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A Mixed Logistics Strategy for Canadian Grain

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Abstract

Deregulation, trade liberalization and government cost-cutting during the past ten years have dramatically changed global grain markets. National centralized buying agencies have, or are in the process of being dismantled, leaving millers and processors to procure their own sources of supply. The result has been a proliferation of customers with a variety of product demands.

Consumers are demanding fresher, more healthful foods free from preservatives. To accommodate consumers, food processors have adopted flexible production technology capable of smaller batch runs. However, Just-In-Time (JIT) production techniques coupled with raw material inputs of specific attributes are not conducive for bulk grain shipping.

Demands for Identity Preserved Grains (IPG) in smaller quantities is a looming problem for Western Canadian bulk grain logistics despite system rationalization and added storage at port terminals. The Western Canadian system is likened to a funnel. There is 62 million tonnes of storage on farms, essentially a year's worth of production. The primary elevator system has 6.5 million tonnes, and the terminal elevators have 2.5 million tonnes of storage. Nearly 60 percent of exports traverse the Port of Vancouver, British Columbia.

Accommodating small IPG shipments within the Western Canadian grain logistics system will escalate cost exponentially as congestion mounts. A labor strike or inclement weather would effectively paralyze the system as "gridlock" occurs. This leaves the Western Canadian grain industry with two choices; either "re-engineer" the logistics system to accommodate smaller IPG shipments or exit the market.

This paper will explore the merits of adopting a mixed logistics system for Western Canadian grain - the bulk system for large quantities of uniform grades and marine containers for small IPG shipments. Institutional barriers, marketing and infrastructure requirements to achieve this objective is presented in a theoretical framework.

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Introduction

A logistics process is a sequence of value adding activities that puts the right product in the right place at the right time. The best logistics practices is the one that achieves these goals at the least cost and maximizes customer value. Any logistical process that has been in place for a considerable length of time is a candidate for re-engineering

Re-engineering involves radical redesign of the logistical processes to achieve a quantum leap in supply chain performance. This paper documents the necessity to re-engineer the Canadian bulk grain handling system. The first section sets the stage with a description of the birth and evolution of bulk grain handling in North America. This follows with a focus on the present and future rationalization of the Canadian bulk handling system and recent performance failures. Subsequently, the analysis examines congestion theory and the five principles of logistics that supports a mixed logistics strategy for Canadian grain - the bulk system for large, uniform grade consignments for price conscious customers and the container system for customers of attribute specific, low volume consignments. The paper concludes with an outline of the framework that would facilitate re-engineering of the Canadian grain handling system.

For the purposes of this paper the "grain handling system" refers to the western Canadian grain handling system of the four provinces of British Columbia (B.C.), Alberta (Ab.), Saskatchewan (Sask.) and Manitoba (Mb.) shown in figure 5. Dollar figures are Canadian and amounts quoted are at the reference date

The birth of bulk grain handling systems

Prentice et al (1997) provides a chronology of the birth of bulk grain handling. Before 1850, most grain was marketed in sacks and dependent almost entirely on water transport. Sacks of grain could fit into the awkward space of river boats and could be carried on a man's shoulder across gang planks, down a set of stairs and narrow corridors. Handling was labor intensive and the water routes were circuitous and sluggish. No buyer would purchase grain sight unseen. Sacks had to be kept separate with a corresponding paper trail. Risk of loss, including price change, was borne by the shipper. Consequently, freight insurance was high with handling grain in sacks. The system was costly to operate, inefficient and slow.

Re-engineering of grain handling in the 1850s was caused by a technological and institutional changes that accompanied the invention of the telegraph (1844) and the expansion of the railway. The speed of oncoming trains had to be slow with a manual system to signal an approaching train. The telegraph enabled trains to run faster and safer. This encouraged the construction of railway lines over long distances that rivaled the river boat system. In 1840, only 4,600 kilometers of railway lines existed. The rail network expanded to 15,000 kilometers within six years of Samuel Morse's invention.

In 1842, Joseph Dart demonstrated a new method of handling grain in bulk at Buffalo, New York. The railways were early promoters of bulk handling because it reduced labor costs. While the superior speed and cost advantages of bulk handling would have had a tremendous impact on handling grain in sacks, the telegraph sealed the fate of the incumbent system. Information about prices, quality and quantity of goods could now move faster than the goods.

