitation of branchlines may actually cost more than the value of the grain being moved. A

second issue is raised concerning can a duplicate system be afforded in a time of scarce resources? The problem is presented as the provinces providing the roads, therefore being reluctant to encourage activities which increase traffic without some form of compensation. The rural municipalities are also reluctant because they expect additional costs without compensation. The costs for branchline upgrading are paid by the federal government. Branchline abandonment could mean additional costs to rural municipalities and provincial governments and no compensating revenues. That is why local and provincial governments tend to oppose it.

Irwin, N. A., L. S. Sims and E. E. Hopkin, "The Role of Trucking in The Grain Industry", CANADIAN TRANSPORTATION RESEARCH FORUM, 1985 pp. 359-378. This report is an overview of changes likely to occur in transporting Canadian grains by 1990/91. They assume elevator numbers will continue to decrease while throughput per facility continues to increase. Farm to elevator transport costs are estimated at \$2.35/tonne (Authors' note: our analysis indicated that only with producers working for zero wages could grain be transported for \$2.30 per tonne), elevation charges at \$6.50/tonne and rail charges are estimated to be \$22.52/tonne for a total estimated transport cost of \$31.37/tonne to an export point 1200 km distant. Farm to elevator costs are estimated to be 8% of total transport costs; elevation charges are 21%; and rail charges are 72% of transport costs for 1990/91.

Chaudhary, G. N., "Impacts of Reforms in the Statuary Rates on Trucking", CANADIAN TRANSPORTATION RESEARCH FORUM, 1986, pp. 14-25. Farmers are replacing their 2 axle (6,000 kg) trucks with 3 axle (14,000 kg) in Alberta. The number of 3 axle increased from 1% to 5.4% of registered trucks from 1976/77 to 1983/84. During the same period 2 axle trucks decreased by 7.7%. Commercial truckers can generally move grain for lower rates because the annual capital costs are spread over more annual miles and tonnes. However because the Western Grain Transportation Act pays the railroads rather than the producers, there is no incentive for the changes necessary to gain the benefits to occur.

Sparks, G. A., PRODUCTIVITY/OPERATIONAL IMPLICATIONS OF VEHICLE WEIGHT AND DIMENSION REGULATIONS, Clayton Sparks & Associates Ltd. Saskatoon, Sask. July, 1986. Sparks research points out that the variables of capacity (weight or volume), distance wage rate and annual use have the greatest effect on cost variation in transporting commodities. In the case of bulk commodities, fuel consumption was also an important variable affecting cost per unit for transportation. Sparks developed a probabilistic model for estimating costs. He then goes on to show the efficiency gains to be derived by service suppliers if axle and gross vehicle weight restrictions were removed. Vehicle configuration (5 axle vs. 7 axle vs. 8 axle) also had a strong influence on productivity. The type of truck (flat bed, bulkier or tanker) did not particularly effect productivity. A and B trains showed efficiency gains of 15 to 25 percent over 6 axle semi's. Axle and gross vehicle weight restrictions are given in the appendices.

Calkins, B. L. and N. L. Meyer, ADOPTION OF NEW MARKETING METHODS BY IDAHO GRAIN PRODUCERS, Bulletin 636, Ag. Experi-

ment Station, Univ. of Idaho, 1985. Based on survey data, the adaptations of Idaho producers to the introduction of 3-5 and 25-26 car rail rates and barge traffic to Lewiston Idaho are described. When multicar rates were introduced, facilities were upgraded and new facilities constructed to load trains within the required loading time. The benefits of lower rates were shared among those providing transportation, handlers, and producers. Producers adapted to the new environment by transporting grain greater distances to take advantage of the higher bid prices being offered for grain. In North Idaho, with ready access to the Snake River, the average transport distance from on farm storage to market was 38 miles. The average transport distance for those selling to points capable of loading barges or multicar trains was 104 miles which was 66 miles greater in distance. South Idaho producers, who are dependent on rail and truck transport, shipped grains an average of 34 miles to traditional markets while those marketing to locations capable of loading multicar trains transported grains an average of 85 miles one way, a distance 51 miles farther. In spite of the greater distances, by using larger trucks which traveled greater distances annually, the total and variable cost of getting grains to locations capable of loading rail cars decreased on a per unit basis as compared to 2 axle farm truck deliveries.

