A Mixed Logistics Strategy for Grain:  
The Competitiveness of Containers Versus Bulk

Prepared for:

Prairie Farm Rehabilitation Administration  
Agriculture and Agri-Food Canada

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Executive Summary

Bulk transport systems are usually product specific, highly automated and designed to handle generic commodities in large volumes. Grain is usually cited as an example of bulk cargo, but intermodal containers are becoming a serious competitor to the bulk handling of grain. Whereas bulk shippers must bear the brunt of a two-way haul, the intermodal system has the advantages of economies of scope to obtain backhaul loads. Once the domain of only manufactured goods, containers are now moving lower valued products like shredded cardboard, waste glass for recycling and increasingly grain as backhaul commodities.

The viability of a containerized grain logistics system is being thrust to the forefront by the demand for Identity Preserved (IP) grains. Biotechnology firms have produced Genetically Modified Organisms (GMOs) that require strict segregation. An IP system is necessary to preserve the value of GMOs and to quell the fears of consumers. Significant pressure is being imposed on governments by consumers to guarantee that safe food supplies have not been compromised by adventitious mixing with GMOs.

The ability of the bulk handling system to efficiently handle GMO grain varieties is increasingly being questioned. The bulk handling system that has evolved in western Canada can be likened to a funnel with large volumes of relatively homogeneous product being channeled into fungible grade categories with little regard for precise end-use requirements. Only with repeated testing and documentation could a bulk system guarantee product integrity. The cost implications of testing and risk of cargo rejection has caused many grain handlers to question whether containers might offer a better solution.

The trade imbalances on the Pacific and Atlantic container shipping corridors result in favourable rates for North American exporters. In recent years containers of grain have been shipped to Asian ports on backhaul rates that are comparable to bulk rates. Unlike bulk shipping however, many opportunities exist to employ economies of size and automation to further lower container costs. The falling costs of containers and the rising
demand for IP grain creates opportunities for Canadian producers to capture/preserve greater value.

Ultimately, logistics is about cost trade-offs: in this case, inventory costs versus transport costs. The competitiveness of container-based grain logistics is a function of the buyers’ plant size. Just-in-time container delivery can be tuned to a plant’s production capacity to minimize inventory-holding costs. Most analysts of bulk handling ignore the cost of storage, and pay scant attention to the impact of other logistics costs that grain buyers bear after the shipment reaches the importing country’s docks.

The results of this logistics study suggest that inventory-carrying costs drive the economics of containerized grain. For small to mid-sized grain processors, large bulk consignments require longer-term storage, which becomes a significant component of cost structures. This is especially true for developing countries where interest rates are high. For processors with low plant consumption rates, containers are a competitive option. Based on a logistics cost model for the Vancouver to Asia corridor, containers could save importers $3 to $5 per tonne over bulk shipping.

The pull from IP grain demands and the push from container liners desperate to fill empty backhaul slots make it only a matter of time before container shipping invades markets now served exclusively by bulk shipment. Containerizing grain has the potential to put more money in the hands of farmers to the extent that a container-based delivery system can lower total logistics costs. Farmers would also have the potential to add value to crops (e.g. cleaning) and gain some share of the better margins. The next step is to undertake a series of trial shipments to refine the logistics model and identify opportunities for system improvements.
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## Nomenclature

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>DWT</td>
<td>Dead Weight Tonnes</td>
</tr>
<tr>
<td>VLCC</td>
<td>Very Large Crude Carrier</td>
</tr>
<tr>
<td>ULCC</td>
<td>Ultra Large Crude (or Container) Carrier</td>
</tr>
<tr>
<td>OPEC</td>
<td>Organization of Petroleum Exporting Countries</td>
</tr>
<tr>
<td>JIT</td>
<td>Just In Time</td>
</tr>
<tr>
<td>GMO</td>
<td>Genetically Modified Organisms</td>
</tr>
<tr>
<td>WAFIR</td>
<td>Widely Available, Foolproof, Inexpensive and Rapid</td>
</tr>
<tr>
<td>HTE</td>
<td>High Throughput Elevators</td>
</tr>
<tr>
<td>CSP</td>
<td>Canadian Short Process</td>
</tr>
<tr>
<td>P&amp;D</td>
<td>Pickup and Delivery</td>
</tr>
<tr>
<td>CWRS</td>
<td>Canadian Western Red Spring (wheat)</td>
</tr>
<tr>
<td>IP</td>
<td>Identity Preservation</td>
</tr>
<tr>
<td>USD</td>
<td>U.S. Dollars</td>
</tr>
<tr>
<td>KVD</td>
<td>Kernel Visual Distinguishability</td>
</tr>
<tr>
<td>TEU</td>
<td>Twenty-foot Equivalent Unit (container)</td>
</tr>
<tr>
<td>CWB</td>
<td>Canadian Wheat Board</td>
</tr>
<tr>
<td>CGC</td>
<td>Canadian Grain Commission</td>
</tr>
<tr>
<td>FOB</td>
<td>Free On Board</td>
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1.0 Introduction

Bulk transportation systems are most economic for large volumes of homogeneous products. Commodities such as coal, potash and sulphur benefit from the economies of size in mechanized handling and shipping. Until recently, grain was considered almost exclusively a bulk commodity. The bulk handling system for grain is now under increasing pressure to change. Grain has ceased to be a homogeneous commodity, or to move in the volumes that are exclusively the domain of bulk handling.

Demand is growing for a more flexible logistics system that can deliver smaller lots of grain with precise product attributes. The industry is divided on the ability of the bulk system to cope with greater product segregation. Optimists believe that the bulk system can handle identity preserved (IP) grains by means of product tests and affidavits at transfer points, and with improved co-ordination of the supply chain. Pessimists have reservations about the costs of testing grain and the effectiveness of bulk handling systems to prevent the mixing of adventitious material. Bulk systems are designed to accommodate neither the product diversity, nor the small volumes of IP grains.

Containerization provides an alternative to bulk systems for moving grain. Once the exclusive domain of high-valued manufactured goods, containers are also handling low valued bulk materials. Logistics theory holds that a mixed system is generally lower in cost than a pure system. In addition to handling IP grains, containers could improve the performance of the bulk handling system by reducing the number of segregations it handles. This study examines the competitiveness of containers to serve markets that demand smaller volumes, or could be served on a just-in-time basis.

1.1 Study Purpose and Scope

The purpose of this study is to provide information to the Canadian grain industry on the economics of grain containerization. The report begins with a brief description of the bulk handling system for grain. This is followed by a survey of market developments resulting from biotechnology and consumer concerns, and the shift from large state
buying agencies to smaller independent grain importers. These market drivers are leading the demand for shipping units that are more easily served by containerization.

Subsequently the logistics and economics of bulk and container shipping methods are compared. The supply side of the analysis includes an examination of advances in port and shipping technology.

The final section of the report presents scenarios for shipping various volumes of grain by container and bulk systems. These scenarios demonstrate the economics, logistics and suitability of bulk and intermodal systems for different customer needs. A worksheet that sets out the costing method is included in the appendices.

2.0 Funnel Effect of Bulk Handling

Bulk supply chains are best utilized in industrial situations where processing capacities warrant large shipments of fungible commodities. Large processing facilities can enjoy production economies of size and are distinguished by a continuous operation. The processing plant’s throughput sets the “drumbeat” of the supply chain, and determines freight flow. A disruption in material supply can be detrimental because plant shutdowns are costly.

International commodity trades are often characterized by an hour glass in which products are funnelled to an ocean port, where the commodity shipments again disperse to the importing countries. The funnel effect of the bulk system for grain is demonstrated in Figure 1 as a fictitious 40,000 tonne consignment amassed as it flows towards the ocean vessel. It takes approximately 1,700 truckloads at 23.5 tonnes per truck to begin the process of grain collection from the farm gate to primary elevators. At the elevator, the grain is sampled for dockage and disease, shrinkage allowances applied and the variety is verified by the Kernel Visual Distinguishability system (KVD). Here the first stage of blending has taken place.
Farm storage is approximately 62 million tonnes. Primary elevation storage is 6 million tonnes at 621 licensed facilities. Terminal elevator storage is 3 million tonnes at 14 licensed facilities.

A 40,000 tonne export shipment of grain begins with 1,700 truckloads from the farm to primary elevators. Four unit trains of 100 cars at 100 tonnes each move the shipment from the country to portside terminals. A 40,000 tonne handymax vessel is loaded at the terminal elevator.

**Figure 1: Funnel effect of bulk grain systems with a 40,000 metric tonne example**

Based on vessel arrival time windows, the grain is loaded to railcars, samples taken and cars are released to the railways for scheduled train runs. Cars are assembled in rail yards and the mainline train travels to the port (unless there are sufficient cars from a High Throughput Elevator (HTE) to assemble an entire train). It takes approximately 4 trains with 100 cars each at 100 tonnes per car to move the 40,000 tonne shipment to port.

Usually within one week of vessel arrival, the 4 strings of railcars are transferred from portside rail yards to terminal elevators. At the terminals, the final stage of blending and cleaning to export standard is done. Upon vessel arrival, the grain stream is sampled as it is loaded to the ships hold. When the Canadian Grain Commission inspector is satisfied that the consignment meets pre-specified grade, quality and contractual standards a *certificate final* is issued. This is the Canadian government’s assurance to buyers of product quality.

While the funnelling effect of the Canadian grain system produces uniformity and consistency in the final shipment to the customer as wheat cascades its way from farms...
to terminal elevators, it is also its Achilles’ heel. The system poses a challenge to trace accountability for shipment contamination with unacceptable varieties. Contamination with genetically modified organisms (GMO) and new breeds that are functionally different, but visually compatible to traditional classes, is unavoidable in the absence of non-visual verification.

Falling costs for communication and intermodal transport are eroding the markets for bulk shipping (Prentice 1998). As manufacturers accommodate an increasing array of consumer tastes with modular processing technology and batch production, the bulk system is forced to cope with segregated shipments and lower volumes. Already bulk shipping has lost major shares of the market for commodities, like lumber and cotton, to containerization. Now the volume of grain shipments in containers is beginning to rise.

3.0 Challenges from the Demand Side for Bulk Handling

Changes in technology are creating a push and pull for a more decentralized and product-oriented marketing system. Advances in biotechnology promise to deliver a cornucopia of new grain varieties tailored to individual buyer needs. At the same time, information and communications technology is permitting smaller entities to achieve the same economies that were once only achievable by monolithic organizations (Prentice, 1998).

3.1 Biotechnology

GMOs are revolutionizing grain production, handling and consumption. The economic value of GMO grains is based on novel characteristics, which can be either input or output traits. Input traits are herbicide tolerance or organic insecticides that simplify agronomic practices and lower perceived risk to the producer. Output traits improve production yield for processors or food appeal to consumers.

Public scepticism about the safety of GMOs has significantly contributed to the fragmentation of markets. Despite great efforts to advance GMO crops, consumers are
not readily embracing “engineered” foods. Figure 2 presents the results of an eight-country consumer survey on perceptions of GMO food. Respondents felt that while the majority of the benefits of genetic engineering in food production accrued to industry, risk was borne primarily by consumers.

![Figure 2: Global Consumer Perception of GMO Foods](image)

Well-publicized cases of safety debacles, such as Starlink corn in the United States, have caused consumers to question the origin and marketing of their food.¹ Consumer groups and grain-buyers are demanding that governments and the agriculture industry ensure product safety. Countries such as Australia and New Zealand have announced plans to introduce mandatory labelling for GMO foods. As of April 2001, the Japanese government requires mandatory GMO food labelling (Doidge, 2000). European Union has finalized labelling rules that permit food containing a maximum of 1 percent of GMOs to be labelled as “non-GMO”. Food with GMO levels higher than 1 percent is to be described as product which “may contain GMO material” (Cocheo, 2000 & Batie, 1999).

¹“Starlink is one example, but there are issues of pesticide residue, E. coli and all kinds of other contaminants, the esters in Coke bottles in Belgium, etc. A whole host of food safety issues come forward in any given year.” (Curtis Rempel, Monsanto, 6th Annual Fields on Wheels Conference, Winnipeg, MB, November 20th, 2001).
The importance of this consumer reaction to the bulk handling system is its impact on costs and risk. Low tolerance levels of adventitious material are difficult for the bulk handling supply chain to guarantee. Individual components of the system may be able to meet strict guidelines, but it is doubtful the entire bulk supply chain in Canada can deliver products that are consistently more than 99 percent GMO free. The costs of mistakes in handling GMOs properly are likely to be severe.²

3.2 Demand Pull Supply Chains

The consumer demand for GMO-free foods would require processors to clean and sanitize their production systems between each batch run. Such strict quality control measures are expensive to maintain. North American, European and Asian consumers may be required to pay premiums of 25 to 50 percent for the higher production costs (Clarkson, 1999). As a result, the processing plants are becoming more attuned to demand pull production in which quality attributes are more narrowly defined.

Some food processors are customizing plants for small batch Just-in-Time (JIT) inventory production methods. Benefits of JIT accrue from reduced capital in acquiring commodity stocks, less storage infrastructure, administering non-compliant stocks and greater product consistency (Clarkson, 1999).³ The increase in the variety of inputs has processors dedicating plants to specific product lines for efficiency gains (Rawlings, 1999). The result is a segmentation within supply chains and production facilities (Christofore, 1999).

Potential sources of waste in food processing include transportation inefficiencies, supply and product defects, excessive inventory, and production and processing

---

² Starlink is a type of genetically engineered corn that was approved only for use in animal feed because of unresolved questions about whether it can cause allergies in humans. During 2000, this corn variety was inadvertently directed to food processing mills and ended up in taco shells on several store shelves in the United States. This mistake and the resultant recall imposed severe costs on the industry in terms of out of pocket cash, plant shutdowns and reduced consumer confidence.

³ An example is the production of packaged cookies. Flour must have precise gluten, moisture, protein and falling number specifications. If there is not enough gluten, the biscuit spreads out during baking making it impossible to put it in the cellophane wrapper. If there is too much gluten, the biscuit does not spread out enough during baking, allowing it to jostle around in the package, causing cookies to chip and crumble during shipping and handling. Inputs that are out of specification and not corrected prior to use can ruin an entire production run including potential for machinery damage. The second problem created by non-compliance is the potential for plant shutdown if there is no inventory buffer.
inefficiencies. JIT food processing (in which inventories are kept at a minimum and inputs are replenished only when they are needed) requires a fast, efficient and reliable supply chain. The implication for the bulk handling system is that smaller shipping sizes raise the average cost of their operations.

A corollary to niche product demand is the need for food processors to secure inputs that meet production requirements. Buyers seeking to secure guaranteed supplies of specific varieties of grain are arranging production contracts with producers. Contract producers benefit from guaranteed prices and can capture significant premiums for harvests that meet pre-arranged quality standards. Also, producers can reduce risk involved in producing grain destined for volatile commodity markets. If the crop fails to meet standards, the contract is voided and the crop is sold to commodity or feed markets.

Reduced price volatility, higher margins and steady demand are attracting a growing number of farmers into contract production. The trend in farming to target niche markets has driven the steady expansion of contract production throughout the 1990s. Figure 3 illustrates that this trend is expected to continue, with some estimates of the amount of acreage under contract production in the United States doubling over the next 10 years.