The first grading system was introduced in 1856 by the Chicago Board of trade. The ability to mix lots into a fungible commodity eliminated the need for buyers and sellers to be in physical proximity of the product, or to each other, when conducting transactions. Prices became linked between surplus and deficit regions with the advent of "electronic" commerce. This greatly reduced price risk of shippers and enabled buyers to purchase when the price was advantageous

Bulk handling, grading standards and the telegraph were prerequisites for a commodity futures exchange. The futures market came into being over the period 1853-65 Traders could make transaction decisions in remote markets based on telegraph quotes of grade and price. Telegraph-enabled buyers could hedge transaction risk by committing to firm prices for future delivery.

The grain handling system in North America was completely re-engineered by the end of the American civil war. Sacks were still used for movement from farm to country elevator but the superiority of bulk movements was evident. The cost of trading and transporting grain from the interior of the continent fell dramatically and volume increased exponentially. This opened the settlement of the great plains, including the prairies of western Canada

Evolution of the Canadian Bulk Grain Handling System

The evolution of the grain handling system in a Canadian context was the result of technology change and shifts in government policy. Two key transportation technological developments shaped the structure of the grain gathering and forwarding network, namely the motor vehicle and diesel engines. Several government policies that for over eighty years confined the grain sector to an export economy and hampered value added industry were either repealed or altered significantly to allow for rapid transformation of the grain handling system. Change that normally would have occurred over a generation is taking place in ten years. The process is currently at the mid-point. This is having a profound impact on farming and rural communities, and municipal and provincial governments to adjust to the new realities

Estey (1998) describes the influence the motor truck and railway technology has had on the primary elevator system. At the birth of the bulk handling system, the primary elevator network grew until 5,200 country elevators dotted the landscape. The country elevator, with storage capacities between 1,500 and 3,000 tonnes compensated for their limited capacity by their proximity to the farm. The distance between elevators was not more than 10 kilometers, dictated by the daily round trip range of horse drawn wagons shown in figure 1. For the first fifty years of this industry, the horse drawn wagon was the only mode of haul from farm to elevator. After World War I, the motor truck crept into the transportation scene. In the early years, trucks were limited by carrying capacity and a primitive road network. From 1910 to 1960, the western Canadian road network grew from 10,000 kilometers of wagon trails to over 500,000 kilometers of grid roads (gravel farm to market) and paved highways. Ironically, the road system was developed for passenger transport, not freight

Likewise the motor truck has transformed from a crude converted Ford model "T" with a capacity of less than two tonnes to the 8 axle "Super B" twin semi-trailer unit capable of hauling 42 tonnes shown in figure 2. The economic hauling distance of early trucks was less than 25 kilometers whereas the "Super B" has an economic hauling distance up to 500 kilometers. The impact the railways had on the demise of the river boat and canal system have in turn led to a decline in the rail branchline network by the rise of the motor truck and road development.

As shown in figure 3, steam locomotives had both limited distance and hauling capabilities. Maximum train length was approximately twenty five cars at forty tonnes each. Today, third generation "mainline" diesel locomotives with 3,500 horsepower are capable of pulling over 120 hopper cars with capacities of 100 metric tonnes each. The desire of railways to operate unit trains led to "block" pricing incentives for submissions of 25 or more railcars. In part, this led to intense capital investment by grain companies to construct inland terminals. As of 1998, 166 new terminals were under construction in western Canada. Of these, 89 are High Throughput Elevators (HTEs) with storage capacity of 15,000 tonnes or more as shown in figure 4. Extensive sidings at the HTEs enable the formation of 100 car trains that can carry 10,000 tonnes in a single movement. When all the 89 are fully operational, they are able to handle 84 percent of all deliveries in an average year. Industry insiders have postulated that by 2015, less than 150 delivery points will be servicing all of western Canada.