Karadininis, K. & G. G. Storey WESTERN CANADIAN GRAIN HANDLING AND TRANSPORTATION SYSTEM; THE IMPACTS OF VARIABLE FREIGHT RATES, Dept of Ag. Economics, Univ. of Sask. Saskatoon, Sask. July, 1986. A model is developed to simulate the introduction of 20, 40, and 100 car variable freight rates for grain. The discounts are respectively 1.50, 1.75, and 3.00 dollars per tonne. The effect of these rate breaks was to concentrate deliveries to fewer points. Alternative one resulted in an additional 31% of the delivery points being closed. Alternative two resulted in 20 more delivery points being closed. Efficiency gains come from reducing the number of miles of track to be maintained and from increases in volumes handled by existing elevators. Farmers greater distances from delivery points would be required to haul grains greater distances thus enduring additional transportation costs. The authors do not make adjustment for technical change in producer delivery of grains in this study. Lack of cost information from the railroads also makes the estimation of gains to the railroads somewhat speculative.

#### IV. METHODOLOGY

**Objective:** To estimate the producer's cost of delivering grains to assembly points under alternative assumptions. Thus permitting evaluation of the impacts resulting from rail line and assembly elevator rationalization. The following cases were used as a basis for estimation.

- (1) base case—two axle farm truck,
- (2) three axle truck,
- (3) three axle tandem pulling a pup,
- (4) five axle semi and
- (5) A-train

Three systems of service provision were evaluated: a producer hauling his own grain, a producer

hauling his own grain plus that of six other producers, and commercial service.

**Theory:** Costs of transporting grain from farm to assembly point can be classified into fixed costs and variable costs. Fixed costs refer to costs having a constant annual value unrelated to the level of utilization. Variable costs refer to those varying with the quantity of use. Total cost is the summation of fixed and variable costs as shown in equation 1.

- (1)  $TC = FC + VC$   
 TC = total cost  
 FC = fixed cost  
 VC = variable cost
- (2)  $FC = D + In + L + I + T$   
 D = annual depreciation  
 In = annual insurance  
 L = licenses  
 I = interest on average investment  
 T = annual cost for tarps

Fixed costs (2) are divided by the annual kilometers of truck use to determine the per kilometer cost. Grain transports part of the total cost are then estimated by the number of kilometers traveled to deliver the producer's annual grain sales.

- (3)  $VC = L + Ti + RM + F$   
 L = labor cost to transport grain  
 Ti = annual tire cost for grain transport  
 RM = repairs and maintenance costs for grain transport  
 F = fuel cost to transport grain

Variable costs (3) increase or decrease with the level of use. Labor is based on the time required to load, transport to the delivery point, unload, and return to the loading point. In the commercial operation an additional fee is paid to the driver for loaded tonne kilometers. Tire cost is based on the return kilometers covered in delivering grains to assembly point and a per kilometer cost. Repairs and maintenance are also based on a per unit rate and the distance covered hauling grain. Fuel is the efficiency (Km/l) times the return distance traveled transporting grain and the cost per liter of fuel.

Economies of scale theory indicates there are gains from specialization. Free trade theory is based on the assumption that the maximum of scale economies can be gained with each producer specializing in what he can do best. Economies of size refers to individual long run average cost curves. Each average cost curve has a minimum cost point for production. This analysis deals with economies of size for individual Prairie grain producers as well as economies of scale in permitting some to specialize in grain production and others in custom or commercial grain transport.

Scale economies dictate that a given service can be provided in alternative ways but there is usually a least cost method at each level of output. In the physical movement of grains, the most efficient tool depends on several factors. Distance, capital investment, operating costs and flexibility are important factors to evaluate. As capital investment increases, the utilization rate becomes more important. As operating costs increase, it becomes more important to control the increases. This is particularly true in the cases of fuel and labor costs for the transport of farm grains to market. Theory tells us that larger loads, more productive kilometers per year, and more rapid

traveling speeds help to increase the efficiency of trucks transporting grains.

The movement of grain from on-farm storage to the assembly point for loading unto rail cars can be divided into three parts. The first part is the loading of grains from farm storage to trucks. The second part is the movement by truck from the farm storage location to the assembly point. The third part is the unloading of grains at the assembly point. A fourth part of domestic transportation is from the assembly point to export or domestic utilization location. This last part of the transportation may be entirely by rail, truck or a combination of rail, truck and water transportation. This paper deals with the assembly of grains, the first three parts.