The rise of contract farming is a function of evolving market conditions. New value chains require a high degree of product specificity and segregation. The identity of the grain produced for specialty markets must be fully preserved, otherwise its added value is lost. Grain blending in the primary elevator system and the pooling of grain in the transportation system have hindered the development of these new chains in Canada (McKinsey & Company, 1998).
3.3 Decommissioning of Central Buying Agencies

International grain importing functions have shifted from large central buying agencies, to smaller more numerous independent buyers. Until recently, the Canadian Wheat Board (CWB) had a stable customer base of 50 state buying agencies that imported large bulk orders. Currently, the customer base is 300 buyers in 100 countries. This change is displayed in Figure 4, which illustrates the shift in buyer patterns. It is also worth noting that these decentralized private importers have much less purchasing power than the state treasuries that they replace.

Ten years ago China and the USSR were purchasing over 10 million tonnes of wheat annually from Canada (nearly 50 per cent of CWB annual wheat sales). In 1999, Canadian wheat exports to China and the former Soviet Union totalled 220,000 tonnes, less than 1 per cent of CWB sales for that year. Today the Canadian grain industry relies on a more diversified customer base, demanding quality-differentiated products as opposed to bulk commodities (Arason, 2000).

Smaller international grain purchasers are encountering the same supply constraints as food processors. They cannot afford to tie up limited capital resources in large
inventories of bulk grain or to invest in storage facilities. Moreover, they are requesting more frequent delivery of specific varieties of grain. Figure 5 shows Canadian wheat exports by shipment size for the 1994/95 to 1998/99 crop years. Shipments under 20,000 tonnes now account for approximately eighty percent of sales, with shipments under 10,000 tonnes accounting for approximately fifty percent of sales.

![Figure 4. Percent of Canadian Grain Purchases by Central versus Private Buyers, 1990-96 (Source: McKinsey)](image)

Previously government controlled central buying agencies purchased and stored grain on behalf of national millers and processors, in consignments of 30,000 tonnes or more. Processors within a nation were required to purchase their grain from the central agency. Now, these individual companies must fend for themselves on world markets. In some cases, smaller buyers within a nation are forming buying associations, or utilizing the services of freight forwarders to consolidate and co-ordinate shipments, thereby lowering transport costs.
A typical case might involve four buyers chartering a 40,000-tonne bulk vessel to transport four 10,000-tonne consignments. This practice is becoming more common in grain transport. However, several industry sources have stated that this method of “grocery boat” operation involves higher material handling costs to prepare the vessel and reduce the potential for contamination. This method of grain transport is not well suited for transporting GMOs and non-GMOs in the same hold. Under the rules set out in the Montreal Biosafety Protocol\(^4\), an entire shipload of grain could be rejected on the protest of one buyer.

The demand for smaller consignments of IP grains is “de-commoditizing” the grain system. At the elevator level, de-commoditization of grain increases material handling and reduces effective storage capacity. As grain becomes increasingly segregated, more time is spent purging equipment between shipments to reduce the risk of contamination.

\(^4\) In January 2000, representatives from 133 countries reached an agreement governing the international trade of GMOs. It has become known as the Montreal Biosafety Protocol. A section in the Protocol contains the “precautionary principle” and allows importing countries to reject imports of GMOs that are deemed to be potentially dangerous – even if no scientific basis for the claim exists.
contamination. The need to segregate GMO crops from standard varieties will accentuate congestion problems.

4.0 Changes in the Supply Side of Grain Handling

Figure 6 illustrates the equipment used to move grain from farm to ocean vessel in the bulk system. Identity preservation in the bulk system ends when grain is moved from small farm storage bins to primary elevators. Once a farmer’s delivery is commingled with other producer deliveries at the primary elevators, the grain becomes a generic commodity. When sufficient quantities of the desired class of grain are amassed, a unit train carries the product to portside terminal elevators. At the terminals, final blending and cleaning take place to meet minimum grading specifications.

Figure 6: Flow Map of Bulk Grain System

By the time grain in the Canadian bulk system is loaded to an ocean vessel, variances in product quality due to geography and weather have been pooled to generate a final product with uniform characteristics and performance. The physical blending and mixing of grain from across the Canadian prairies is a marketing asset to the extent that variations between shiploads exhibit little difference. In conjunction with a strict variety licensing system that has narrowed grain attribute differences, Canadian grain has a reputation for product quality reliability that is well established.

Grain companies in Western Canada have constructed High Throughput Elevators (HTE’s) to capture economies of size. Table 1 shows that between 1992 and 2001, 58
percent of the grain elevators on the Prairies were closed. During the same period, storage capacity declined only 11 percent because the new elevators are much larger. About 130 of the 621 elevators have storage space of 8,000 tonnes or more, with 76 of the 130 at 20,000 tonnes or greater. The latter accounts for 1.52 million tonnes, or 25 percent of all space. Of the 25 to 27 million tonnes of grain exported annually, HTE’s handle 45 percent of the total.

<table>
<thead>
<tr>
<th>Crop Year</th>
<th>Alberta Number</th>
<th>Capacity Tonnes</th>
<th>Tonnes/Elevator</th>
<th>Saskatchewan Number</th>
<th>Capacity Tonnes</th>
<th>Tonnes/Elevator</th>
<th>Manitoba Number</th>
<th>Capacity Tonnes</th>
<th>Tonnes/Elevator</th>
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<tr>
<td>1992/93</td>
<td>452</td>
<td>2,386,890</td>
<td>5,281</td>
<td>779</td>
<td>3,351,850</td>
<td>4,303</td>
<td>256</td>
<td>1,086,480</td>
<td>4,244</td>
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<td>1996/97</td>
<td>317</td>
<td>1,870,010</td>
<td>5,899</td>
<td>656</td>
<td>3,545,040</td>
<td>5,404</td>
<td>220</td>
<td>1,040,270</td>
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<tr>
<td>1999/00</td>
<td>239</td>
<td>2,072,460</td>
<td>8,671</td>
<td>526</td>
<td>3,712,090</td>
<td>7,057</td>
<td>205</td>
<td>1,150,950</td>
<td>5,614</td>
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<tr>
<td>2000/01</td>
<td>154</td>
<td>1,789,960</td>
<td>11,623</td>
<td>302</td>
<td>3,032,660</td>
<td>10,042</td>
<td>165</td>
<td>1,240,000</td>
<td>7,515</td>
</tr>
<tr>
<td>Change</td>
<td>-65.9%</td>
<td>-25.0%</td>
<td>+120.1%</td>
<td>-61.2%</td>
<td>-9.5%</td>
<td>+133.4%</td>
<td>-35.5%</td>
<td>+14.1%</td>
<td>+77.1%</td>
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HTEs are built to capture economies of scale and can thus accommodate 75 to 100-car unit trains. This may present a problem for the consistency of Canadian wheat exports. With HTE-unit train movements, the origins of individual shiploads are likely to be more concentrated leading to wide variations of average quality from shipload to shipload. Table 2 shows CWRS wheat attributes from the 1997 to 1999 crop years. Under the present system, by the time grain reaches port terminals, the product possesses the weighted average values from all growing regions based on production volume. There is less than 10 percent variance by attribute in the three year span, with the exception of the Canadian Short Process (CSP) being low for 1998. Within each region, variability is greater. Protein content alone ranges from a low of 12.6 percent to a high of 14.8 percent.

Variability in the quality aspects of export shipments because of HTE’s removes one of the important arguments for bulk shipping. Inter-regional blending to amass a composite load adds additional logistics costs.
Table 2: CWRS Wheat Characteristics in Three Crop Years

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
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<td></td>
<td>14.8</td>
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<td>Protein %</td>
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<td>75.2</td>
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<td>74.8</td>
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<td>64.5</td>
<td>64.4</td>
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<td>Water Abspn. %</td>
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<td>8.5</td>
<td>11.0</td>
<td>9.0</td>
<td>8.0</td>
<td>9.5</td>
<td>11.5</td>
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<td>Stability Time (Max.)</td>
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<td>9.6</td>
<td>10.0</td>
<td>10.9</td>
<td>11.1</td>
<td>10.8</td>
<td>10.1</td>
<td>11.6</td>
<td>9.9</td>
<td>10.4</td>
<td>10.5</td>
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<tr>
<td>CSP Mix. Time Min.</td>
<td>14.8</td>
<td>11.5</td>
<td>13.8</td>
<td>10.0</td>
<td>10.0</td>
<td>8.5</td>
<td>10.8</td>
<td>8.8</td>
<td>11.1</td>
<td>9.6</td>
<td>10.9</td>
</tr>
</tbody>
</table>


4.1 Changes in Grain Segregation

The bulk handling system in Canada relies on a Kernel Visual Distinguishability (KVD) grading system. The KVD system helps produce consistent results in grain shipments on an annual basis despite a capacious environment that affects quality and grade characteristics.

The Canadian grading system has seven classes with assigned seed-coat colour and physical kernel attributes that are distinctive to each class. The differences are great enough for inspectors to readily distinguish each class. The visual separation assures both inspection expediency and consistent end use quality.

A wheat variety within a class must have minimum quality and performance characteristics. The link between kernel shape and quality is unequivocal. Before a variety can be registered in Canada it must undergo scrutiny for end use quality, agronomic performance and disease resistance, and be proven equal (or better) than
the reference variety for the class. A new variety that looks like a Canadian Western Red Spring (CWRS) wheat must possess the same performance and end-use attributes (flour yield, protein content, gluten properties, etc.) or it will not be registered. The strict quality requirements inherent in this system impede the introduction of new varieties. Seven wheat varieties are responsible for 80 percent of the 15 to 20 million tonnes of CWRS grown annually in Western Canada.

With such an effective and simple means of quality assurance, the question is raised, why change it? The prominent factors forcing replacement of the KVD system are:

1) the demand by some customers to purchase on specific variety factors;
2) the imminent arrival of transgenic (GMO) wheat varieties;
3) private plant breeding interests; and
4) the potential to create additional wheat classes with GMO varieties (e.g., hard white wheats).

Agronomic and quality criteria are compromised by KVD as plant breeding technology advances\(^5\). Even with genetic alteration, it is difficult to introduce agronomic and quality traits that currently exist in specified kernel traits. The Canadian grain industry has accepted that change is inevitable in light of competition from other countries that are developing transgenetic varieties. The challenge is to re-configure the present system from a logistics, grading and quality control perspective while retaining buyer confidence in Canada.

The CWB stated that the extent of consumer opposition to biotech crops warranted a moratorium on the introduction of GMO wheat and barley varieties until an efficient system of segregation and safety protocols are in place (DNS, 08/05/00 and Arason June 14, 2001). Channelling GMO and non-GMO grains through a common bulk system would require stringent controls to prevent contamination.

A standardized testing, verification and documentation procedure accepted worldwide must be economical and efficient. Prolonged segregation awaiting test results would

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\(^5\) The KVD system has been criticized for the loss of opportunity that the narrow gene bank imposes on farmers in Western Canada (Carter and Loyns, 1996).
impose significant costs on the Canadian grain industry. Current detection methods, which rely on DNA, chemical or enzyme testing for verification of a consignment, are still prohibitively expensive to deploy widely. In Europe, Deutsche Banc projected that between 1999 and 2003, the revenues earned from the testing and diagnostics of GMO and non-GMO grain could reach nearly US$1 billion (Papanikolaw, 2000).

In addition to developing standardized tolerance levels and agreeing upon testing methods, testing location must be addressed. Ideally, testing should take place at every point of transfer along the entire supply chain with documentation following each leg of the shipment. Testing in the bulk system could be required at the farm, elevators, export and import terminals, and at the end user’s location (Papinikolaw, 2000).

Flaten and Seguin (2000) suggest a method of affidavits and non-visual quality control checkpoints in the bulk system as a means of maintaining integrity. Current methods of variety identification are Polyacrylamide Gel Electrophoresis (PAGE) and High-Performance Liquid Chromatography (HPLC). PAGE is the test most commonly used but is slow, expensive, and not widely available. Moreover, PAGE cannot distinguish all varieties. While the actual PAGE test takes less than 24 hours to complete, the samples must be prepared and forwarded to a central laboratory. The test is expensive, costing about $155 for only 30 kernels of wheat.

The cost and deficiencies of using the current PAGE technology to maintain an affidavit system is demonstrated in the following example. Assume that a 25,000 tonne shipment is tested and found to contain excessive amounts of undesirable varieties. The first problem is that the test results would be obtained after the vessel has sailed. The alternatives would be to divert the load to another customer willing to accept the shipment (in the case of the original buyer rejecting the load), or negotiate with the buyer to accept a price reduction or new consignment.

The second problem is tracing the contaminant back to the source. A 25,000 tonne shipment is equivalent to 280 railcars. Testing each car to a 90 percent confidence level with the PAGE method would cost $43,000. This would track the contaminant
back to the primary elevator. Further testing would be required to determine the bins or truckloads that were the primary source. As the damages from contamination could result in the millions of dollars, all parties in the supply chain (elevators, marketers, farmers) would want to hold the source responsible. Proving that an individual knowingly compromised the grain supply chain by submitting an adventitious load would be difficult in a court of law without “hard” evidence.

The need for a Widely Available, Foolproof, Inexpensive, Rapid (WAFIR) method of non-visual quality control in the system is apparent. Automated Quality Testing (AQT) is an ongoing research project established by the Canadian Grain Commission (CGC), CWB, Agriculture and Agri-Food Canada and other players in the grain industry to develop non-visual technologies to replace KVD for identification, safety and end use functionality.

WAFIR technology may even have limited value at the primary elevator. If an elevator manager was able to identify a GMO variety at the time of delivery, the grain would have to be rejected, or stored until its disposition was determined. This would tie up valuable storage space in elevators and would encourage elevator managers to attempt to blend it off (in the face of a random check and penalties). The alternative would be to send the rejected load back to the farm which would please neither producer, nor elevator manager. The alternative is to channel GMO grains and other IP grains into containers such that the bulk system is not challenged to provide guarantees that are economically prohibitive.  

5.0 Economics of Bulk Versus Containerized Transport

The concept of a mixed logistics strategy is based on the economics of specialization. Bulk and container transport systems each have advantages applicable to specialized logistics scenarios. A single system cannot provide peak performance with divergent

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6 A second related issue that is emerging is concern over the threat of international sabotage. In the wake of terrorist attacks, methods to secure covered rail hopper cars during transit are being discussed. Such measures would add time and complication to both loading and unloading. Bulk shipping is vulnerable of course because contamination of one rail car could affect an entire shipload of grain. In contrast, containers are routinely sealed and are only mixed at final destination. In terms of security, containers are far more attractive than bulk shipping.
customer requirements - or one size does not fit all. Directing shipments into the most applicable logistics channel improves overall system performance and lowers total cost.

5.1 Economics of the General Bulk System

Bulk systems have a lower value to weight and/or volume ratio than manufactured goods. As a result logistics costs are a greater proportion of the selling price for bulk goods, which means that these industries favour large scale, automated systems that minimize labour inputs. A typical bulk supply chain is depicted in Figure 7. The size of the parcel in which a bulk commodity is shipped represents a trade-off between the economies of vessel size, routing (including transhipping) and the cost of holding inventory.