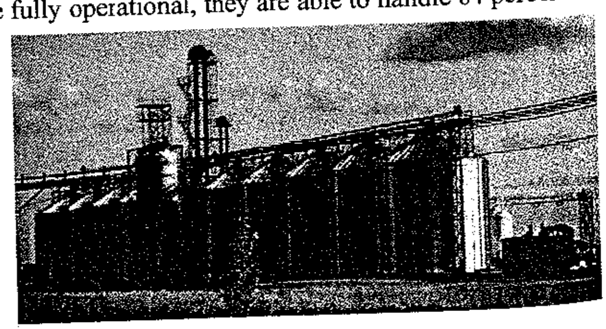

Figure 4: Modern multi-bin inland terminal with its own 112 car yard and shunting locomotive in foreground near Virden

Although a complete history of Canadian federal government grain and rail transportation policy is beyond the scope of this paper, two key acts have been influential in shaping the grain handling network. The repeal of the *Western Grain Transportation Act (WGTA)* in August of 1995 removed $725 million in annual export support payments. Farmers now bear the full cost of transport and turning to larger tractor-trailer units to gain hauling efficiencies as depicted in figure 2

The second was an amendment to the *Canadian Transportation Act (1996)* that allows for branchline abandonment without a public hearing. Previously, railway applications to abandon track were met with mandatory, and often raucous public debates. Today, railways tender lines for purchase, and if not sold within 120 days, can tear up track without government intervention. Since 1989, 25 percent of the western Canadian branchline system has disappeared entirely with the remainder rapidly becoming a series of shortlines.

Encumbrances of the grain handling system

Unlike coal, potash, and sulfur - grain shipments do not satisfy the prerequisites of bulk handling. Production occurs at a single period (harvest) with a sharp demand in the fall and a second peak in the spring. Grain must be collected from over 511,000square kilometers and as of 1998, shipments were assembled from 1,170 delivery points. Compounding this problem are over 100 varieties of grain grade classifications, pulse and specialty crops competing for rail cars and bin space at terminals. Despite the construction of HIEs and the expansion of port storage, the bulk system will be unable to cope with the volume of Identity Preserved Grain (IPG) and alternate crop shipments.

Western Canadian grain exports for 1997 by port of clearance and percentage are shown in figure 5. *Demmans and Roth* (1998) surmise the Canadian grain handling and transport system to work as a "funnel". Farmers can store a years worth of grain (62 million tonnes) and associated segregations in their bins. The primary elevators are the first constriction of the funnel with 6.5 million tonnes of storage. The railways have minimal storage in the form of hopper cars, and the terminal elevators are the neck of the funnel with 2.5 million tonnes of storage. Over 60 percent of Canadian grain traverses through the lower British Columbia mainland. The remainder exits the Great Lakes-St. Lawrence Seaway, Prince Rupert, Churchill and U.S. markets. The objective of grain companies is to have over 15 inventory turns per annum in the HIEs from the current 8 per year. This may be unrealistic. The funnel effect plus the demand for increased segregations means there is a looming problem as the primary elevator and rail branchline system continues to rationalize.

Exacerbating the congestion in Burrard Inlet at the port of Vancouver is the interswitching of railway cars to terminal elevators and restricted access over a single Canadian National Railway (CN) bridge on the east side as depicted in figure 5. Table 1 shows that congestion is costing farmers approximately $55 to $90 million annually and may exceed the benefits of bulk grain pooling, although this has never been quantified.

The Canadian system is especially vulnerable to labor disputes and inclement weather, effectively shutting down Canada's grain export capabilities during these events. Two examples illustrate this point In December 1995 and January 1996 western Canada had record snowfall and cold temperatures. Railway tunnels and major highways such as the Trans-Canada through the Rocky Mountains were blocked for weeks until snow was cleared Cold temperatures in the -40 C range wreaked havoc on train operations as locomotives failed and air lines froze. At the height of the crisis there were 34 vessels waiting in Vancouver with only 25,569 railcars unloaded as compared to the normal rate of 41,160 for the two month average. The cost to farmers was $65 million in lost sales and demmurage.

The second example was a two week shutdown of grain exports in 1998 by west coast grain handlers and inspectors during a contract dispute. Although costs for the second example were difficult to calculate, the Canadian Wheat Board confirmed losing a $9 million sale to an Asian client.