Farm storage to delivery point shipping requires loading the truck at the farm. The time required for this operation depends on the equipment used. Larger trucks are assumed to require more time to load. Loading of grain is assumed to be on a units per time period basis. Loading includes setting augers, opening bins, loading and cleaning up complete. These values differ for the quantity of grain shipped, the number of different types handled and size of the storage facility. Total cost and variable cost per unit would be expected to change with the situation.

Transporting grains to the assembly point involves movement from the farm on a grid road to the provincial highway and then transport on the highway to the assembly elevator. This distance will vary for deliveries to local elevators and to more distant multistar loading sites (Calkins & Meyer). Travel distance from farm storage points to the assembly points will likely be greater to larger assembly points than to the local assembly locations. This travel distance will generally be covered at highway speeds. The additional distance on provincial highways can be covered much more rapidly and the additional cost is only the cost of moving down the road, no waiting, loading or unloading time.

Transporting grains involves fewer trips if the trucks are larger for transporting the same quantity of grain. These larger trucks are less likely to have overloaded axles because they have more axles under them. Load on roads per square inch of tire is likely to be less because larger trucks must pass over scales and are more likely to travel on main roads. Larger loads require fewer trips over the road, therefore fewer vehicles to meet. Costs to the producer may also be less depending on the haul distance and truck size.

The third portion of the cost is the unloading cost at the assembly point. Because many of the locations accepting greater quantities of grain have larger capacity facilities, the required unloading time will be less. These are the reasons: the larger trucks are of bottom dump design which unload faster; because of larger loads fewer trucks need to be unloaded; and larger capacity pits and legs permit faster handling of grains. These factors translate into potentially increased capacity and lower costs for grain handling.

## V. ANALYSIS

To analyze the options which producers have for moving their grains under alternative arrangements five vehicles were evaluated under assumptions of

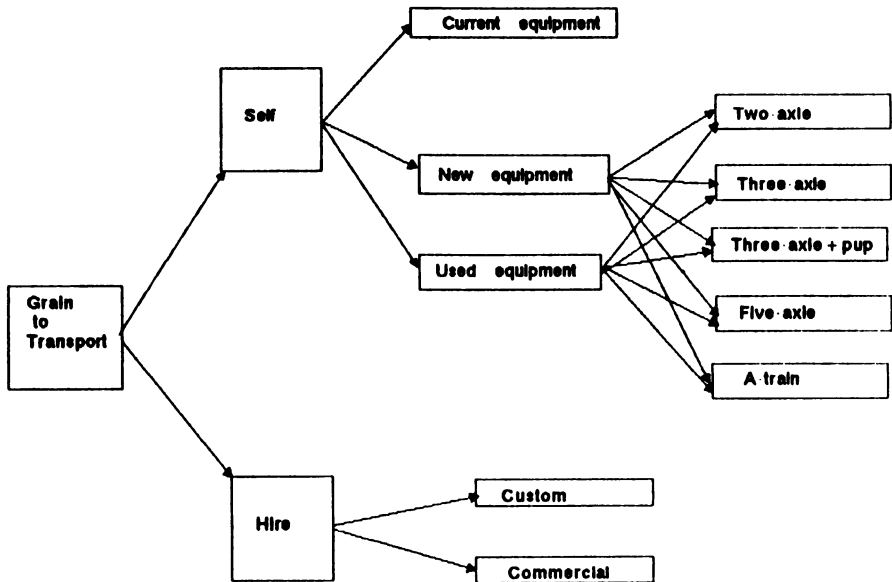
delivery to assembly points 10 km. up to 160 km distance from the farm. These alternatives were evaluated with respect to different wage rates for the driver and with different levels of vehicle utilization. The impact of fuel efficiency on the cost of grain assembly was then evaluated. Combining all the options defines a decision tree which can help policy makers, as well as producers decide which alternatives are best for a given situation.

A decision tree is an outline of the different steps in making a decision (Howard). It notes the alternatives available at each decision point. The number of variables at any decision point as well as alternative outcomes entered into the decision model. Figure 1 outlines a decision tree for a producer deciding how to deliver his grain to an assembly point. First he has the options of doing it himself with his present equipment or hiring it done. If he decides to hire, then it is a matter of who is available to provide the service, what quality of service is likely to be offered and what the cost will be. If the producer decides to do it himself, then he must decide if it should be done with his current equipment or with different equipment. if the producer decides different equipment is needed, should it be new or used? What size should it be? What is the cost trade-off versus the probability of breakdown with new versus used equipment? Is there enough volume to warrant the addition of a pup to the main trucking unit to increase capacity? Should custom work for neighbors be done to increase utilization and reduce per unit costs? Each of these alternatives is a potential answer to the producers question of what is the best for my overall situation?