Bulk commodities have most of the following attributes:

1. they use pipeline, conveyor belt or pneumatic material handling systems for loading and unloading;
2. they are handled in sufficiently large quantities to utilize full vehicles (rail car, barge or ocean vessel);
3. they have a relatively low value to weight (or volume) ratio;
4. they suffer minimal damage in mechanical handling; and
5. they are generally fungible commodities with few grades or segregations.
A bulk commodity moves through the system in discrete parcels with stockpiles at transfer points. Stockpiles are required to buffer differences in consumption and production rates because the capacity and service frequency of transport modes often differ. For example, a large ocean vessel could require ten trainloads of product to fill its holds. Delays due to weather for ships could easily exceed 24 hours, while trains are seldom blocked by weather. Inventories at transfer points are necessary, but impose time and cost penalties on bulk transport systems.

The costs of bulk systems may be reduced in one of four ways:

1. reduce the number of transfer points;
2. integrate the elements of the transport chain;
3. reduce the requirement for buffer stocks; and/or
4. introduce further mechanization.

Almost all these opportunities for cost reductions require the owners to seek investments that experience economies of size with the attendant increase in fixed costs. Economies of size requires the use of the largest transport vehicles possible to obtain the lowest per unit costs. As a mature industry, bulk handling has exhausted most of the gains from economies of size. An example in sea transport is the employment of “Capesize” ships that range between 75,000 to 300,000 Dead Weight Tonnes (DWT). These large ships are restricted to deep water ports and open sea lanes. “Panamax” ships in the range of 50,000 to 75,000 DWT are the largest vessels that can navigate the Panama Canal. “HandyMax” ships in the range of 10,000 to 50,000 DWT are used in circumstances where parcel size or port draft restrictions rule out the use of larger vessels, such as the St. Lawrence Seaway.

Evidence suggests that bulk trades have reached maximum physical and system capacity. The closing of the Suez Canal in the 1950’s prompted the increase in ship size, which reached its peak in the mid-1980’s. Ultra-Large-Crude-Carriers (ULCC) of over 500,000 DWT category have not been built since the 1970’s. The modern oil tanker averages 300,000 DWT. The largest dry bulk carrier is the 260,000 DWT
Hyundai Giant, built in 1985. New bulk carriers are typically around 200,000 DWT. Similarly, the largest ore carrier, the 365,000 DWT Berge Stahl, was built in 1986. Few ore ships have been built since, but all are under 300,000 DWT.

Vessels built for a particular commodity are subject to the vagaries of the product’s market. Operational variations due to weather and human failure (e.g., port strikes) are expensive and the least controllable elements of a supply chain. The dedicated nature of bulk systems makes it difficult to re-route shipments in the event of such disturbances. When the OPEC nations curtailed petroleum production in 1973, idle vessels resulted in substantial losses to owners.

Refining the coordination between links in a supply chain reduces uncertainty, and the size of buffer stocks. Improved communications such as GPS, internet tracking and computerized scheduling have combined to compress lead times in supply chains, but cannot reduce all uncertainties. Events such as weather and accidents will preserve the need for some stockpiles.

A further economic problem for large specialized ships is the inability to find balanced traffic lanes. The more specialized the vehicle, the greater the probability of empty return. Efforts to obtain economies of size in one logistical function generally require improvements in other areas of the supply chain. Higher productivity material handling is needed to reduce the port dwell time of larger vessels to an acceptable demurrage grace period. Port investments have also exhausted the economies of size in bulk loading systems and some locations are now experiencing chronic over capacity.8

The number of transfer points in a bulk supply chain affects the cost of storage facilities, inventory holding costs and product damage (from re-handling). “Direct hits” from trains to ship can reduce costs of transfer inventories, but require either a short haul to the port or investment in rail cars as temporary storage (warehouses on wheels). In addition, direct hits require precise timing and well coordinated supply chains. Offsetting

7 The navigation from Montreal to Lake Erie is restricted to ships of less than 30,000 DWT.
8 The terminal grain elevators at Thunder Bay, Ontario have capacity that far exceeds the actual throughput.
the inventory cost savings of direct hits, the high fixed costs of grain terminals mean that they price their services to maximize throughput.

5.2 The Container Revolution – Challenger to the Bulk System

Container shipping is based on standard-sized 20 and 40 foot length steel boxes. Due to their uniformity, containers can be handled mechanically and moved expeditiously with standardized equipment and procedures. The construction of cellular container ships specifically designed for high-volume container movement permitted economies of scale that previously were only available to homogeneous freight such as bulk commodities.

Table 3 shows the evolution of container ships compared to bulk vessel equivalents. The size of container ships lags approximately twenty years behind bulk vessels, but the increase in containership size has accelerated during the past five years. Four Maersk “S” class vessels now ply the oceans with orders for larger ships under negotiation as of 2001, and the Malacca Max class under study (Winjolst et al.). The post-panamax container ships are larger (lower operating costs) then the majority of the bulk ships used to carry grain.

<table>
<thead>
<tr>
<th>Shipping</th>
<th>Delivery</th>
<th>TEU’s</th>
<th>Category</th>
<th>Approx. DWT</th>
<th>Bulk Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCL</td>
<td>1972</td>
<td>3,000</td>
<td>All Ocean</td>
<td>37,500</td>
<td>Handy Max (&lt;50,000 DWT)</td>
</tr>
<tr>
<td>USL</td>
<td>1984</td>
<td>4,300</td>
<td>Panamax</td>
<td>53,760</td>
<td>Panamax (&lt;75,000 DWT)</td>
</tr>
<tr>
<td>NYK</td>
<td>1994</td>
<td>4,743</td>
<td>Panamax</td>
<td>59,288</td>
<td>Panamax (&lt;75,000 DWT)</td>
</tr>
<tr>
<td>Maersk - K</td>
<td>1996</td>
<td>6,600</td>
<td>Post Panamax</td>
<td>82,500</td>
<td>Capesize (&lt;100,000 DWT)</td>
</tr>
<tr>
<td>Maersk - S</td>
<td>2000</td>
<td>8,400</td>
<td>Super Post</td>
<td>106,000</td>
<td>Capesize + (&lt;150,000 DWT)</td>
</tr>
<tr>
<td>P&amp;O</td>
<td>?</td>
<td>10,000</td>
<td>Super Post</td>
<td>134,800</td>
<td>Capesize + (&lt;150,000 DWT)</td>
</tr>
<tr>
<td>Under Development</td>
<td>11,989</td>
<td>Suez Max</td>
<td>157,935</td>
<td>Capesize ++ (&lt;200,000)</td>
<td></td>
</tr>
<tr>
<td>Under Development</td>
<td>14,000</td>
<td>Suez Max</td>
<td>189,000</td>
<td>Capesize ++ (&lt;200,000)</td>
<td></td>
</tr>
<tr>
<td>Theoretical Studies</td>
<td>18,000</td>
<td>Malacca Max</td>
<td>243,600</td>
<td>VLCC (&lt;250,000 DWT)</td>
<td></td>
</tr>
</tbody>
</table>

Container ships are classified in terms of the number of twenty-foot equivalent units (TEUs) they carry. Sixty percent of containerships commissioned between 1999 and 2001 have capacities of 4,000 TEUs or more, with 20 percent of world container slot capacity resting in ships of 4,000 TEUs or greater (Baird, 1999). Consolidation of international container shipping lines resulting from alliances, mergers and acquisitions has coincided with the trend towards larger vessels. Considerable fleet replacement is impending as older and slower ships are decommissioned.

Many carriers are cutting rates to fill large containerships. The tariffs on some goods have dropped by 50 percent in the last 15 years. Lower valued products such as unsawn logs, waste paper and crushed glass for recycling are a common backhaul in containers. As ship size increases, traffic growth will be derived from new markets, break bulk and commodity trades. For some goods, container and bulk rates have coalesced, with container carriers accused of “poaching” freight from the bulk fleets (Fairplay, 1999). Figure 8 shows the correlation between world slot capacity, container rates and traffic growth. Increasing ship size creates a virtuous cycle of lower rates and greater availability, but also drives the ship owners to search for more cargoes to fill their capacity. Forecasts predict a doubling of world container traffic by the year 2010.

Figure 8: Growth in Global Container Traffic versus World Slot Capacity and Rates (Source: IICL Fleet Surveys)

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9 A 20 foot container is one TEU; a 40 foot long container is counted as two TEUs.
10 An American shipper recently negotiated with a Far Eastern (India) paper producer to accept 180,000 tonnes of shredded cardboard in containers.
Figure 9 details the costs per TEU per day for different ship sizes. Container mega-ships are faster and more cost effective than their older counterparts. Designers are developing hulls that reduce drag, increase speed and reduce fuel consumption. The Malacca Max ship offers an “at sea” per slot cost of approximately 40 percent of the current Panamax class vessel.

<table>
<thead>
<tr>
<th>Vessel Size (TEU's)</th>
<th>Slot Cost (USD$/TEU-Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panamax</td>
<td>$11</td>
</tr>
<tr>
<td>Post Panamax</td>
<td>$10</td>
</tr>
<tr>
<td>Super Post Panamax</td>
<td>$9</td>
</tr>
<tr>
<td>Suez Max</td>
<td>$8</td>
</tr>
<tr>
<td>Malacca Max</td>
<td>$7</td>
</tr>
</tbody>
</table>

Figure 9. Containership Size vs Cost per TEU-Day
Source: Winjolst et al., 2000

The cost at sea per TEU decreases as ship size increases, but the efficiency of a vessel depends on the total time the ship takes to complete a round trip (Winjolst et al., 2001). It is the total supply chain, including hinterland and port container handling - in addition to vessel cost - that determines the overall cost. The benefits of larger and faster container vessels can be offset by port diseconomies that increase with size. Deep-water ports are investing in new technology to process larger vessels in anticipation of becoming “super hubs” and by extension the presumed economic activity they generate.

The pressure to accommodate larger ships has focused attention on channel depth and width, and crane reach and speed. Deltaport at Vancouver, which can handle two post-panamax vessels simultaneously, has a depth of 15.85 meters. The Suez and Malacca
Max vessels will require dredging to accommodate a draught of 21 meters. Current generation ships have an average deck width of 13 rows of containers. The new generation of ships will be 24 rows wide. The port of Halifax recently purchased two gantry cranes at CDN$10 million each to handle the new generation ships, but will require further investment for wider vessels.

Terminal operators (or stevedores) are adopting innovative technologies to handle containers faster. Port of Amsterdam is completing construction of a “U” shaped berth at the Ceres Terminal shown in Figure 10 that will load/discharge a vessel from two sides at 300 containers per hour; double the rate of traditional berths (World Cargo News, April 1999).

The indented berth features nine computer controlled wide carriage cranes, able to handle the largest container ships. The Ceres Terminals Inc. is developing 680 acres of storage and rail sorting facilities and 12,500 feet of deepwater quay to accommodate the discharge of containers. Shuttle trains will move containers quickly to an off-dock sorting centre to avoid dockside congestion. The Port of Amsterdam’s decision to invest in these facilities is based on the port’s confidence in the future and recognition that traditional bulk and break bulk freight is shifting to containers.

Similar handling technology will be introduced at other ports to compete for the mega-ship traffic. Port Amsterdam has confirmed the move by two carriers to its new Ceres terminal at the expense of Port Rotterdam. The mega containership will also have a major influence on the growth and diversion of inland logistics corridors. All aspects of the logistics system and transportation networks are being recalibrated by the larger
vessel size. Sustained investment by landside service providers in concert with mega-
ship partners will be required to provide an efficient operation.

5.3 Trends in Bulk and Container Freight Rates

The Baltic Panamax Index represents the freight rates for bulk ships that are most
frequently used in grain forwarding. Figure 11 presents these data for the past seven
years. While no pattern is discernable since the sharp drop in 1995, the two main forces
impacting the index are trade volumes and vessel supply.

Figure 11: Baltic Panamax Index: Bulk Shipping Rates
January 1995 to January 2002
(1985=1,000)

Depressed vessel prices have helped keep freight rates low for the bulk shipping
industry. The Korean and Chinese governments heavily subsidize shipyards and
provide incentives to attract ship buyers. The European Community (EU) recently
provided evidence to the World Trade Organization (WTO) claiming that South Korea
was selling ships below cost (Journal of Commerce, April 2002), yet with first quarter profits for 2002 in decline the Korean National Assembly approved another aid package for its shipbuilders (Journal of Commerce, May 2002). The European Union, Japan, South Korea and Norway have agreed to begin negotiations on a treaty aimed to outlaw government aid to shipbuilders (Journal of Commerce, May 2002).

Without subsidies, the bulk shipping fleet will contract, and commodity freight rates will increase to reflect the true value of vessel capital costs. Shippers can either pass on rate increases to the end consumer, or search for alternative forwarding methods, namely containerization.

The direction of containerized trade imbalances favours grains exports from North America to Asia and to Europe. Figure 12 illustrates the magnitude of the imbalance. Westbound to Asia the equivalent of one empty container is returned for every two full containers coming across the Pacific to North America. Eastbound to Europe, empty returns account for approximately 20 percent of all slots on containerships. These numbers could be adjusted by routings to other destinations (e.g. South America), but in general the imbalances determine freight rates.

**Figure 12: Global Container Imbalances**

![Figure 12: Global Container Imbalances](image)

The opportunity and scope for backhaul is the intermodal systems forte. Figure 13 reports container freight rate trends on North America’s major traffic lanes since 1993. The only traffic lanes to hold rates level are the eastbound leg from Asia to the United States (Asia/US EB), and the westbound lane from Europe to the U.S. (Europe/US WB). The rates on the backhaul legs (US/Asia WB and US/EUR EB) have declined by 30 to 40 percent over this nine year period. Some carriers claim that these backhaul rates are below variable cost. Three commodities, wastepaper, hay and scrap metal, are major cargoes in the transpacific trade that have base rates generally below the costs to move an empty container to Asia.

Container carriers are attempting to fix floor rates and add destination surcharges and documentation fees to improve their margins. Transpacific carriers are likely to find it difficult to collect ancillary fee and base rate increases. The continuing glut in capacity encourages shippers to resist additional fees (On-Line Shipper News, October 2001). Shippers in China and Japan have challenged carriers and their alliances in court over
terminal handling charges, documentation fees and general rate increases by conferences (Containerization International News, April 2002).

Prices in the westbound North American-Asian lanes are averaging around US$450 per 20-foot container and are considered to be at or near the variable cost of moving a container in this corridor. Recently, Trans-Pacific rate quotes of US$350 per 20 foot and another for US$260 were reported for “spot” movements. If these containers were loaded with standard milling wheat at 21.5 tonnes per 20 foot container, this would equate to US$12.05 per tonne, or the average price of a Panamax bulk vessel (Kosior, 2002).