Table 1: Annual congestion costs in the Canadian grain Handling system ($ millions)

Cost Element	Logistical Element	Amount
Storage	Excess storage costs due to mismatches between customer demand and inventory at portside	15 - 25
Ocean Freight	Higher than average ocean freight rates based on historic waiting times and loading performance at Vancouver	15 - 25
Demmurage	Direct cost for vessels held at Vancouver	15 - 20
Terminal Inefficiencies	Additional rail to terminal transfers from non-compliant stocks	5 - 10
Multi-berth loading	Ship transfer costs between berths to meet volume and grade specifications	5 - 10
	Total Cost	55 - 90
Source: *McKinsey* (1998)		

The post mortem of the events prompted the Canadian government to appoint Supreme Court justice W. Z. Estey to assess what went wrong during the winter of 1995-96 and provide recommendations for improving the grain handling system. The recommendations are now being implemented with a target completion date for the 2001 crop year. The second reaction was to amend the *Canada Labor Code* to prohibit grain workers at the port of Vancouver from holding farmers hostage during labor disputes.

Although these changes will undoubtedly improve the performance of the bulk grain handling system, they fail to address a fundamental issue. The structure of the world grain market is shifting from a bulk procurement mentality to one of small shipments with specific attributes for which the bulk handling system was not designed.

The changing global marketplace

The global marketplace is undergoing significant change as governments focus on trade liberalization and cost cutting. Central buying agencies worldwide have or are in the process of being dismantled allowing millers and processors to act on their own behalf. Trade patterns and increased demand for specific product attributes are now driven by market forces rather than government policies.

The loss of the Former Soviet Union (FSU) and China has been replaced by other Asian and Latin American countries who do not have the financial resources nor infrastructure to handle bulk shipments, but can take smaller parcels of containerized grain. Although global bulk shipping rates have been under pressure to respond to the "Asian monetary crisis", many customers are loath to commit to large bulk tonnages given economic uncertainty. Smaller shipments provide an alternative for cash strapped economies.

Table 2a and 2b provide evidence of the structural change. Grain exports have nearly recovered from the 1995-96 performance failure as customers are regaining confidence in Canada as a supplier. Eighty percent of shipments are less than 20,000 tonnes with the majority of growth, both in relative and absolute terms, in the 10,000 tonnes or less category. Although the 1998-99 crop year is not yet complete, figures indicate that shipments over 30,000 tonnes will decline further. Likewise the volume of grain purchased by central agencies has declined from 82 percent in 1990 to 44 percent in 1996.

Consumer demand for more varied, fresher food products, free from preservatives has forced millers and food processors to re-engineer their supply chains. Modern processing technology employing Just-In-Time (JIT) inventory techniques requires grains of specific attributes in smaller batch runs to satisfy customers. Large bulk shipments are being phased out for smaller, more frequent shipments. Higher transport costs for raw materials can be offset by reduced processing costs and more consistent quality.

Table 2 (a): Canadian Coarse* Grain Exports by Shipment Size and Crop Year

Percent of shipments by tonnage category	Year of Production				
	1994-95	1995-96	1996-97	1997-98	1998-99**
>50,000	1.7%	1.0%	2.5%	1.6%	0.5%
40,000><50,000	1.5%	1.6%	1.3%	1.1%	0.7%
30,000><40,000	4.3%	3.1%	3.6%	3.1%	4.2%
20,000><30,000	13.8%	14.9%	13.1%	13.9%	15.2%
10,000><20,000	26.1%	27.0%	24.4%	24.7%	28.3%
0><10,000	52.6%	52.3%	55.2%	55.5%	51.0%
Millions of Tonnes	30.3	23.1	26.2	27.2	16.1

Source (table 2a): *Canadian Grain Commission*, * Wheat, Canola, Flax, ** Sales at April, 1999.