**BASE CASE**

A basic model was set up to evaluate the costs of delivering grain various distances in alternative transport units. The traditional two axle farm truck was used as a base. (The basic assumptions and data are available from the authors upon request). For comparison, producers were assumed to deliver their grain 10, 20, 40, 80, and 160 km. to the assembly elevators. Each farm was assumed to have 353 tonnes of grain to transport annually to market. Data from the University of Saskatchewan Top Management Program indicate each farm had an average of 1.6 trucks being used to deliver grain in 1985. Based on the assumptions in the model, if the average delivery distance is 10 km. (6.2 mi.), the producer's estimated variable and total delivery cost would be respectively \$4.54 and \$7.90 per tonne (Table 1). Converting to a used tandem would reduce a producer's total cost \$2.45 per tonne to \$5.45 for the same distance haul. Adding to pup behind the 3-axle truck would permit hauling over 20 kilometers for less than is presently being paid. A neighbor hauling with a used semi or a used A-train could transport the grain up to 40 kilometers for less than the present cost of transporting with a two axle truck. The most economical for the producer would be to use a commercial A-train or hire custom transport from a neighbor. Both of these could transport his grain up to 80 kilometers (50 mi.) for less than the present estimated total cost for transporting grain. A producer choosing not to be paid for his labor could transport grain the 10 kilometers for a total cost of \$5.67/tonne and a variable cost of \$2.30/tonne.

**Figure 1**  
Decision tree for a producer concerning grain transport from farm to assembly point



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**Table 1**  
Total and Variable cost per tonne for grain assembly

		Kilometers				
Equipment	Costs	10	20	40	80	160
2-axle	total	7.90	11.16	15.34	21.75	38.26
	variable	4.54	6.42	9.38	14.77	27.03
3-axle	total	5.45	8.70	13.21	18.83	27.86
	variable	2.84	4.32	6.61	9.95	16.12
3-axle /pup	total	5.15	7.39	11.57	15.96	22.19
	variable	3.45	4.30	5.91	7.96	11.32
5-axle	total	5.25	8.94	14.70	22.45	31.61
	variable	2.52	4.01	6.42	9.94	14.79
A-train	total	3.69	6.47	11.15	18.16	27.17
	variable	1.76	2.84	4.70	7.60	11.68
<hr/>						
Custom						
3-axle + pup	total	2.96	3.93	5.35	7.79	13.37
	variable	1.68	2.14	2.98	4.76	8.47
5-axle	total	3.88	5.21	7.58	12.16	20.19
	variable	1.98	2.66	3.99	6.80	12.00
A-train	total	2.86	4.11	5.58	8.71	15.17
	variable	1.47	2.04	2.81	4.62	8.47
<hr/>						
Commercial						
A-train	total	**	**	3.55	5.60	9.60
	variable	**	**	2.65	4.40	7.83

\*\* A commercial operator could not generate adequate revenue to cover cost transporting these short distances.

Custom service could deliver it 20 km. in a 3 axle truck plus pup or a 5 axle semi for less than the cost of delivering it 10 km. in a 2 axle unit.

The total cost, variable cost and variable cost without labor cost show the decision points for a producer with a two axle truck (Figure 2). Decisions start with the current equipment and variable cost. That is compared with total costs for all other alternatives.

Considering total costs and a producer paying himself \$10 per hour for his labor, all alternatives considered reduce per unit transport costs. Compared to producer per tonne variable costs, the custom and commercial total transport costs were lower for delivering grain equal distances. The greatest reduction is with a commercial A-train which could transport the producer's grain over 40 kilometers for less than he would expect to pay in variable costs doing it himself.