The technology of the bulk sector reached maturity over 30 years ago and relatively few cost reducing technological gains remain to be exploited. In contrast, the intermodal container sector is still in a state of rapid growth. Innovative container handling methods are continuing to increase speed and lower costs. The current woes of the liner industry are a result of traffic imbalances and competition from a new generation of larger containerships that are driving down revenues faster than the cost structure of networks can be addressed. Potential for further technological improvements in the liner industry such as robotics, artificial vision and computerized handling make substantial gains to reduce cost relative to bulk shipping more than likely.

6.0 Cost Methodology

A direct comparison between container to bulk logistics requires common starting and ending points. The bulk system is focused on moving a large consignment within a single trip. The container system is “tuned” to the buyers’ processing plant’s weekly production rate. The analysis is based on an identical consumption of grain that originates at a common geographic point, the primary elevator, and ends at the customer’s production line.
Figure 14 illustrates an hypothetical, simplified bulk and container system developed for this study.\textsuperscript{11} For the purpose of direct evaluation, the analysis begins at the intake of the primary elevator for both systems. The primary elevator offers an initial point for pricing, blending, cleaning and a checkpoint for disease and insect control. A second reason for using the primary elevator as a start point is that trucking costs vary on a farm by farm basis, depending upon distance, volume, truck configuration and service used.

The bulk cost estimates are very conservative. The costs are excluded for GMO testing and diagnostics, which could be substantial. Grain is assumed to be derived from a HTE and shipped in a unit train which is the least cost combination for bulk.

For both the bulk and container system, average rail prices are utilized from primary elevators within a 75 kilometre radius of the five major Prairie centres (Calgary, Edmonton, Regina, Saskatoon and Winnipeg). These centers have the main intermodal yards. Cost items along each supply chain are described and aggregated in a system approach.

For an analysis of Eastern corridors, the Port of Montreal is the first choice for containers exiting Canada, although the ports of New York and Halifax are alternatives, depending on the container shipping lines. About 5 percent of Western Canadian container traffic exits through the Port of New York. For bulk shipments the two logistical choices depend on volume and time of year. “Regulated” rail rates apply to the Port of Thunder Bay where Handy Max and laker vessels are loaded.\textsuperscript{12} Unit grain trains can also bypass Thunder Bay and go directly to Montreal, with commercial rates from Thunder Bay to Montreal. Direct rail shipments are common during the Great Lakes winter closure. Additional storage and transfer charges are incurred at the Port of Montreal, or at other elevators on the lower St. Lawrence.

\textsuperscript{11} A more complicated, flexible bulk and container system flow map with inspection points can be found in the appendix.

\textsuperscript{12} Technically, individual freight rates are not regulated, but the railways operate under a “revenue cap” for grain transport to designated ports.
The analysis of the Pacific corridor is more straight-forward. Bulk grain and containers follow the same route exiting through the Port of Vancouver. For the purposes of demonstrating the methodology, only the Pacific traffic lane is examined in detail.
Figure 14: Bulk and Container System Example – Starting at Primary Elevator
6.1 Bulk System Cost Elements and Assumptions

HTE’s with capacities greater than 20,000 MT possess the storage capacity to accumulate sufficient grain for unit train loading. Also, the HTE provides a single point for rail pricing, volume discounts and provide geographic comparisons to the intermodal system. In terms of comparison, the HTE case provides the toughest competition to the containerized grain alternative.

Primary elevator tariffs for common services are filed with the Canadian Grain Commission (CGC) on a provincial basis. All elevator services within a provincial jurisdiction are assessed a tariff regardless of location. However, actual cost by location is dependent upon equipment, volume, age and manufacturer. Tariffs for up to 25 percent of grain exports are based on the tender process adopted by the CWB during the summer of 2000, and can be as low as half of filed figures. Grain company submitted bids are based on geographic supply within vicinities of specific elevators, forwarding procedures, required product conditioning, etc. Examples of primary elevator tariffs are provided in the appendix. The average elevator tariff within a province is utilized for cost comparison for product drawn from a particular province. Although company specific tariffs and discounts for commercial bids can be accommodated in the costing spreadsheets, the average is used in the example.

Terminal elevator tariffs are also filed with the CGC. Each company lists tariffs for their port terminals for services on a facility basis, by port. The actual cost on a per tonne basis is dependent upon anticipated volume throughput, but the example is based on the commercial charges. Examples of terminal elevator tariffs are provided in the appendix.

Railway grain transport rates are regulated by a “revenue cap” and governed under the Canadian Transportation Act. Rail freight rates for grain are provided on a per tonne basis, by commodity type, from licensed elevator points, by province for specific origin-destination pairs. Rail carriers offer incentives on an escalating scale for block movements and can be up to $6 per tonne for submissions of 75 cars or more.
Examples of railway tariffs, which can be found on both CN and CP websites, are listed in the appendix for illustrative purposes.

The Canadian Grain Commission provides inspection, verification and certification services for both domestic and export shipments. In the bulk system, CGC conducts “inward” inspection of railcars at the terminals, and “outward” inspection as the cargo is loaded to vessels. Country inspections can be conducted at HTE’s if there is a “direct hit” involved or sufficient railcars to justify an inspector to travel to the site, otherwise terminals are the funnelling points for the Canadian grain system and cars can be inspected en masse. Basic inspection costs are on a per tonne basis. Ancillary services are priced per car, per job or a quote can be provided if the request is beyond the context of tariffs. Examples of basic CGC services are provided in the appendix.

The CWB does not own infrastructure within the supply chain, but renders considerable influence by its mandate to producers. The marketing and administrative costs of the CWB are reflected in a 5 year rolling average, per tonne basis and is included in both the bulk and intermodal system. At the time of writing this document, the CWB did not indicate if surcharges for either small volumes or containerized grains would be levied. A CWB administrative and marketing cost was assessed at $2.50 per tonne, with the actual levy varying on an annual basis by volume exported.

Bulk ocean rates are market dependent. Rates depend upon vessel availability and type, season, cargo, trade routes, risk and ultimately the demand (what shippers are willing to pay). Rates for comparison purposes can be obtained via websites, but vessel brokers can provide a comprehensive rate. Numerous ancillary fees are bundled with the vessel costs depending on the responsibilities born by the charterer or vessel owner. Generally, the vessel owner prepares a rate based on the origin and destination port distances, but includes harbour, piloting and other ship related charges to move the vessel in and out of ports. The charterer is responsible for dockside related charges while the vessel is moored at berth. Charterer’s insurance is the only cost associated with vessel movement for which the vessel owner does not bear responsibility. This charge is to cover items such as potential damage to a berth from the vessel. The
charterer books the vessel into the port, and must accept responsibility for any damages. A table of Trans-Pacific vessel charges is provided in the appendix for the summer of 2001.

Bulk ancillary charges consist of pipeline related holding and administrative charges. The CWB interest rate for holding stocks in storage or while in rail transit is based on the Canadian government loan rate. Buyers’ interest rates for pipeline holding costs are based on their negotiation with a financial institution. These two interest rates are independent. Holding costs are based on the days in pipeline for each of the suppliers or buyers on a straight line basis.

6.2 Container (Intermodal) Supply Chain Costs

The container system has similarities to the bulk system in terms of the shipment forwarding sequence, but employs different technology. An inspection point is eliminated at bulk port terminals and storage charges are virtually non-existent. Food security is enhanced by having the cargo in a sealed container.

The paucity of intermodal yards in Western Canada raises costs for shippers. Unlike bulk shipping that has loading at over 621 licensed elevators, only five points have intermodal yards. Unless container loading takes place within the confines of rail intermodal yards, an additional truck trip is incurred from a licensed elevator point (that fills containers) to container terminals. Railways are reluctant to allow shippers to place containers onto intermodal cars, citing safety and loading protocol.

Inspection of grain can be done at the licensed elevator, drawing from the product stream as it enters the container. The alternative method is a probe sample at the intermodal yard. Either method requires travel to the site by an inspector from the CGC or a private firm such as SGS Inc. The alternative method is likely less expensive because an inspectors travel time can be greatly reduced. Probe sampling is used with

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13 This analysis uses a conservative interest rate estimate of 5 percent. In many developing countries, interest rates can be as high as 20-25 percent, making inventory-carrying costs significantly higher in these markets.
hopper cars, but only occasionally with containers. Risk of injury to personnel accessing the rear of a container with a conventional wooden bulkhead is cited as the reason.

In this example, verification of the load is by submitted sample. The sale is “FOB primary elevator,” which becomes the responsibility of the Canadian grain supplier (as per the CWB “producer direct” sales program). The commercial grain supplier assumes the risk for product integrity as well. Grain inspection costs for the bulk system is used as a proxy for inspection costs in the container system because this provides consistency on a per tonne basis.

Container loading is conducted at designated elevators within the vicinity of major urban centres. Grain companies that specialize in organic grain have dedicated elevators for the purpose of maintaining product consistency, quality control and a common pricing point. Primary elevator tariffs are used in the exercise as a proxy for storage and elevation only.

Like rail hopper cars, containers can be loaded using a spout. However, the spout must be retrofitted with an elongated “nose” to reach the rear of the container, otherwise product will bridge at the doors of the container. The truck can move forward as the container is loading to provide a uniform load. A level load within the container is desirable to ensure even weight distribution when moving containers onto vessels and to observe highway truck axle weight laws.

Container pricing is done on a “terminal to terminal” basis with a single rate, usually specified in U.S. currency. The price is effective from the nearest intermodal terminal specified by the shipper to the consignee’s specified port. All inland costs, lift charges, port charges, administrative and ancillary fees are included. Additional charges consist of shipper specified insurance and fuel surcharges. Fuel prices have fluctuated greatly in the past few years prompting carriers worldwide to add a surcharge on transport rates that fluctuate with fuel costs.
In the container system, the buyer can assume responsibility of the shipment at any point along the supply chain, but the most prevalent is at the dock at the consignee’s port (CIF). In bulk shipments, the most common ownership transfer point is the shippers port (FOB vessel). At this point, all subsequent charges reside under the buyers account.

Ancillary costs consist of interest charges and administrative fees for each of the “players” accounts, namely the CWB, Canadian grain company and buyer respectively. Each will be applied to the pertinent pipeline segment.

7.0 Bulk versus Container Supply Chain Cost Comparison

Cost impacts to the buyer vary with increases in size of consignments and factory production rates. The objective is to find the circumstances where bulk or container grain forwarding are the best option from the buyer’s perspective. A spreadsheet approach considers cost elements for bulk and container systems and accumulates the costs as the shipment progresses through the supply chain until the product enters the production process.

A Pacific trade corridor example is used for demonstration of the spreadsheet analyzer. A full range of other corridors must be explored to assess the sensitivity and interaction of variables because no single element dominates a supply chain cost structure. The spreadsheet analyzer is a theoretical tool that must be verified by real world trials. Although contacts were made with foreign buyers who were interested in participating in trial shipments, efforts to engage the Canadian Wheat Board and grain companies to conduct such trials failed to produce results.

7.1 Model Assumptions

The commodity used in the example for comparison between bulk and container supply chains is CWRS1 wheat (CWB grain) shipped from Western Canada to Asia. The comparisons are done in a two step process. The first scenario considers buyers with plant consumption rates of 100 to 800 metric tonnes per day, and bulk consignment
receipts of 5,000 to 50,000 metric tonnes. The second scenario involves a consortia of buyers chartering a single hold bulk vessel with separation layering, or a “grocery boat” operation. There are 24 cost alternatives based on bulk shipment options and plant milling capacities. Table 4 presents the single buyer comparison for four plant sizes and six bulk shipping sizes. Alternatively, this demand could be served with four container volumes.

<table>
<thead>
<tr>
<th>Shipment Size (MT)</th>
<th>Buyer’s Plant Consumption (MT/Day)</th>
<th>24 Cost Alternatives (Bulk)</th>
<th>4 Cost Alternatives (Container)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000</td>
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<td>10,000</td>
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<tr>
<td>50,000</td>
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</tbody>
</table>

Notes: The 24 cost scenarios for bulk are based on the six bulk categories coupled with the four plant capacities. For the container system, the supply chain is established based on the plant capacities only.

The costing differences for bulk arise from economies of scale for transport and from the effects on holding and storage costs from alternative shipment sizes. Each consignment is calculated to arrive at the per tonne cost.

For the bulk system, consignments of 20,000 MT or less should not significantly increase primary or terminal elevator storage time because of sufficient handling capacity. Storage days are assumed to be approximately 10 to 15 days. It is further assumed that shipments of specific varieties can be drawn from a single locale served by a 20,000 tonne capacity HTE. This represents two unit trains at 10,000 tonnes each. Technically speaking, the geographic distribution of crops makes this difficult, but does represent the ideal scenario for bulk grain handling.
A shipment size of 30,000 MT or more may be difficult to draw from a single locale. In this case, a train run from another location could be required to minimize time in storage at primary and terminal elevators. Storage days required to co-ordinate train runs are estimated to be 15 to 22 days. As bulk shipments increase in size, the spreadsheet model applies the appropriate “block” discount for rail rates, based on car submission increments of 25 or more cars. The block discount rate is adjusted on a per tonne basis.

No special services are added (de-stoning, drying, IP, special blending, etc.) for either container or bulk costing alternatives. The comparisons are based solely upon the logistics and “out-of-pocket costs” to move product from supplier to buyer.

Each bulk shipment size category has a distinct price resulting from inventory holding and storage costs. The container system has only four cost levels, based on plant milling capacities and customer preferred safety stock levels (in case of intermodal system disruptions). The container system is established in a manner to coincide with weekly processing plant consumption and vessel schedules. In essence, it performs in a Just-In-Time (JIT) fashion, with new stock arriving on scheduled vessels. Bulk inventory is held in the container supply chain at the primary elevator for blending, and at the customer’s plant for safety stocks. The safety stock is preset according to the customer’s “comfort” level depending on possible container delivery disruptions. Three weeks of container safety stock was assumed for this study, but can be adjusted in the model. Three weeks provides enough time for the buyer and shipper to divert containers in the pipeline to alternative channels.

Sufficient container availability in Western Canada is assumed for an Asian plant capacity of up to 200 metric tonnes per day (70 containers weekly). Beyond this volume, it may be necessary to supplement the carrier fleet with “lessor” boxes from Toronto or Chicago at a repositioning rate of US$350 each per TEU.

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14 The safety stock is the volume of product needed to maintain plant production during supply chain disruption while corrective action is taken by the supplier and buyer.
While containers are capable of being loaded directly on the farm, the issue of grain uniformity and quality control cannot be readily addressed. Unless the buyers milling and/or baking process can achieve the desired end product specifications from pre-selected container inventories at the farm level, then blending/cleaning will be required at a primary elevator. In this study, comparisons between the container and bulk systems begin at the primary elevator load out spout. It is assumed that sufficient bulk ships and container slot availability exist.

A 50,000 metric tonne single-hold vessel is used as the base case to compare a “grocery boat” operation to containers. While this provides the lowest cost for both inland rail and ocean line-haul rates, additional costs are incurred from layer separation, material disposal and increased liability from possible contamination between layers during unloading. It is assumed that there are no claims resulting from this grocery boat shipment and layers remain intact.