Table 2 (b): Canadian Grain Customer Profiles by Sales Percent and Year					
	Year				
Customer Profile	1990	1991	1992	1995	1996
Private Buyer	18%	42%	45%	55%	56%
Central Buyer	82%	58%	55%	45%	44%
Source (table 2b): *McKinsey*, 1998					

Demmans and Roth (1998) calculated the benefits of segregation to be $3 00/tonne for Canada number 1 Western Red Spring Wheat (1CWRS) and $2 30/tonne for Canada number 2 Western Red Spring Wheat (2CWRS) for the 1990-91 to 1994-95 crop years for protein content 12% or greater During the 1995-96 crop year, protein segregation greater than 12 0% in 1CWRS contributed an average of $9 14/tonne more to sales revenues than had it been sold as 1CWRS with 11 5% protein These calculations were based on moving the IPG shipments through the bulk system. By their own account the figures are for revenues only, the marginal costs of providing these segregations were not calculated.

An innovative monitoring program is proposed to ensure accountability for IPG shipments as they move through the Canadian bulk system (Canadian Grain Commission, 1998). The plan is to take samples for analysis at each point of transfer and/or change of ownership of the product This scenario should feasiblely work for lower proportions of large consignments of IPG shipments. However, as both the number of segregations and smaller shipments increase, congestion effects will increase cost exponentially, eliminating segregation benefits In addition, new breeds of grain that do not meet Kernel Visual Distinguishability (KVD) characteristics are prohibited from registration, but may possess some attribute of value to an end customer A separate marketing and logistics channel could allow these speciality grains to co-exist without compromising the visual grading system.

Congestion theory as applied to grain transport

Prentice and Craven (1980) foretold the problems associated with the grain handling system nearly twenty years ago. The theory of congestion posits that each additional unit in a transportation system not only incurs its own cost of operation, but imposes additional costs on other units already in the system Figure 6 shows marginal costs (C'(q)) exceed average costs (C(q)/q). As the number of units

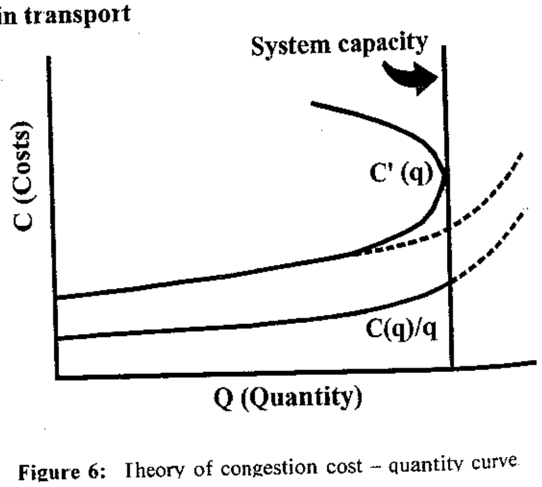

Figure 6: Theory of congestion cost – quantity curve

increase, marginal costs increase with slower railcar cycle times, higher coordination costs and excess capital spending As more grain moves into port terminals, additional storage must be provided to meet peak demand. None of these costs can be specifically attributed to particular shipments because added costs are distributed among all units from grain pooling.

As the system approaches capacity, marginal costs increase exponentially. At full capacity, bottlenecks form and the volume getting through the system actually decreases - "gridlock" occurs. But marginal costs continue to increase because excess storage costs are incurred and demmurage must be paid to vessels. The relevant segment of the marginal cost curve slopes to the left

Congestion theory suggests that substantial reductions in cost will not occur by an expansion of the present system; rather the true cost of moving grain will increase. Such costs are depicted by the dotted lines in figure 6.

Planned improvements to the bulk handling system have been undertaken with the implicit assumption that the benefits exceed the additional capital investment and operating cost involved. Alternatives to bulk handling have largely been ignored because it has been believed that bulk handling represents the lowest cost means of delivery. The appropriate approach is a comparison of the long-run marginal costs of increasing grain handling capacity to alternative supply channels.

Strategic concepts of logistics for re-engineering

Innovations in transportation and communications create opportunities for developing improved logistical systems. The alternative to handling grain in bulk is to ship grain in ISO containers. Containers can be loaded at the farm, or at a consolidation facility, e.g., a country elevator. Containers can be trucked to double-stack train terminals, and forwarded to marine container ports. Grain in containers moves with other containerized cargo to foreign buyers. As a result, containerized grain faces only the marginal costs of the intermodal shipping system, rather than the full costs of the bulk handling system.