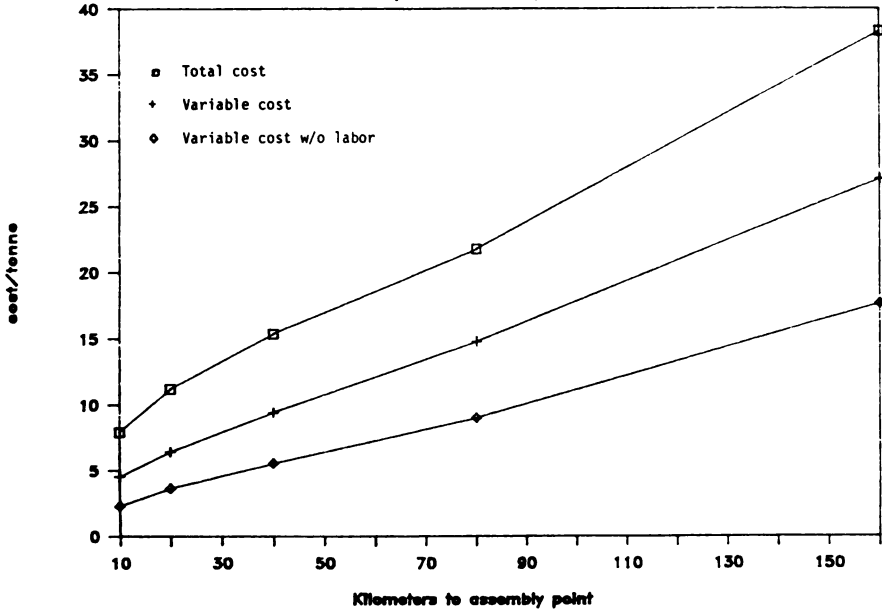
Examining the producer's total transport cost for grain (Table 2) shows that total costs could be reduced by adapting other trucking alternatives over the present predominant 2-axle truck system. Doubling transport distance to 20 km while purchasing a used 3-axle or hiring custom service could actually reduce transport costs. In the case of a custom 3-axle with pup or a custom A-train, it could be by almost half.

In all cases using a larger truck reduced the per tonne transport costs for the same distance and in certain cases for additional distances. Figures 3 and

4 show cost reductions were greatest when trucks are used for custom work or commercial service (high km annual usage example). In that case the estimated costs per tonne for delivery were lower even though distances were up to four times greater. In the cases of custom 3-axle plus pup and commercial A-train the distance up to eight times greater cost less per tonne to deliver to the assembly point. The differences tended to get larger as the delivery distance increased. Even in cases where the producer did not charge a labor cost for transporting his own grain, the commercial and custom services cost less than he presently spends to transport his grain to the assembly point 10 km from his present grain storage.

The majority of producers have at least one truck, therefore the decision criteria for an individual producer is the variable cost which must be covered. If the variable cost of delivering grain to the assembly point in the producers truck is less than the commercial or custom rate, it pays the producer to haul his grain with his present unit. Table 3 shows the additional cost of moving grains by alternative size trucks additional distances. Larger trucks reduce the transport costs for all distances. Use of custom or commercial services permits hauling grains up to four times greater distance for less cost. If a new or different truck is needed, then full costs must be used as a basis for decision making rather than variable cost because new unit costs must be paid.