The grocery boat comparison is structured to emulate the consignment increments (on a per buyer basis) within the confines of maximizing rate benefits of a fully loaded bulk vessel. That is to say, for the first grocery boat comparison, there are 10 buyers of 5,000 MT each, in the second there are 5 buyers at 10,000 MT each, in the third there are three buyers of 16,667 MT and the final scenario is 2 buyers at 25,000 MT each. In all cases, the combined layers amount to 50,000 metric tonnes, all traveling to a single port with single berth discharge.

It is assumed that all the product requirements for the grocery boat operation can be supplied at a single berth.\textsuperscript{15} In each case, the number of separation layers is \((N-1)\), where \(N\) is the number of buyers. All these assumptions result in the lowest estimated cost.

In this study, all assumptions are based on the objective to derive the lowest possible cost to the bulk system. Specifying a single HTE as an inland sourcing point, to a single terminal elevator in Vancouver, to a single berth for unloading in Asia minimizes

\textsuperscript{15} While this is not typical, it simplifies our example.
ancillary costs, although it may not be typical industry practice. Ancillary costs on an individual basis are not overly significant, but its cumulative effect can be substantial.

Prices used for the container system analysis were quoted by a freight forwarder and are for terminal to terminal movements. Actual P&D charges are used in calculations for both supplier and buyer portions of the supply chain. In a commercial situation, low volume movements (less than 5 containers per week) do not usually garner a contract volume discount from freight forwarder-quoted prices. If the annual traffic flow provides more than 10 containers weekly, it becomes useful to carriers for balancing containers between regions. A carrier would therefore wish to “lock in” the customer with contracted incentive discounts. Incentives can range from 5 to 10 percent in normal situations, with up to 20 percent in some circumstances. A conservative approach was used in this example, with 5 to 10 percent applied to larger container movements.

7.2 Model Output - Container versus Bulk Delivery, Single Buyer Comparisons

Figure 15 shows that for a plant consumption rate of 100 metric tonnes per day, the container system appears to be better suited than bulk delivery. For consignments of 10,000 bulk metric tonnes or less, transport costs become a significant component of the final price of the product.

The ocean rate for a 5,000 tonne consignment is US$28/MT and US$24.50/MT for a 10,000 tonne consignment. Parcel carriers are loath to commit to a single 5,000 tonne shipment, since they must seek similar shipments to fill a vessel to the same destination. Some carriers will impose a minimum 10,000 tonne submission before providing a rate. A consignment of 10,000 metric tonnes represents almost half a small vessel load and is thus more palatable to carriers. This is a driving force behind the rise in buyer’s consortia’s.

For a factory consumption rate of 100 metric tonnes per day, the container delivery system has a per tonne flat cost of US$195.79, because container delivery is “tuned” to the plants consumption rate. The lowest cost in the bulk system is US$197.60 per
tonne for a consignment of 10,000 tonnes. For all intents and purposes, at this point the two systems are nearly equal from a cost perspective.

Canadian rail discount rates for a single unit train length are realized in the 10,000 metric tonne shipment size category. Block rates for 25 or more cars (representing 2,500 tonnes or more) begin at CDN$2.00 per tonne and rise to CDN$6.00 per tonne for 100 car submissions. For 100 car submissions this translates to a discount of US$3.70 per tonne for consignments of 10,000 tonnes and larger.

While further volume-based rate reductions in rail and vessel transport can be realized, inventory holding and storage costs negate transportation savings for such a low plant consumption rate. For a 20,000 tonne consignment, the bulk vessel rate drops to US$22 per tonne and the rail discount rate is maximized at US$3.70 per tonne. While the opportunity cost of capital is assumed to be a mere 5 percent, the inventory takes nearly 200 days to consume. A further rate reduction of US$3.00 per tonne is realized from a full handy-sized vessel submission, however, the inventory and storage costs are greater than the transport savings and the overall cost per tonne rises to US$202.59.
Beyond 30,000 metric tonnes, further rate reductions are realized in ocean transport, from US$21 per tonne for a 30,000 tonne shipment to US$19 per tonne for a 50,000 tonne shipment. Although this represents only a $2 per tonne reduction, the low consumption rate means inventory could sit for over a year. For shipments this large, the inventory holding costs are sufficient to drive the costs to US$224.54 per tonne, which is US$26.64 per tonne higher than the lowest overall cost for a 10,000 tonne shipment.

In figure 16, plant consumption is increased to 200 metric tonnes per day. This is low to moderate sized mill capacity. The container system for this scenario is arranged in the same manner as for the previous 100 metric tonne daily consumption rate but with a two week safety stock of 200 MT per day. This represents approximately 65 to 75 container loads weekly. A volume-based rate reduction of 5 percent is assumed in the container system.16

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16 While the discount was placed at 5 percent, this would be negotiated between shipper and carrier.
An applied volume discount of 5 percent in the container system yields a reduction of US$2.60, from US$195.87 to US$193.27 per tonne. This may not actually be the case as the commercial discount rate may be significantly different from the assumed rate of 5 percent.

By applying the 5 percent volume-based discount rate, the container system generates lower costs per tonne compared to the bulk system for all tonnage consignments. The narrowest price gap between the two systems is in the 10,000 tonne shipment category. In the bulk system the lowest overall combination of inventory and transportation costs (saddle point) occurs at the 10,000 tonne shipment size. The cost gap is only US$0.26, with US$195.61 for bulk and US$195.87 per tonne for containers without volume-based discounts.

Without the volume discount, the container rate remains at $195.87, still rendering the bulk system only marginally competitive with containers in the 10,000 to 20,000 tonne shipment size category. Beyond a 30,000 tonne consignment, inventory holding and storage costs render the bulk system non-price competitive against the container system, including the non-discounted per tonne container price.

In Figure 17, the factory consumption rate is increased to 400 metric tonnes per day, equal to that of a moderate sized mill. This represents approximately 120 to 150 container loads weekly. At such high volumes, shipments would most likely be under contract and could garner a rate discount of at least 5 percent. Volume-based rate discounts of 5 percent or greater would make the container system competitive with bulk in this trade corridor under all consignment sizes (provided of course sufficient empty container supply exists in Western Canada, which it currently does not). The narrowest price gap occurs at 20,000 tonnes where the bulk system is US$193.65 per tonne versus US$190.68 per tonne for containers that face a 5 percent volume-based discount, a difference of $2.67 per tonne.

As shown in Figure 17, the bulk system is more competitive against standard, non-contractual, non-discounted container pricing from 10,000 to 40,000 tonnes, with the
largest price gap at $2.20 per tonne in favour of bulk at the 20,000 tonne mark. However, plant volumes requiring up to 150 container loads weekly could face container equipment shortages in Western Canada. This would be the case if two or more customers of equal volume requirements are acquired, necessitating carriers to place large volumes of empty containers on the Prairies. At present there is insufficient imports directed to the Prairies for this to occur. Carriers or lessors would have to “reposition” this equipment to the Prairies from Vancouver, eastern Canada or the U.S. mid-west.

Figure 17: Container versus Bulk Supply Chain Costs for Plant Consumption Rate of 400 Metric Tonnes per Day

Repositioning costs for a single container from Chicago to the Prairies is approximately US$350 per container. If 50 percent of the total equipment supply were repositioned from Chicago, this would equate to US$175 per container for a mixed carrier and shipper pool (if shippers bring in their own equipment on lease). This increases costs by US$8.14 per tonne to US$198.02. On pure logistics costs (no mark-ups), this
scenario would render the container system non-price competitive with bulk over most pricing regimes except for the lowest category of a 5,000 tonne parcel lot.

Figure 18 shows the results for a 800 metric tonne per day production rate. This mill is in the moderate to high range of production volume, and would represent a typical bulk customer. The figure shows that circumstances would have to be optimum in favour of container systems to be competitive for the larger buyer. However the practicalities and logistics of a container system with this volume would require long term planning and co-ordination. The container supply chain would require a two week safety stock of 520 containers at the buyers dock, with a weekly inbound volume of 260 containers. This is near the upper limit of some mid-sized container feeder vessels in terms of deadweight tonnage that could be committed to a single consignment. For such an arrangement to occur commercially, shipper, buyer and carrier(s) would need to commit to a long term relationship.
Figure 18 shows that only a discount of 10 percent, with no “repo” charges would result in a supply chain cost of $191 per tonne. This scenario would be competitive in this corridor over bulk under all consignment sizes. The lowest cost for bulk is around $192 for consignments of 20,000 tonnes to 40,000 tonnes. At 50,000 tonnes, inventory and holding costs in the bulk system begin to increase. However, it requires several additional calculations in the 60,000 plus consignment size range to verify this assertion. Larger bulk consignments realize incremental decreases in freight rates, but impose diseconomies on other areas of the supply chain.

For a container freight rate discount of 5 percent, the bulk system is competitive for consignments larger than 10,000 metric tonnes. In this range, the container system is US$193.25 per tonne versus US$192 for bulk.

In practical terms, unless container carriers can provide sufficient equipment in Western Canada to meet demand, the “repo” charges would raise the cost to US$198 per tonne for 50 percent of the supplemented fleet. This would render the container system uncompetitive with bulk under all consignment categories except the 5,000 parcel submission. Of course, this also assumes that the shipping lines make no effort to reduce the costs of re-positioning containers.

Figure 18 also shows that for customers that consume 800 metric tonnes per day, the incremental interest charges for carrying inventory in larger bulk consignments approximately equals the decrease in transport rates. This has the effect of flattening the bulk cost curve. In a 50,000 metric tonne shipment, interest carrying charges increase total costs by $1 per tonne. This analysis demonstrates that it may be difficult for container systems to attract large bulk customers since the plant consumption rate minimizes both inventory holding and storage costs along with transport rates.

7.3 Model Output - Container versus “Grocery Boat” Operations

A grocery boat operation describes the chartering of a vessel by buyers consortia’s, shippers associations, or by forwarders pooling several bulk shippers to a single port or
“circuit” of ports. The goal is to attain the lowest vessel rate for the group, while each shipper realizes lower interest carrying costs for their individual consignments. There may be several buyers pooled on a single vessel with plastic tarpaulins separating the layers in a single hold Panamax vessel.

For grocery boat operations, separation layering does not contribute a significant amount of cost to consignments. In most instances it is below US$2.00 per tonne for a Panamax vessel. There are, however, additional costs and risks associated with this type of forwarding method. Waiting time to prepare each layer at the Canadian port, and disposal of the tarpaulin at the buyers premises (or port) can be significant depending upon the destination country’s environmental laws. The opposite of this would be in countries with lax environmental laws, and locals who value the plastic tarpaulin, hence little or no disposal costs.

Risk arises from contamination between shipments during loading or unloading or failure of the separation layer. Customers have the right to refuse loads based on suspected contamination. Cargo loss and resale can add significant administrative costs. The degree of risk is wholly dependent upon the customer and port of destination. However, the extent of this occurrence on an industry average basis has not been explored in the context of this report.

The cost of separation layering is based on the number of layers required, less one (N-1), where N is the number of buyers at a cost of US$6,500 per layer. Plant ancillary costs of $1.00 per tonne for disposal and labour are added at the buyer’s factory. Each buyer has a plant daily consumption capacity of 400 metric tonnes, an average plant consumption rate.

Communal buying partnerships utilizing grocery boat operations are common practice in the grain industry, with single buyers being large multi-national corporations or state buying agencies like China.
The preferred method of bulk ocean delivery is to use ships with natural separations. However, in the current weak freight market, ship owners without separated holds are willing to absorb some of the costs of tarp separations and more grain is being shipped this way. Anything from 25,000 DWT ships up to panamaxes are used to supply the Chinese market and many of these vessels do have some separations. The biggest buyers focus on achieving the lowest unit cost and so frequently use panamaxes without separations. Roughly 35 to 40 percent of shipments from the West Coast move this way.

The configuration used in this report is not the most common. Roughly 5 to 10 percent of West Coast shipments use the configuration outlined in this analysis. However, it represents the lowest cost scenario for low-volume, bulk shipping.

17 Typically, these shipments are more likely to involve different grades of the same product (e.g. wheat) than a mix of commodities (e.g. wheat and canola).
Figure 19 provides a comparison of grocery boat operations for various sized buyer groups chartering a 50,000 metric tonne single hold bulker vessel. All the costs of amassing a 50,000 tonne shipment within the Canadian system to FOB vessel at export port position are borne by the buyers group. However, the benefits of Canadian railcar block rate incentives at US$3.70 per tonne along with vessel rate of US$19 per tonne are included in the rates.

Figure 19 shows that 10 clients at 5,000 metric tonne purchases each (an unlikely scenario but provides a comparison) would have a collective per tonne cost of US$191.34. At this rate, grocery boat operations would for all intents and purposes be equal to a container delivery system with a discount of 10 percent. There would be nine separation layers in the vessel that adds US$1.50 per tonne to the ship preparation costs.

At 5 clients with 10,000 metric tonnes each, the cost of the grocery boat operation drops slightly to US$191.11. This is for 4 separation layers and a minimal increase in inventory carrying costs for each client. As the number of buyers decreases, the higher inventory carrying costs begin to override the benefits of mutual buying. Three clients with 16,667 tonnes each represents only two separation layers of added cost, but disproportionately extends the amount of product held in buyers’ inventory. At two buyers of 25,000 metric tonnes each, the benefits of mutual partnerships are completely diluted by the higher inventory carrying costs. The container system for the latter two cases would be competitive against grocery boat operations.

Grocery boat operations are best suited for mid to larger sized mills with the market power to mutually charter a vessel to achieve freight rate discounts and minimize inventory and storage costs. These mills must also work with a single shipper (in this case the CWB) to a single port and berth to achieve the lowest cost, otherwise multiple berthing and “circuit” porting will induce incremental costs.
7.4 Supply Chain Example Caveats

The scenarios presented do not include the retail mark-ups of either the CWB in the container and bulk systems, or the commercial suppliers mark-up at the FOB primary elevator position. All costing conducted in this report is based solely on zero profit margins. Each simulation is meant to provide a guide to the relative cost between the two systems under the lowest cost situations, or ideal conditions.

Only 50 empty containers per Western Canadian city are available on a weekly basis. If more than a few buyers opt to use the container system, this demand would strain container availability in Western Canada, necessitating carriers to alter network patterns or shippers to augment container supply by establishing pools. Naturally, the competitive market could lead to various shipping lines reducing their re-positioning charges to capture more volume, but this is not assumed to be the case.

For single buyers with plant consumption in the 100 to 400 metric tonne per day range, containers can be a competitive option, at least in the Vancouver to Asia corridor. Depending on the circumstances, containers can be cheaper than bulk shipments by $3 to $5 per tonne.

For a plant consumption rate of 800 metric tonnes per day, inventory carrying costs for the single buyer is not significant until the bulk shipment size reaches 50,000 metric tonnes. Containers are only competitive with bulk for consignments of less than 10,000 tonnes, or if the maximum container freight rate discount is realized.

A container system is competitive with grocery boat operations only if the maximized discount of 10 percent (or more) is realized. However, this is for groups of 5 buyers or less. For buyers with plant consumption rates of 400 metric tonnes per day, inventory carrying costs override the benefit of mutual buying.