A key problem in re-engineering logistical systems is to escape entrenched ideas. Logistical theory has developed strategic concepts that are useful in assessing the prospects for re-engineering marketing channels (Prentice *et al*, 1997). Five strategic concepts of logistics theory are used to argue why the grain handling system should be re-engineered to move grain in containers.

Mixed systems are superior to pure systems

A mixed system is always superior if the process is subject to fluctuating volumes. The low utilization of the fixed capacity during the off-season can make it less expensive to use an alternative that has variable capacity. This is the argument for using public warehousing to supplement a private warehouse during a peak sales period It is less expensive to use a small private warehouse at full capacity all year, and hire public warehousing as needed Congestion theory supports the principal that mixed systems are superior

Variety exacts its price

The greater the variety of products in a logistical system, the higher the inventories necessary to maintain customer service. Product variety increases pipeline inventories. This raises the logistical costs for storage and financing inventories. Greater variety also lowers the average shipment size. Assuming the same volume of demand, dividing the product into more classifications produces smaller shipments. Variety is the soft underbelly of the bulk handling system for grain. The demand for "Identify Preserved Grains" (IPG) is increasing: organic wheat, variety preferences, specific quality attributes, e.g., protein. Advances in genetics and the demands for product differentiation threaten to congest the bulk system with further variety.

One size does not fit all

A differentiated distribution strategy may be applied to products, sales volume or customers. Some consumers are willing to pay more for premium service, while others are just interested in the lowest price. A standard level of service dissatisfies the "quality-sensitive" customers, and has attributes for which the "price-sensitive" customer will not pay. Containerized grain offers a premium service that JIT processors may be willing to pay.

Delay commitment to the final product until the last possible moment

This logistical strategy is used to lower finished inventory costs and increase customer service. The classic example is the distribution of paint. Untinted paint is shipped to retail outlets. Tints are added after the customer chooses the desired color. This reduces inventories held at retail and eliminates obsolescence while improving the selection of colors available. The strategy of delaying commitment is now being used in a range of products. For example, assembly plants have been established in the Netherlands to finish the manufacture of Japanese computers and other electronic equipment for the European market.

Bulk handling reduces the foreign miller's opportunity to tailor processed grains to the exact specifications of the buyer. Commitment is made to the quality of the final product, as soon as the grain is commingled at the country elevator. Containerized grain would delay commitment and give the foreign processor a multitude of options. The foreign processor could blend grain with different quality attributes from an inventory of containers to fit a wide spectrum of finished product specifications.

It's Total Costs that matter

In traditional supply chain management each participant views the next agent in the marketing channel as the "customer". Great efforts may be made to reduce costs and improve the service to this customer, without considering the impact on the entire supply chain. Only system changes that lower total costs to the end consumer make everyone better off. The principal of the total cost concept is that producers need to be as concerned about their customer's customer as they are with their customer.

The North American grain handling system is designed as if all the important transportation and handling costs ended at the port of export. Most grain exporters have no idea of the total costs to the processor in the foreign country. For example, large bulk shipments may be the lowest cost method of moving grain from farm to port, but impose high inventory holding and storage costs on importers. A JIT container system could have higher transportation costs than bulk, but would virtually eliminate the storage, inventory holding and shrinkage costs for the foreign processors

Intangible costs, such as reliability, are also important. The greater uncertainty of the bulk handling system adds to costs. Foreign buyers must have contingency plans and additional inventories to guarantee service to their customers. A rough comparison of the shipping time for the bulk handling system and the proposed container system is presented in Table 3. The comparison is only approximate because no informed opinion could be obtained of the unloading time and storage of grain in foreign import terminals. The data shows that the bulk handling pipeline is four times longer than a container system. A 25 percent variation in delivery time of the bulk system would equal the time required for a container movement. This also means that farmers - through grain pooling - are financing inventories four times longer than needed and is reflected in final payments by the Canadian Wheat Board.