**Figure 2**  
Two axle farm truck grain per tonne delivery cost  
per tonne delivery cost

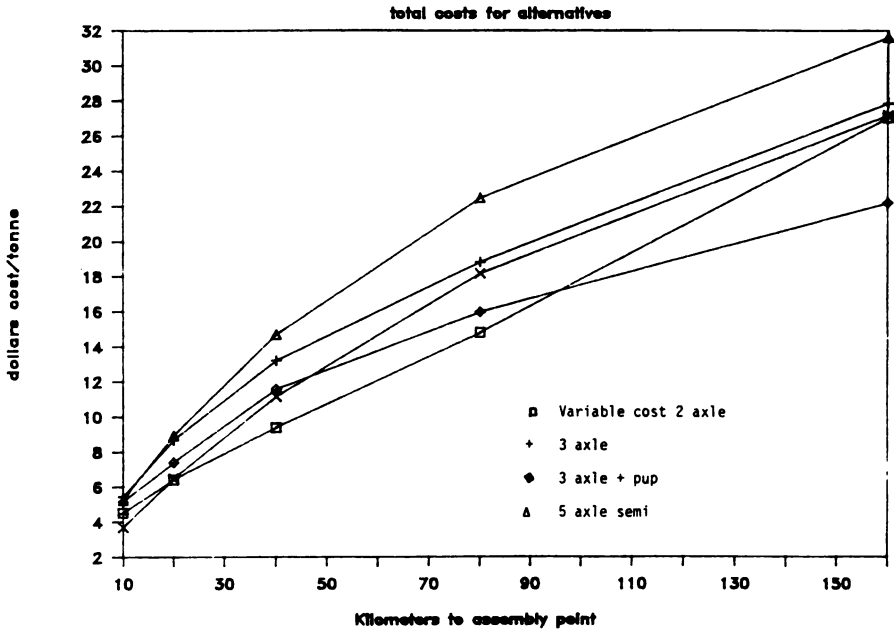


**Table 2**  
Total cost to deliver 353 tonnes to assembly points

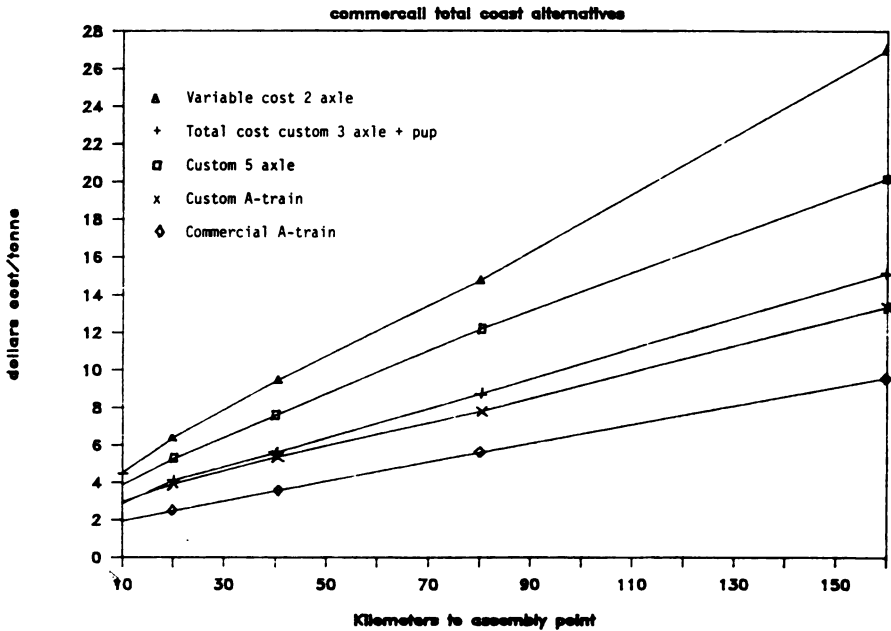
Equipment	Units	Kilometers				
		10	20	40	80	160
2-axle (5.6)	total cost	2789	3940	5415	7678	13507
	cost/tonne	7.90	11.16	15.34	21.75	38.26
3-axle (12)	total cost	1922	3070	4464	6646	9834
	cost/tonne	5.45	8.70	13.21	18.83	27.86
3-ax + pup (24)	total cost	1818	2608	4083	5632	7833
	cost/tonne	5.15	7.39	11.57	15.96	22.19
5-axle (22)	total cost	1854	3157	5188	7925	11156
	cost/tonne	5.25	8.94	14.70	22.45	31.61
A-train (35)	total cost	1303	2283	3937	6411	9592
	cost/tonne	3.69	6.47	11.15	18.15	27.17
Custom 3-ax + pup (24)	total cost	1045	1387	1889	2749	4721
	cost/tonne	2.96	3.93	5.35	7.79	13.37
5-axle (22)	total cost	1368	1859	2677	4292	7129
	cost/tonne	3.88	5.27	7.58	12.16	20.19
A-train (35)	total cost	1008	1452	1969	3076	5353
	cost/tonne	2.86	4.11	5.58	8.71	15.17
Commercial A-train (35)	total cost	400	605	1013	1816	3409
	cost/tonne	1.13	1.72	2.87	5.15	9.66

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**Figure 3**  
Two axle variable cost versus total costs for alternatives



**Figure 4**  
Two axle variable versus custom/commercial total costs alternatives



**Table 3**

Additional total cost of transporting 353 tonnes of grain additional distances over base cost of \$2789.