Containers are a viable option in the Vancouver to Asia corridor provided that sufficient equipment exists, otherwise supplementing fleets with shippers pools or repositioning
equipment at a cost would render the use of containers non-cost competitive. If 50 percent of the equipment fleet is provided by shippers (by repositioning equipment) this would add roughly $5 per tonne to the container supply chain, making it non-competitive with the bulk system.

The container rate used in this analysis is one of the lowest rates in trans-pacific trade corridors. Most other corridors (or carriers) would add USD$200 or more to the USD$1,075 container freight rate used in this analysis. This will increase costs by $8 to $10 per tonne, rendering the container system viable for smaller mills only.

7.5 Material Handling Issues

Once the product arrives at the consignee’s premises, it is up to the receiving department to determine how to unload the truck or container. Truck bodies for bulk commodity movements have generally developed in two ways, the hopper bottom and end dump (Figures 20, 21 and 22). Both types are used in a variety of commodity trades, some examples are: plastics, agricultural goods, fertilizers and chemicals. In the bulk system, an end dump truck, hopper bottom railcar or truck coupled with a floor-receiving pit are the worldwide standard.

The standard marine container was originally designed for palletized and bagged freight handled by forklift and labour. Retrofitting the container system to utilize floor pits has spurred several ad hoc approaches to solving the problem, with no single design as an acceptable practice for shippers and consignees.

The most basic method of forwarding “neo-bulk”\(^\text{18}\) goods is in a washed and sanitized container with a half bulkhead at the rear door to retain product in the container at the

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\(^{18}\) This refers to placing bulk commodities into a marine container with or without a liner and with either a half or full rear door bulkhead. The product is unloaded with a tilt chassis, shovelled out by hand or with a pneumatic unloader to a bulk system, hence the term “neo-bulk”; not quite bulk but not fully intermodal.
consignees dock when the doors are opened. This process is used only with food grade (or new) containers to ensure no contamination of human-consumption product. A higher quality food grade, or new container is used to ensure that there is an airtight door seal.

Whether there is a reliable supply of food-grade, or new containers in the region to satisfy demand, could be a problem. These containers are generally higher priced than standard industry containers.

The second shipping method is to use a container liner (or bag for short) coupled with a bulkhead system. This method ensures air tightness to reduce the risk of moisture degradation, assumes no product contamination, and can be used in older, non-food grade containers to provide a physical separation from the container walls. Figure 23 shows a typical bag and wooden bulkhead system.

A third method also uses a container liner as in the previous method, but instead of a wooden bulkhead, reusable and removable steel rods are used as the retaining system. For certain applications with low density, high cube product this may be desirable, but is more expensive than a wooden bulkhead.

Unloading containers received at a consignees dock requires either high or low technology approaches. Low technology is labour intensive and refers to pneumatic unloading, or simply shoveling the grain out.

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19 For example, plastic pellets and shredded recyclables for moulding.

20 In some countries like China, labour is cheaper than the electricity to move grain into silos. A team of three labourers are used to shovel out containers.
The high technology approach using a container liner and wooden bulkhead system also faces its set of problems. First, labour and material must be expended to fabricate the bulkhead system. This adds cost and delay at loading. In some cases, bulkheads are fabricated from scrap material, such as plywood, to keep costs low. Unloading a container with this type of bulkhead requires the consignee to break open the wooden bulkhead, usually with a forklift truck. This can cause a sudden release of grain, posing a safety hazard to employees, and may contravene occupational health and safety policies\textsuperscript{21}. In addition, wood splinters may enter the grain stream as it flows into the pit and pose consumer liability problems. Finally, liners and wood bulkhead disposal can create problems. Scrap wood in bulkheads can be recycled or reused for other purposes. Where special disposal bins may be required for the liners and lumber, administration and labour cost are incurred.

Reusable steel rods, used to retain the liner bag, present different concerns. Steel rods are more costly than wooden bulkheads and must be made available at the loading site. If the rods are installed improperly, they can “pop” out during loading and prevent the containers doors from shutting. Additionally, the type of rod must be matched to the product type. High density product, such as grain, would require a more robust rod. Finally, steel rods must be returned to the shipper. Unless the consignee has a control mechanism in place to account for rods, a percentage of the rods will “disappear” in the pipeline and require replacement at additional expense. As with the previous method, a disposal bin is required at the consignees dock for the expended bags.

These methods do not endear the container system with consignees for neo-bulk commodities. Surveyed buyers\textsuperscript{22} stated that if containers could be made to behave more like bulk without the labour, additional costs and administration of managing disposable liners and retention material, they would consider it. Although some grain is currently containerized, and this number is growing, it is not the primary mode of choice. When volumes become sufficient, shippers and consignees switch back to bulk when the opportunity arises.

\textsuperscript{21} A representative of Shifton Mills of the UK stated to the author that wooden bulkheads have rendered using containers for grain receipt as undesirable due to employee and union complaints.

\textsuperscript{22} A global survey of grain buyers was conducted by the Transport Institute during the summer of 2000 to gauge perceptions and needs of global grain supply chains. A discussion of this survey can be found in the appendix.
A container tilt chassis at the consignee’s port is a key to the success of neo-bulk shipments. In many parts of the world a container tilt chassis is considered specialized equipment. It is heavier than a standard chassis and therefore reduces the cargo weight that can be carried in the container due to various countries’ truck road axle restrictions. In addition, a carrier (or the consignee) must realize steady flow of containers to justify a purchase of tilt units.

A second key to success is for the container to act like an end dump, without the agitation, labour and expense of liners and bulkhead fabrication and disposal. An integrated liner and bulkhead that is reusable, robust and cost effective, plus is easy for shippers and consignees alike to set-up and take down is the ultimate solution.

Finally, a container system must be cost effective; not only with conventional liners and bulkheads but with the incumbent bulk system as well. This must be conducted on a total supply chain perspective, focusing on the buyers end cost.

8.0 Transport Policy Reforms

In Canada and the United States, several federal acts influence intermodal (container) and bulk transport.

8.1 Canadian and American Intermodal Legislative Amendments

Recent changes in American legislation affecting the ocean shipping industry include the Ocean Shipping Reform Act of 1998 (OSRA) and amendments to the Carriage of Goods by Sea Act (COGSA). Under OSRA, the freedom to contract is the most significant change for shippers. “Expected outcomes from OSRA include: multi-year agreements; lower rates; carrier-shipper partnerships; and confidential rates.” (Mark, 2000). As a result, U.S. tariffs no longer have to be filed with the Federal Marine Commission and shippers and carriers can negotiate confidential contracts. OSRA
amendments benefit most shippers that move large volumes of containers, but smaller shippers can pool shipments or sign long term loyalty contracts to gain rate reductions.

The attempt to modernize COGSA is expected to provide increased protection to shippers against cargo loss or damage. Previously, liability treaties protected carriers from cargo loss while placing the onus on shippers to protect themselves from incidents on the high seas. Revisions of COGSA will repeal this nautical defence from carriers while increasing the current limitation of US$500 per container (Augello, 2000). Additionally, foreign forum clauses, which appear in all ocean bills of lading, adversely affect shippers’ ability to recover losses stemming from lost, damaged or delayed cargo. Revisions of COGSA will allow U.S. importers and exporters to have their cargo claims assessed in the U.S. where laws protect shippers more than many foreign laws are capable of.

OSRA and COGSA revisions in the U.S. put pressure on the Canadian government to make similar changes in Canada’s ocean shipping laws. The Shipping Conferences Exemption Act (SCEA) of 1970 allows ocean carriers to form conferences, while remaining immune to Canada’s Competition Act, and set common corridor tariffs for inland rates. The carriers negotiate with a federally appointed entity acting as an umbrella organization on behalf of Canadian container shippers.

The rationale for this policy is based on the uncompetitive nature of Canadian markets. Canada has only three container ports - Montreal, Vancouver and Halifax - and two railways. By comparison, the U.S. has several container ports on each coast, four Class I railways plus access to two Canadian Class I railways. Hence, the U.S. is a very competitive market when compared to Canada. The objective of SCEA was to protect Canadian land carriers from undue pressure or collusion from container lines.

Changes to SCEA could afford protection for Canadian inland carriers while allowing for greater flexibility for shippers and importers to enter into confidential contracts with

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23 One of the most common is “captain’s privilege” whereby the captain can order the release of deck cargo into the ocean to lighten the vessel during a storm, thereby saving the vessel, but losing some cargo. Shippers are responsible for acquiring their own insurance for such loss.
ocean lines. Amendments would also allow smaller shippers that are not able to realize volume discounts to form shippers associations and thereby pool freight and leverage rate discounts.

Canada’s railways (CN and CP) can offer line haul service to American shippers and importers via their subsidiary lines\textsuperscript{24}. The SCEA amendments allow Canadian carriers to access additional American freight that builds traffic to increase service frequencies and spread fixed costs over greater volumes. Competitive container rates have been falling during the past several years while inland bulk freight rates have remained regulated. SCEA amendments for confidential volume and loyalty contracts would make the intermodal system more attractive to bulk shippers. The move towards greater harmony between SCEA and OSRA will allow shippers on both sides of the border to take advantage of a continental intermodal system. Canadian grain could move unfettered through U.S. ports since grains would not be commingled as with bulk systems.

Smaller shippers are likely to make greater use of shipper organizations and associations, freight forwarders and other consolidators of containerized agriculture products to achieve leverage when negotiating rates. Economies of size for containerized IP grain movement could be achieved in the inland intermodal network. A potential constraint to rail operations is through the Canadian Rockies, where the daily maximum is 36 trains for all commodities. Unlike bulk grain, whose movement is constrained largely to Canadian ports,\textsuperscript{25} containerized grain can access world markets by virtually any port. This flexibility enables shippers to avoid congestion by re-routing their cargo.

8.2 Canadian Container Cabotage Regulations

Cabotage describes a transport activity that was first applied to ocean vessel shipping, specifically the pick-up and delivery of goods along a coastline by a foreign vessel.

\textsuperscript{24}CP Rail has the Soo Line and the Delaware Hudson railways, CN Rail has the Grand Truck, Illinois Central and Wisconsin Central railways.
These regulations have been a part of North American history since 1651 when the British Navigation Acts were implemented. Today, the Canada Customs Act continues to regulate the carriage of all domestic cargo by the different conveyances available to shippers. In the U.S. the same is true; cabotage regulations are outlined in the U.S. Customs Act. While these laws are in place to protect domestic carriers from international competition, changes in the global container market, resulting from deregulation and shifting trade patterns, justify the need to revisit the effects of cabotage regulations on efficiency and economic growth (Vido, Prentice and Kosior, 2001).

Containers are instruments of international commerce. They allow diverse goods to be loaded inside standard-sized units that could be handled and transported with greater efficiency. In essence, they are simply reusable packaging. Imposing restrictions on using containers constrains the efficient flow of goods. This is harmful to shippers and reduces their competitiveness in global markets.

Canadian legislation limits the amount, type and direction of cabotage moves that may be undertaken by a foreign-owned container. Each foreign-owned container may engage in one domestic “incidental” operation during its maximum 30-day, duty-free duration in Canada. The incidental domestic operation must take place totally within Canada’s boundaries over a route that is consistent with the international route, and only minor deviations off this route are acceptable. Additionally, the container must not have entered Canada for the purpose of an in-transit movement through Canada to a point outside Canada (Vido, Prentice and Kosior, 2001).

Two specific types of cabotage moves are allowed in Canada: the repositioning move – solely domestic transport between an import move and an export move; and the sufferance warehouse pick-up – equipment switching at sufferance warehouse stations. Under Canadian cabotage restrictions, a foreign-based container is considered a temporary import. No duty is charged during the first 30 days of cabotage activity.

25 Some Canadian bulk grain shipments have been sent via U.S. ports on an experimental basis, but political and practical realities prevent this from becoming a long term proposition.
Subsequently the foreign carrier must remove the container or pay the customs charge. It is governed under tariff item *9801.10.00*.

The U.S. considers a foreign-based container a temporary import, but permits a duty-free period of 1 year. The U.S. is also more liberal with respect to the use of foreign-based containers in their domestic market. As long as the container is moved on a U.S. carrier, the foreign container owner is allowed to offer freight services to domestic shippers.

These regulations are costly to Canada’s transportation network. Cabotage regulations hinder the operational efficiency of foreign-based containers. Imbalances of equipment availability make container operations in Canada inherently more costly and inflexible than in the U.S.

The tangible rewards from cabotage liberalization include a reduction in freight rates. To the extent that cabotage can reduce empty mile ratios for carriers, they can lower the rates for shippers. Furthermore, export container levels could be expected to improve given that shippers would gain access to more equipment. Both shippers and carriers can profit from more freedom to position equipment toward demand areas.

Most cabotage issues involve bilateral and reciprocal arrangements between two trading partners. Container cabotage, on the other hand, is distinct because it affects third party relationships. The U.S. is Canada’s largest trading partner, foreign-owned container lines view the NAFTA countries as a trading bloc. Differences in how the U.S. and Canada treat a third party affect the competitiveness of Canadian goods in global markets. Container lines prefer to route their equipment through the American ports where they can more easily manage their resources.

With containerization and trade significantly rising, carriers, shippers and intermediaries are in a position to take advantage of a welcoming regulatory environment. The tight restrictions placed on foreign-based containers in Canada are a source of economic inefficiency and lost opportunity that cannot be discounted. This policy causes empty
containers to accumulate in the port areas of the country and under serve the interior, taking up rail capacity, burning fuel and costing shippers when carriers charge, or build in their rates, the empty repositioning moves. These policies may have been designed to reduce cabotage and protect domestic Canadian container carriers, but at considerable cost to the Canadian importer / exporter community.

**9.0 Conclusions**

Grain logistics is becoming increasingly complex. New crops, additional grain segregations and rising demand for Identity Preservation (IP) requires better tracking and tracing of product from producer to consumer. The bulk handling system is designed like a funnel to channel large volumes of individual grain varieties into fungible grade categories, with little concern for precise quality or origin. It cannot be assumed that such a logistics system will be able to cope economically with the challenges of strict separation required by IP grain buyers.

Biotechnology has accentuated the demand for IP grain. Consumers are concerned about the safety of genetically engineered food. As a result, they are much less willing to accept grain that has been genetically modified or even mixed with small quantities of GMOs. De-commoditization of the grain industry has far-reaching effects in the bulk handling supply chain. Risk of contamination could require expensive testing and diagnostics of grain during storage, handling and transportation.

These demand trends portend a looming crisis for the traditional western Canadian grain handling and transportation system. The massive investments in high throughput elevators on the Prairies are contrary to market trends toward smaller consignments of identity preserved grains. Central buying agencies that once consistently imported large bulk shipments of grain from Canada have been replaced by more numerous and discriminating private buyers soliciting smaller quantities. As the average size of export shipments fall, the economics of high throughput elevators and unit trains become less certain.
A containerized grain logistics system could solve the public policy issue of GMO segregation and offer supply chain advantages in terms of cost and service. By ignoring the opportunities presented by the containerization of grain, Canada risks falling behind other, more progressive countries. On the other hand, the container trend could provide valuable opportunities for producers to expand tight margins in the face of global agricultural subsidies. The falling costs of containers and the rising demand for identity preserved grain creates opportunities for Canadian producers to capture/preserve greater value. Canada has a higher capacity for on-farm storage than do other countries, which provides a lower cost option for holding product until it is ready to be marketed. Canada also has a well-educated, adaptable, hungry and aggressive producer group who can respond to economics almost instantly (Pike, 2001). No international grain producer is as well positioned to offer a just-in-time continuous grain delivery system as is western Canada.