Table 3: Approximate Shipping Time Comparison for Bulk Handling versus Containerization of Canadian Wheat

Bulk Handling System	Days	Container System	Days
Farm Storage	??	Farm Storage	??
Local Delivery	1	Local Delivery	1
Primary Elevator	40	Intermodal Terminal	2
Rail Hopper Cars	11	Double-stack Train	2
Export Terminal	19	Intermodal Port	2
Bulk Shipment	15	Container Ship	11
Import Terminal	10	Intermodal Port	2
Local Delivery	1	Local Delivery	1
Final Customer	??	Final Customer	??
Total	97		21

Cost trade-offs: bulk versus containers

Cost trade-offs are central to re-engineering. The scope and design of logistics involve a balance between conflicting activities. Logistical functions can never be eliminated, only the cost of one activity can be traded-off against the cost of another. For example, transportation costs can be reduced by opening additional warehouse distribution points, but at the expense of increasing inventory holding costs.

Cost of physical handling versus container transfer. Grain is loaded and unloaded at least four times before reaching the final customer. Containerized grain would be handled once. The economics of size in bulk handling may not be totally exhausted, but further gains are likely to be marginal. Container systems are experiencing rapid productivity improvements. Computer controlled cranes and robotic trolleys are reducing labor costs and increasing handling speed.

Pipeline storage costs versus use of containers. Farmers already possess most of the storage they require to protect the crop after harvest. The storage provided in the bulk handling pipeline duplicates on-farm storage. The container serves as transportation unit and storage. Farmers could use containers to supplement on-farm grain storage. When the grain was sold, the storage would move into the handling system.

Economics of shipping versus inventory holding costs. The speed of the container system, and the opportunity to use JIT scheduling reduces the costs of financing pipeline inventories. Lower inventories also reduce the risk associated with spoilage and shrinkage due to pests. On the other hand, approximately two tonnes of metal have to be physically moved with each container shipment. Adding 10 percent to the weight of the shipment increases the cost of transport.

Empty backhauls versus tare weight of containers. Containers are the new "boxcars" of the railways. Whereas bulk systems experience empty backhauls, the availability of empty containers could attract a variety of freight. This may be useful in balancing container trade deficits between global regions.

Low freight costs/average quality versus freight premiums/exact quality. The bulk system offers low-cost service but delivers only average quality grain. Containers cost more to transport, but can deliver exact specifications. Some buyers may find the quality benefits more than offset the extra transportation charges. Its worthwhile bearing in mind that the value of grain contained in a loaf of bread, or a bottle of beer, is measured in pennies. A penny more for transportation might be easily extracted as a quality premium for the final product.

Factors Favoring Containerization of Grain

A range of technological and economic factors favor the containerization of grain.

Freight costs

Container rates on all oceans are plummeting. In certain trade lanes, container rates are *below* bulk rates. In addition, the capacity of the containerships has nearly doubled. In 1980, containerships carried 2,000 to 3,000 TEUs (twenty foot equivalent unit). The new 6,000 TEU containerships operate with the same crew complement and fuel consumption of their smaller predecessors. Freight rates for cargo are being bid down as steamship lines compete for cargo to fill these new ships.

Container terminals are becoming highly automated worldwide. The railways are improving their double-stack service as they upgrade and add equipment. Container volumes in North America have enjoyed a compound growth rate of 5 7 percent since 1988. Better service and lower costs are anticipated as improvements continue.

Further cost reductions are likely as the container system matures. Steamship lines jealously guard their container fleets. The railways have invested in "domestic" containers that are larger, and do not move overseas. The pooling of container fleets is beginning to gather support. Increasingly, the industry is pointing to "grey boxes," which are owned by third parties, as a method of increasing vehicle utilization

Communication Costs

The revolution in communications can be summed up with one word: Internet. The information highway may be the most important innovation of this age. Global commerce via the Internet are already taking shape The impact of the Internet on grain marketing in the 21st Century could be akin to the changes that occurred in the 19th Century when the telegraph was introduced. Just as the telegraph decentralized the physical transaction of grain, the Internet could decentralize the electronic transaction of grain. Information is replacing the need to store large inventories and reducing the economies of size in order processing.

Price/quality Considerations

Bar codes and computer data bases reduce the effort of tracking container shipments Importer demand for IPG will lead the move to larger container volumes Quality premiums to farmers are encouraging the production of organically grown crops, specific varieties of mainstream crops, and a variety of "special crops" that range from herbs to pulses. These products cannot move economically through the bulk handling system.