Equipment	Kilometers					
	Base	10 km	20	40	80	160
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
2-axle	0	1151	2626	4889	10718	
3-axle	-867	-282	1876	3857	7045	
3-axle + pup	-971	-181	1294	2843	5044	
5-axle	-935	368	2399	5137	8368	
A-train	-1486	-506	1148	3622	6803	
Custom						
3-axle + pup	-1744	-1402	-900	-39	1932	
5-axle	-1421	-930	-112	1503	4340	
A-train	-1781	-1337	-821	287	2565	
Commercial						
A-train	N/A	N/A	-1776	-973	621	

**SENSITIVITY**

Solution sensitivity to various parameters was tested to determine how changes in various factors effect the per tonne cost of transportation. Subjectively, to estimate sensitivity to changes in parameters, a 20 percent over and under variation in each variable was tested. The most important factor was truck capacity for 2-axle and 3-axle units hauling 40 kilometers. This resulted in a 42 percent cost per tonne kilometer variation for a 2-axle truck, and a 39 percent variation for a 3-axle truck, both hauling 40 kilometers (Tables 4 and 5). The next two most important variables for both units were the annual kilometers driven and the purchase price of the unit.

As can be expected commercial truck operations were most sensitive to annual kilometers, delivery distance, truck capacity and drivers wages. A plus or minus twenty percent variation in each of these resulted in a 28.6 percent variation in cost per tonne kilometer (Table 6).

Sensitivity to increasing or decreasing the fuel efficiency was small. It effected total delivery cost

**Table 4**

Deterministic sensitivity for operating costs of a two axle farm grain truck hauling 40 kilometer (24 miles)

Inputs	Typical value			Associated productivity			
	- 20%	most likely	+ 20%	min	costs/tonne kilometer expected	max	%
Tonnes haul annually	282	353	424	.38	.38	.38	0.0
Annual travel	5424	6780	8136	.44	.38	.35	23.6
Delivery distance	64	80	96	.41	.38	.37	10.5
Delivery time (min)	104	130	156	.36	.38	.43	18.4
Truck cap (tn)	4.5	5.6	6.7	.48	.38	.32	42.1
Plates & Ins	118	147	176	.38	.38	.39	2.6
Truck cost	13920	17400	20880	.34	.38	.43	23.7
Service life	8	10	12	.42	.38	.36	15.8
Salvage value	2088	2610	3132	.38	.38	.38	0.0
Tarp cost	800	1000	1200	.38	.38	.38	0.0
Tarp service	8	10	12	.38	.38	.38	0.0
Fuel cons (km/l)	1.7	2.1	2.5	.40	.38	.37	7.9
Fuel cost/l	.27	.34	.41	.37	.38	.40	7.9
Tire cost (\$/)	202	252	302	.39	.38	.38	2.6
Tire life (km)	64000	80000	96000	.38	.38	.38	0.0
Interest rate	.09	.11	.13	.37	.38	.39	5.3
Drivers wages/hr.	8.00	10.00	12.00	.36	.38	.40	10.5

**Table 5**  
Deterministic sensitivity for 3 axle farm grain truck delivering 40 km (24 mi).

Inputs	Typical value			Associated productivity			
	- 20%	expect	+ 20%	min	expect	max	% var
Tonnes /year	282	353	424	.33	.33	.33	0.0
Km/ year	3792	4740	5688	.39	.33	.29	30.3
Del dis (ret)	64	80	96	.34	.33	.32	6.1
Del time (min)	112	140	168	.32	.33	.34	6.1
Truck cap tn	9.6	12	14.4	.41	.33	.28	39.4
License & ins.	120	151	181	.33	.33	.33	0.0
Price truck	24000	30000	36000	.28	.33	.38	30.3
Service life	8	10	12	.37	.33	.30	21.2
Salvage value +	3600	4500	5400	.33	.33	.33	0.0
Tarp cost	800	1000	1200	.33	.33	.33	0.0
Tarp ser-yrs	8	10	12	.33	.33	.33	0.0
Fuel con (km/1)	1.7	2.1	2.5	.34	.33	.33	3.0
Fuel cost/1	.27	.34	.41	.32	.33	.34	6.1
Tire cost	298	373	448	.33	.33	.33	0.0
Tire life	96000	120000	144000	.33	.33	.33	0.0
Interest rate	.09	.11	.13	.32	.33	.34	6.1
Driver wages	8.00	10.00	12.00	.32	.33	.34	6.1

per tonne 7.9 percent for the two axle, 3 percent for the 3-axle and insensitive for the commercial A-train.

One option simulated was to have a producer do commercial work for six additional producers. This was called a custom operator. This increased the volume over which the fixed costs were allocated and reduced per kilometer costs. Figure 3 shows the effect of having more units over which to allocate the fixed costs. Doing custom work for others reduces the per unit cost of transporting the producer's grain because it reduces per unit fixed cost. Certainly a question to consider is, does the individual have adequate labor to begin another business. If so, it could be a viable part time employment for a producer. Certainly in all cases the costs per unit transported were reduced by hauling greater volumes with the same unit.

#### TRIPS

For many producers the second thought concerning grain assembly point consolidation is that of road maintenance and expected higher taxes associated

with longer hauls. One result of using larger trucks is fewer loads are required to transport the same quantity of grain. As shown in Table 7, it takes 10 A-trains to move the same quantity of grain as 63 2-axle farm trucks. Traffic on roads could be reduced by 84 percent by switching grain transport to larger trucks. However there would still be traffic concentrations near larger capacity assembly points. Road damage rates would be expected to decline rapidly a few miles distant from the assembly point.

#### VI. SUMMARY AND POLICY IMPLICATIONS

The above factors reduce the marginal per unit cost of moving grain the additional distance to higher capacity loading sites. The net result is that under certain circumstances the cost of delivering grain can decrease permitting a greater net return to the producer despite the greater transport distances. Trucks transporting the grain may be commercial or custom operations or producer owned. The key to greater efficiency and lower per unit cost is higher

**Table 6**  
Deterministic sensitivity for high annual use A-train grain truck delivering 40 km (24 mi)

Input	min	expect	max	min	exp	max	var
Tonnes yearly	282	353	424	.07	.07	.07	0.0
Km/year	80000	100000	120000	.08	.07	.07	28.6
Delivery dist	64	80	120	.08	.07	.06	28.6
Delivery time (min)	152	190	228	.07	.07	.07	14.3
Truck cap (tonne)	28	35	42	.08	.07	.06	28.6
License & ins	2758	3448	4138	.07	.07	.07	0.0
Truck price	104000	130000	156000	.07	.07	.08	14.3
Service life	8	10	12	.07	.07	.07	0.0
Salvage value	15600	19500	23400	.07	.07	.07	0.0
Tarp cost	2000	2500	3000	.07	.07	.07	0.0
Tarp life	8	10	12	.07	.07	.07	0.0
Fuel con (km/l)	1.7	2.1	2.5	.07	.07	.07	0.0
Fuel cost/l	.25	.31	.37	.07	.07	.07	0.0
Tire cost	385	481	577	.07	.07	.07	0.0
Tire ser	149000	187000	224000	.07	.07	.07	0.0
Pup tire cost	184	230	276	.07	.07	.07	0.0
Pup tire ser	104000	130000	156000	.07	.07	.07	0.0
Interest rate	.09	.11	.13	.07	.07	.07	0.0
Driver wages	15.07	18.84	22.61	.06	.07	.08	28.6

**Table 7**  
Trips required to transport 353 tonnes of grain with different capacity trucks.

Truck axles	Net capacity tonnes	Trips	Axle trips
2	5.6	63	126
3	12	30	90
3 + pup	24	15	75
5	22	16	80
7	35	10	70

annual volumes to spread fixed costs over a larger number of units to be moved.

Hauling grains greater distances does not necessarily cost more. It depends totally on how the producer hauls the grain the additional distance. If the producer is expected to change the manner in which he is doing business and be exposed to new risks, he must receive compensation for his efforts. If he does

not, he will not willingly change. Presently producers have little incentive to change. Will the efficiencies to be gained by elevator rationalization be shared with producers to an extent they are more than compensated for their extra transport expense? This analysis indicates that the additional cost to producers of transporting grain varies widely depending on the assumptions used for equipment and transport distance. Larger equipment with adequate volume reduces total transport cost for the producer. The cost reductions more than compensate for the additional transport distances. This analysis does not consider road maintenance costs but does point out that the larger trucks with more axles require fewer trips to move the same quantity of grain. That means fewer vehicles on the road.

## VII. NEEDS FOR FURTHER RESEARCH

This paper reports on estimates of additional costs to producers of transporting grains greater distances under several assumptions. This research needs to be

evaluated in conjunction with other parts of the grain handling system to access the impact system rationalization will have on producers and how the benefits need to be allocated among participants in the system for equitable treatment.

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7. Appendices (Methods of data development, copies of the data and the model used for this analysis are available from the authors.

#### ENDNOTE

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