Electronic Markets for Grain

The impact of communications technology and containerization could be far reaching for the grain industry. Electronic markets could shift some functions performed by grain handlers back to the farm Operationally, farmers could post container loads of products on an Internet site, and field purchase offers via e-mail. Potential buyers could be sent grain samples by express courier. Transactions could be consummated with container shipments that never touch the current bulk handling system, or use the services of grain handlers. Naturally, some institutional arrangements would have to be put in place to assure the farmer received payment, and the buyer received the actual quality according to the contract These institutional arrangements constitute the requirements of an electronic market.

Electronic markets enable traders to buy and sell complicated products without being in physical contact. There are certain institutional prerequisites that must be developed for an electronic market (*Prentice and Mulligan*, 1996) A computer-supported system must be used to search and negotiate the transaction. There must be membership rules, a method of quality checking and a system for settling transactions. Some elements of an electronic market for containerized grain are in place; the missing pieces present no significant barrier.

The need for containers could create a second electronic market for farmer-owned "grey boxes". Essentially, producers would purchase containers and form a leasing pool. While the containers are at the farm, they store grain. When the grain was sold, the container would enter a leasing pool that would return a payment to the farmers. In the next harvest season, the producer could request the delivery of a container, and the cycle would begin again. Farmers would not necessarily receive the container they purchased, but would receive "rights" to a container. Container leases could be traded electronically, with bids and offers entered by producers, grain handlers, carriers and buyers. This would encourage utilization of equipment and maximize producer returns.

Conclusions

The Canadian bulk grain handling system is not consistently able to get "the right product to the right place at the right time". The privatization and fragmentation within Canada's customer base have resulted in increasingly complex customer requirements. This has increased the number of customers, reduced consignment quantities, requiring more frequent shipments and stringent product specifications. With the Canadian system still based on physically pooling shipments from the country, these customer changes have strained the system's ability to reliably deliver the right product on time.

Looking to the future, there are additional weaknesses in the system. New opportunities such as contract farming, are characterized by direct involvement of food processors in the procurement of raw materials and supply chain management. These new developments are growing at a rate of eight percent per annum in North America. However, the structure of the Canadian grain handling system - based on physical pooling and balanced sourcing - will hinder the development of these supply chains that require product specificity and segregation. Moreover, breeding programs that could provide customers and farmers alike with new opportunities are constrained by a visual grading system designed for bulk pooling.

The rationalization and institutional changes currently taking place in the Canadian bulk grain handling system (*Estey* 1998, *McKinsey* 1998) will no doubt enhance performance, however, they amount to nothing more than tinkering with a logistics system incapable of accommodating new market realities. The case for re-engineering the grain handling system, rather than an overhaul, is imminent.

Prentice et al (1997) states that complacency in business is always risky, but it is particularly dangerous during periods of economic transition. Rapid changes in global trade are being spurred and reoriented by growing world populations and rising incomes. Competitive advantage is being sought through technological advances in computers, genetics, robotics, telecommunications, and transportation. Governments are intensifying competition with policies of deregulation, "free" trade, and privatization. The drivers of structural change have seldom been more diverse, or more profound. To survive, businesses are being forced to re-engineer their manufacturing and logistical processes to lower costs and increase quality.

After 150 years of growth and development, most grain exports are still marketed through grain elevators, rail hopper cars and bulk carriers. The bulk handling system is so ubiquitous and entrenched as to be uncontested. No doubt it appeared the same to the handlers of bagged grain when the bulk method was first introduced. There have been many refinements and productivity improvements in the bulk handling system, but the basic concept remains unchanged. Technological advances in information collection and transmission now make the container system a rival for the bulk handling of grain.

The motto of the Industrial Age (1850-1975) can be summed up with the expression: *"If it ain't broke, don't fix it!"*. In the modern era, which some have termed the Information Age, this expression could be changed to *"If it still works, it's probably obsolete!"* Rapid changes because of new information technology are forcing many systems to be re-engineered. These changes spare no sector of the economy, least of all the grain handling industry.

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