The viability of a containerized grain logistics system is more sensitive to backhaul economics than is bulk shipping. The large trade imbalance on the Pacific trade corridor has resulted in favourable rates to Asian ports, allowing containers of grain to flow to Asian ports on backhaul rates that are comparable to bulk rates. Unlike bulk however, further opportunities exist to employ economies of size and automation that can lower container costs. Port authorities worldwide are scrambling to get ready to serve the new 6,000 plus TEU ships that are currently under construction or on the order book for delivery during the next five years.

Ultimately, logistics costs are about trade-offs: in this case, inventory costs versus transport costs. The container is the storage unit as well as the transport device, which is perfectly designed for just-in-time production. Container delivery can be scheduled to meet a plant's capacity such that it minimizes inventory-holding costs. Most analyses of bulk handling ignore the cost of storage, and pay scant attention to the impact of these costs on grain buyers after the grain reaches the importer's shore. These costs are not easily quantified, but cannot be ignored. This is particularly true in developing countries that lack efficient bulk handling systems and face much higher interest rates to finance
their inventories. Furthermore, this analysis does not consider the costs of GMO testing and diagnostics, which can be substantial.

The competitiveness of container-based grain logistics is a function of the buyer’s plant size. For low plant consumption rates (100 – 200 metric tonnes/day), the container system appears to be better suited than bulk delivery. At low consumption rates, transport costs for bulk consignments of 10,000 metric tonnes or less become a less significant component of the final cost to the importer than inventory costs. For small scale processors, inventory costs may cancel any transport cost savings derived from bulk shipping. Container delivery can be “tuned” to a plant’s consumption rate and overall logistics costs fall when shipment sizes are small and less frequent. Larger plants with higher consumption rates would require volume-based freight rate discounts from container carriers in order to remain competitive with the bulk system.

Grain is already shipped in containers but in most cases these are specialty products (e.g. organic wheat) or crops that are too delicate to be shipped in bulk (e.g. lentils). Over the past ten years the costs of container shipping from North America have fallen dramatically. Given the pull from IP grain demands, and the push from container liners desperate to fill their empty slots, it is only a matter of time before container shipping invades markets now served exclusively by bulk shipment.

9.1 Constraints

Approximately 300,000 tonnes of Australia’s annual wheat exports are shipped in containers, making it the world leader in containerized wheat exports. Some industry officials believe that Australia has a corner-hold on this market due to their proximity to Asian countries like India and Vietnam. However, Australian containerized wheat exports are shipped to several European countries including Spain and Italy, and into South America. Distance is not as significant an issue as some currently believe. Australia’s wheat exporters have proven that the market for containerized grain exists and is growing.
More capital investment is needed for handling/transfer facilities for containerized grain here and abroad. Individual producers may be able to access this logistics system, but will likely require the expertise of grain companies and brokers to secure, load and ship containers.

A significant impediment to securing greater container volumes in western Canada is the cost of repositioning empty containers. One source of these higher “inland” costs is the regulations of Canada Customs and Revenue Agency that limit the flexibility of the container lines to route empty boxes through western Canada. It is critical for Canada Customs to reevaluate container cabotage regulations. These regulations impose considerable costs to Canada’s importer/exporter community and limit their access to equipment for international commerce.

The Canadian Wheat Board, currently the sole marketer of Canadian wheat, has not yet made the transition to source-loaded container shipping. A distinctly Canadian container program based on superior product quality and first-rate material handling capability would be very competitive. The marketing authority for the largest, most suitable crop for containers has the influence needed to support the volume of shipments necessary to drive the handling investment, and to stimulate the shipping lines to aggressively pursue Canada’s grain sector. With aggressive business planning and marketing, the CWB could eventually surpass the service offered by growing Australian containerized wheat sales.

9.2 Recommendations

Based on the assumptions outlined in this report, shipping grain in containers can be economical. The potential windfall of benefits to producers and the bulk handling system of containerizing small export shipments has yet to be explored.

This report provides the theoretical tool necessary to move forward in developing a containerized, identity-preserved grain logistics system. A container delivery program
under the auspices of the CWB is a realistic goal. The Australian model of licensing individual exporters under its Wheat Export Authority (WEA) is not unlike the CWB “producer direct” program. Although contacts were made with foreign buyers who were interested in participating in trial shipments, efforts to engage the Canadian Wheat Board and grain companies in conducting such trials failed to produce timely results. The potential benefits from this system therefore remain obfuscated. The CWB has maintained an ongoing dialogue with the authors and commercial partners regarding the project. When material handling issues regarding unloading at the consignee’s door are resolved, buyers will be solicited to accept test trials. Performing actual trial shipments of containerized grain would provide more accurate cost data to calibrate the model used in this report.

Furthermore, each region of the world differs in their ability to efficiently handle containerized cargo. For example, China appears to lack the truck chassis for containers that include hydraulic tipping capability that would be useful for unloading grain. An investigation of global container ports to assess bottlenecks for this logistical system should be undertaken.

The shortage of empty 20-foot containers on the Canadian Prairies is a major impediment to shipping containerized grain on a regular basis. Governments and industry must work together to find innovative solutions to this problem. Modification of Canadian container cabotage rules to match U.S. regulations could help make containers more available on the Prairies. A study on the impacts to container availability, carrier operations and freight rates of removing these cabotage restrictions is deemed necessary.

10.0 References


26 The CWB does use containers to serve some customers who demand this method of delivery. In this case however, the containers are stuffed at the ports after having paid all the costs of movement through the bulk handling system.


51. “Ceres gets Amsterdam Green Light”, World Cargo News, April 2000


55. www.tdctrade.com/shippers/17/03ports/ports01.html

Appendices

Appendix A: Sample Container Costing Sheet
Appendix B: Flexible Bulk and Container System Flow Map with Inspection Points
Appendix C: Primary and Terminal Elevator Tariffs
Appendix D: Rail Tariff Examples
Appendix E: Canadian Grain Commission Services
Appendix F: Trans-Pacific Bulk Grain Rates
Appendix A
Sample Container Costing Sheet

This section contains a worksheet that highlights the logistics cost items that were considered for this study. This worksheet is an example only and contains the cost items from Prairie inland points up to the customers receiving dock. It does not include product costs (retail mark-up, profit margins) or the customers’ end costs (unloading, storage, drayage). Product costs and customers’ end costs differ from supply chain to supply chain and customer to customer and are usually negotiated on a commercial basis.  

The container-costing sheet can be found in Table A1, and follows the supply chain diagramed in Figure A1. The blue highlighted items (item #: 25, 26, 28, 29, 40) are the SEGMENT COSTS. The green highlighted items (item #: 3, 27, 30, 41) are the CUMULATIVE COSTS (including the product cost). The grey highlighted items (item #: 2, 4-11, 13-14, 16-22, 24, 35-37) are user entry values.

27 All costs, including the product costs and customers’ end costs were included in the analysis in the body of this report. However, due to the sensitive nature of this information, it cannot be disseminated here.
Figure A1: Bulk and Container System Example – Starting at Primary Elevator
<table>
<thead>
<tr>
<th>Item#</th>
<th>Unit Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CANADIAN to USD Converter</td>
<td>0.64</td>
</tr>
<tr>
<td>2</td>
<td>“Farmgate Price per tonne” (Point A)</td>
<td>$180.00</td>
</tr>
<tr>
<td>3</td>
<td>“Farmgate Price per tonne” (Point A)</td>
<td>$115.20</td>
</tr>
<tr>
<td>4</td>
<td>Producer delivery sampling costs (if any, per tonne)</td>
<td>$0.00</td>
</tr>
<tr>
<td>5</td>
<td>Receiving, Elevating, Loading out( per tonne)</td>
<td>$11.27</td>
</tr>
<tr>
<td>6</td>
<td>Dockage/Blending Charges (per tonne basis)</td>
<td>$3.61</td>
</tr>
<tr>
<td>7</td>
<td>Fumigation ( If any, per tonne basis)</td>
<td>$0.00</td>
</tr>
<tr>
<td>8</td>
<td>Insurance (if any, per tonne)</td>
<td>$0.00</td>
</tr>
<tr>
<td>9</td>
<td>Primary grading charges (if any, per tonne)</td>
<td>$0.00</td>
</tr>
<tr>
<td>10</td>
<td>Drying (if any, per tonne average)</td>
<td>$0.00</td>
</tr>
<tr>
<td>11</td>
<td>Shrinkage &amp; spoilage (per cent)</td>
<td>0.25%</td>
</tr>
<tr>
<td>12</td>
<td>Shrinkage &amp; spoilage (per tonne)</td>
<td>$0.45</td>
</tr>
<tr>
<td>13</td>
<td>Average number of days in storage</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>Storage cost (per day/per tonne)</td>
<td>$0.06</td>
</tr>
<tr>
<td>15</td>
<td>Storage Cost (per tonne)</td>
<td>$0.00</td>
</tr>
<tr>
<td>16</td>
<td>CWB ancillary charges (if any, per tonne average)</td>
<td>$2.50</td>
</tr>
<tr>
<td>17</td>
<td>CGC Outward Inspect Charge per tonne</td>
<td>$2.33</td>
</tr>
<tr>
<td>18</td>
<td>CGC Weight Scale Verification per tonne</td>
<td>$0.93</td>
</tr>
<tr>
<td>19</td>
<td>Interest Rate</td>
<td>5.0%</td>
</tr>
<tr>
<td>20</td>
<td>Storage Hold Costs</td>
<td>$0.12</td>
</tr>
<tr>
<td>21</td>
<td>Drayage Cost</td>
<td>$1.62</td>
</tr>
<tr>
<td>22</td>
<td>Trip Length</td>
<td>37.5</td>
</tr>
<tr>
<td>23</td>
<td>Total Elevator to Intermodal Terminal Dray Charges</td>
<td>$121.50</td>
</tr>
<tr>
<td>24</td>
<td>Container Load Limit Allowance (by Canada or Receiver - Minimum)</td>
<td>21.5</td>
</tr>
<tr>
<td>25</td>
<td>Elevation, Container Loadout &amp; FOB Charges (Segment cost - Point A to B)</td>
<td>$21.21</td>
</tr>
<tr>
<td>26</td>
<td>Elevation, Container Loadout &amp; FOB Charges (Segment cost - Point A to B)</td>
<td>$13.58</td>
</tr>
<tr>
<td>27</td>
<td>Cumulative Costs (Point A to Point B)</td>
<td>$128.78</td>
</tr>
<tr>
<td>28</td>
<td>Drayage to Intermodal Terminal (Segment cost - Point B to C)</td>
<td>$5.65</td>
</tr>
<tr>
<td>29</td>
<td>Drayage to Intermodal Terminal (Segment cost - Point B to C)</td>
<td>$3.62</td>
</tr>
<tr>
<td>30</td>
<td>Cumulative Costs (Point A to Point C)</td>
<td>$132.39</td>
</tr>
<tr>
<td>31</td>
<td>Port of Destination</td>
<td>N/A</td>
</tr>
<tr>
<td>32</td>
<td>North American Port of Exit</td>
<td>Vancouver</td>
</tr>
<tr>
<td>33</td>
<td>Inland terminal to Receiving Port transit days</td>
<td>21</td>
</tr>
<tr>
<td>34</td>
<td>Pipeline Hold Costs</td>
<td>$0.33</td>
</tr>
<tr>
<td>35</td>
<td>Terminal to Terminal CIF Port from Canadian origin</td>
<td>$1,025.00</td>
</tr>
<tr>
<td>36</td>
<td>Container Fuel Surcharge</td>
<td>$112.00</td>
</tr>
<tr>
<td>37</td>
<td>Reposition Charges (if applicable)</td>
<td>$0.00</td>
</tr>
<tr>
<td>38</td>
<td>Volume Pricing Discounts</td>
<td>0.00%</td>
</tr>
<tr>
<td>39</td>
<td>Terminal to Terminal CIF Port from Canadian origin (incl fuel)</td>
<td>$1,137.00</td>
</tr>
<tr>
<td>40</td>
<td>Price/tonne from Western Canada to CIF terminal destination (Point C to D)</td>
<td>$52.88</td>
</tr>
<tr>
<td>41</td>
<td>Cumulative Costs (Point A to D)</td>
<td>$185.28</td>
</tr>
</tbody>
</table>

**SUMMARY**

Logistics Costs ONLY  $70.08

Logistics Costs as % of total Cost 37.8%

**NOTES:** Storage Costs at primary elevators are 10 DAYS FREE, but client must still pay HOLD costs

---

28 Comments and Calculation Details to accompany Table A1 can be found on the following page in Table A2.
## Table A2: Calculation Details and Comments on Container Costing Sheet

<table>
<thead>
<tr>
<th>Item#</th>
<th>Calculation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Elevator price offer - Mb./Sk. Origins blended - Cdn</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>#2*#1</td>
<td>Elevator price offer - Mb./Sk. Origins blended - USD</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CGC Tariff Tables - Average - Cdn</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CGC Tariff Tables - Average - Cdn</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>New CGC Rules do not allow this shrinkage</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>#11*#2</td>
<td>Shrinkage cost per tonne - Cdn</td>
</tr>
<tr>
<td>13</td>
<td>If less than 10 days, no storage charges apply</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>=IF(#13&lt;10,0,#14*#12*#1)</td>
<td>&lt; ten days, no storage costs apply</td>
</tr>
<tr>
<td>16</td>
<td>CWB 5 year average marketing costs to pool</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>per tonne - Cdn</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>per tonne - Cdn</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>#19*(#13/365)*#2</td>
<td>5 days inventory hold</td>
</tr>
<tr>
<td>20</td>
<td>=#19*(#13/365)*#2</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>per km</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Distance from terminal to load site in kms</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>=2*(#22*#21)</td>
<td>ROUND TRIP COSTS</td>
</tr>
<tr>
<td>24</td>
<td>in tonnes per container</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>=#4+...+#10+#12+#15+...+#18+#20</td>
<td>Per Tonne - Cdn</td>
</tr>
<tr>
<td>26</td>
<td>=#25*#1</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>27</td>
<td>=#26+#3</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>28</td>
<td>=#23/#24</td>
<td>Per Tonne - Cdn</td>
</tr>
<tr>
<td>29</td>
<td>=#28*#1</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>30</td>
<td>=#29+#27</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>31</td>
<td>Asian Northern Port</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Point to Point Days</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>=(#33/365)<em>#19</em>#3</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>35</td>
<td>=(#33/365)<em>#19</em>#3</td>
<td>Per Container - USD</td>
</tr>
<tr>
<td>36</td>
<td></td>
<td>Per Container - USD</td>
</tr>
<tr>
<td>37</td>
<td></td>
<td>Per Container - USD</td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>=(#35+#36+#37)*(1-#38)</td>
<td>Per Container - USD</td>
</tr>
<tr>
<td>40</td>
<td>=#39/#24</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>41</td>
<td>=#40+#30</td>
<td>Per Tonne - USD</td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>=#40+#29+#26</td>
<td>Per Tonne USD</td>
</tr>
<tr>
<td>44</td>
<td>=#43/#41</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B:

Flexible Bulk and Container System Flow Map with Inspection Points
Figure B1: Flexible Bulk and Container System Flow Map with Inspection Points
### Appendix C: Primary and Terminal Elevator Tariffs

**Summary - Licensed Primary Elevator Tariff/Sommaire - Tarifs des silos primaires agréés**

- **Crop Year 2000-2001/Campagne agricole 2000-2001**

**Elevator-Levage** Receiving, elevating and loading out/Reception, envoi et déchargement

<table>
<thead>
<tr>
<th>Origin/Point d'origine</th>
<th>Wheat (Including durum)</th>
<th>Canola.</th>
<th>Sunflower</th>
<th>Soybeans</th>
<th>Other Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bale/comp. (ton)</td>
<td>Oats/ Avoine</td>
<td>Barley/ Orge</td>
<td>Ryed/ Seigle</td>
<td>Rapeseed/ or Mélange</td>
</tr>
<tr>
<td>AgPro Grain</td>
<td>10.75</td>
<td>14.75</td>
<td>11.96</td>
<td>10.73</td>
<td>13.79</td>
</tr>
<tr>
<td>AgriCo Inc. Ltd. - MB/Sk/Ab.</td>
<td>11.00</td>
<td>12.00</td>
<td>11.00</td>
<td>10.25</td>
<td>13.45</td>
</tr>
<tr>
<td>Canada Malting Co. Ltd.</td>
<td>9.75</td>
<td>-</td>
<td>12.00</td>
<td>-</td>
<td>16.90</td>
</tr>
<tr>
<td>Cargill Limited</td>
<td>-</td>
<td>11.50</td>
<td>14.67</td>
<td>13.00</td>
<td>9.50</td>
</tr>
<tr>
<td>Manitoba</td>
<td>10.75</td>
<td>13.00</td>
<td>10.50</td>
<td>9.50</td>
<td>11.45</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>11.00</td>
<td>17.03</td>
<td>11.00</td>
<td>11.29</td>
<td>16.92</td>
</tr>
<tr>
<td>All Alberta &amp; B.C. locations/ Tous les endroits en Alberta &amp; C.-B.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CMI Terminal Joint Venture</td>
<td>12.00</td>
<td>12.50</td>
<td>11.50</td>
<td>12.50</td>
<td>14.00</td>
</tr>
<tr>
<td>ConAgra Grain - Manitoba</td>
<td>11.48</td>
<td>12.25</td>
<td>10.80</td>
<td>8.20</td>
<td>11.50</td>
</tr>
<tr>
<td>ConAgra Grain - Saskatchewan</td>
<td>10.48</td>
<td>12.25</td>
<td>10.80</td>
<td>8.20</td>
<td>11.50</td>
</tr>
<tr>
<td>Dalmar Commodities</td>
<td>9.50</td>
<td>12.90</td>
<td>12.10</td>
<td>13.25</td>
<td>-</td>
</tr>
<tr>
<td>Dominion Malting Ltd. - MB/Sk/Ab.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Great Northern Grain Terminal</td>
<td>10.00</td>
<td>13.00</td>
<td>10.00</td>
<td>10.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Great Sandhills Terminal Ltd.</td>
<td>12.00</td>
<td>12.00</td>
<td>12.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Johnson Seeds, S.E.</td>
<td>10.75</td>
<td>15.00</td>
<td>13.00</td>
<td>10.00</td>
<td>18.00</td>
</tr>
<tr>
<td>Louis Dryfus - MB/Sk/Ab.</td>
<td>11.00</td>
<td>7.50</td>
<td>12.00</td>
<td>7.50</td>
<td>12.00</td>
</tr>
<tr>
<td>Mid-Sask Terminal Ltd.</td>
<td>10.75</td>
<td>13.00</td>
<td>10.50</td>
<td>9.50</td>
<td>11.45</td>
</tr>
<tr>
<td>North-East Terminal</td>
<td>10.75</td>
<td>13.00</td>
<td>10.50</td>
<td>9.50</td>
<td>11.45</td>
</tr>
<tr>
<td>North West Terminal</td>
<td>10.75</td>
<td>13.00</td>
<td>10.50</td>
<td>10.00</td>
<td>13.00</td>
</tr>
</tbody>
</table>

1 Gross weight (GW) = Total weight received / Poids brut (PB) = Poids brut sous béton
2 Accurate gross weight (AGW) = Gross weight less shrinkage / Poids comptable brut (PCB) = Poids brut moins perte de poids net (PN) = Poids comptable brut moins la perte d'humidité
3 Quoted elevator to license the flowage de sortie aux yeux de couverts
4 Effective September 18, 2000/Effetif septembre 18, 2000
5 Effective October 13, 2000/Effetif octobre 13, 2000
6 Effective December 22, 2000/Effetif décembre 22, 2000

**Primary and Terminal Elevator Tariffs**
### CANADIAN GRAIN COMMISSION / COMMISSION CANADIENNE DES GRAINS

**SUMMARY - LICENSED TERMINAL ELEVATOR TARIFS / SOMMAIRE - TARIFS DES SILOS TERMINAUX AGRÉÉS**


<table>
<thead>
<tr>
<th>Elevations / Levages</th>
<th>Receiving, elevating and loading out / Réception, levage et déchargement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheat (including durum) / Canola, Rapeseed or Mustard / Other</td>
</tr>
<tr>
<td></td>
<td>Bé or (compris le béré dur) / Canola, colza, or moutarde / Grains or Sorgs, J.</td>
</tr>
<tr>
<td></td>
<td>Dates / Barley / Rye / Flaxseed / Soja ou pois / Other</td>
</tr>
<tr>
<td></td>
<td>Orge / Seigle / Lin / Malt / Autres</td>
</tr>
<tr>
<td></td>
<td>Graines de tournesol / Cribleurs / Grains ou cribleurs</td>
</tr>
<tr>
<td>Agricore Ltd. - Thunder Bay</td>
<td>6.83 11.32 8.55 7.24 11.07 11.07 7.45 23.92 9.38 11.48</td>
</tr>
<tr>
<td>Cascadia Terminal - Vancouver</td>
<td>7.14** 11.23 8.87 10.35 12.24 11.02 - - 10.46 13.50</td>
</tr>
<tr>
<td>Hudson Bay Port Co. - Churchill</td>
<td>6.47 10.35 8.03 6.83 9.93 10.09 6.94 22.38 8.41 10.35</td>
</tr>
<tr>
<td>Cargill Limited - Thunder Bay</td>
<td>7.00 11.25 8.70 7.21 11.00 11.25 7.57 24.35 9.35 11.50</td>
</tr>
<tr>
<td>Mission Terminal Inc.</td>
<td>6.50 10.35 8.00 6.50 9.90 10.10 6.95 22.40 9.00 10.35</td>
</tr>
<tr>
<td>Pacific Elevators - Vancouver</td>
<td>7.14** 11.22 8.87 10.20 12.24 11.02 - - 10.97 10.85</td>
</tr>
<tr>
<td>Parrish &amp; Heimbecker - Thunder Bay</td>
<td>7.00 11.25 8.50 7.20 10.85 10.85 7.30 24.00 9.20 11.25</td>
</tr>
<tr>
<td>Prince Rupert Grain - Prince Rupert</td>
<td>7.28 11.23 9.05 10.35 12.24 11.02 - - - -</td>
</tr>
<tr>
<td>J.R.I. Terminals - Thunder Bay</td>
<td>7.10 11.35 8.80 7.30 10.95 10.95 - - 9.30 11.35</td>
</tr>
<tr>
<td>J.R.I. Terminals - Vancouver</td>
<td>7.25*** 11.35 8.80 7.30 11.00 11.00 - - 10.00 11.50</td>
</tr>
<tr>
<td>S.W.P. - Thunder Bay &amp; Vancouver</td>
<td>7.28+ 11.45 9.05+ 10.56 11.25 11.23 7.59 24.39 10.65 11.70</td>
</tr>
<tr>
<td>U.G.G. - Thunder Bay</td>
<td>7.00 11.25 8.75+ 7.20 11.00 11.00 7.50 24.00 10.00 11.50</td>
</tr>
<tr>
<td>- Vancouver</td>
<td>7.25 11.35 9.05 10.35 12.00 11.05 7.50 24.00 10.00 11.50</td>
</tr>
<tr>
<td>Vancouver Wharves Ltd.</td>
<td>7.00 11.00 8.70 10.15 11.35 10.95 7.30 24.00 10.75 11.25</td>
</tr>
</tbody>
</table>

*Calculated on the total weight shipped* / Tarif calculé selon le poids total expédié

**Durum wheat / Bé ou durum** 7.54

* Additional charges for receiving from box cars / frais additionnels pour la réception de grains par wagons couverts, Saskatchewan Wheat Pool 2.14 2.60

*** Proso Wheat / Proso ou blé proso** 7.50

1/ Effective September 20, 2000 / Entré en vigueur le 20 septembre 2000
2/ Effective September 26, 2000 / Entré en vigueur le 26 septembre 2000
3/ Effective October 2, 2000 / Entré en vigueur le 2 octobre 2000
4/ Effective January 2, 2001 / Entré en vigueur le 2 janvier 2001
5/ Effective April 2, 2001 / Entré en vigueur le 2 avril 2001
Appendix D:
Rail Tariff Examples

Table D1: Rail Tariff Examples

<table>
<thead>
<tr>
<th>Stations</th>
<th>Prov</th>
<th>Railline</th>
<th>Terminal Dest.</th>
<th>Tonnes</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winnipeg to Vancouver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65372</td>
<td>MB</td>
<td>CEMR</td>
<td>VANCOUVER, BC</td>
<td>268</td>
<td>$46.46</td>
</tr>
<tr>
<td>64838</td>
<td>MB</td>
<td>CN</td>
<td>VANCOUVER, BC</td>
<td>286</td>
<td>$46.75</td>
</tr>
<tr>
<td>65356</td>
<td>MB</td>
<td>CEMR</td>
<td>VANCOUVER, BC</td>
<td>268</td>
<td>$46.46</td>
</tr>
<tr>
<td>64858</td>
<td>MB</td>
<td>SMNR</td>
<td>VANCOUVER, BC</td>
<td>268</td>
<td>$47.10</td>
</tr>
<tr>
<td>64846</td>
<td>MB</td>
<td>CN</td>
<td>VANCOUVER, BC</td>
<td>286</td>
<td>$47.10</td>
</tr>
<tr>
<td>Morris</td>
<td>MB</td>
<td>CP</td>
<td>VANCOUVER, BC</td>
<td></td>
<td>$44.95</td>
</tr>
<tr>
<td>Marquette</td>
<td>MB</td>
<td>CP</td>
<td>VANCOUVER, BC</td>
<td></td>
<td>$43.09</td>
</tr>
<tr>
<td>Elm Creek</td>
<td>MB</td>
<td>CP</td>
<td>VANCOUVER, BC</td>
<td></td>
<td>$43.71</td>
</tr>
<tr>
<td>Dominion City</td>
<td>MB</td>
<td>CP</td>
<td>VANCOUVER, BC</td>
<td></td>
<td>$45.57</td>
</tr>
<tr>
<td>Teulon</td>
<td>MB</td>
<td>CP</td>
<td>VANCOUVER, BC</td>
<td></td>
<td>$44.95</td>
</tr>
</tbody>
</table>

| Regina to Vancouver |
|---------------------|------|----------|----------------|--------|-------|
| 76410 | SK | CN | VANCOUVER, BC | 268 | $35.05 |
| 76915 | SK | CN | VANCOUVER, BC | 286 | $36.40 |
| 76182 | SK | CN | VANCOUVER, BC | 286 | $38.04 |
| 76884 | SK | CN | VANCOUVER, BC | 268 | $37.69 |
| 76934 | SK | CN | VANCOUVER, BC | 286 | $37.80 |
| Qu’appelle | SK | CP | VANCOUVER, BC | | $35.62 |
| Wilcox | SK | CP | VANCOUVER, BC | | $35.00 |
| Moose Jaw | SK | CP | VANCOUVER, BC | | $33.70 |
| Lajord | SK | CP | VANCOUVER, BC | | $35.62 |
| Cupar | SK | CP | VANCOUVER, BC | | $36.85 |
Appendix E:
Canadian Grain Commission Services and Costs

Table E1:
CGC - Inward / Outward Services, as at July 2001

<table>
<thead>
<tr>
<th>Inward</th>
<th>Outward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopper Car</td>
<td>Protein Count / Hopper Car</td>
</tr>
<tr>
<td>$20.16</td>
<td>$7.16</td>
</tr>
</tbody>
</table>

Table E2:
CGC Load Out / Fobbing Services

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel Loading (Stevedoring)</td>
<td>$0.65</td>
<td>per tonne</td>
</tr>
<tr>
<td>Ship Preparation (layers, liners, etc.)</td>
<td>$9,500.00</td>
<td>per layer</td>
</tr>
<tr>
<td>Wharfage</td>
<td>$0.16</td>
<td>per tonne</td>
</tr>
<tr>
<td>B.C. Shipper's Clearance</td>
<td>$0.05</td>
<td>per tonne</td>
</tr>
<tr>
<td>Warehouse Cancellation</td>
<td>$0.08</td>
<td>per tonne</td>
</tr>
<tr>
<td>BCMEA Surcharge</td>
<td>$0.60</td>
<td>per tonne</td>
</tr>
<tr>
<td>Outward Fumigation</td>
<td>$0.85</td>
<td>per tonne</td>
</tr>
<tr>
<td>Outward Weight Shortage (Shrinkage) Percent</td>
<td>$0.00</td>
<td>per tonne</td>
</tr>
</tbody>
</table>
Appendix F:
Trans-Pacific Bulk Grain Rates

Table F1:
Trans-Pacific Bulk Grain Rates - Vancouver/China Eastbound FIFO
as at August 2001

<table>
<thead>
<tr>
<th>Consignment Size</th>
<th>Vessel Type</th>
<th>Number of holds</th>
<th>Rate USD/tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000</td>
<td>Handysize</td>
<td>1</td>
<td>$28.00</td>
</tr>
<tr>
<td>10,000</td>
<td>Handysize</td>
<td>2</td>
<td>$24.50</td>
</tr>
<tr>
<td>20,000</td>
<td>Handysize</td>
<td>4</td>
<td>$22.00</td>
</tr>
<tr>
<td>30,000</td>
<td>Handymax</td>
<td>N/A</td>
<td>$21.00</td>
</tr>
<tr>
<td>40,000</td>
<td>Handymax</td>
<td>N/A</td>
<td>$19.50</td>
</tr>
<tr>
<td>50,000</td>
<td>Handymax</td>
<td>N/A</td>
<td>$19.00</td>
</tr>
<tr>
<td>60,000+</td>
<td>Cape</td>
<td>N/A</td>
<td>$16.25</td>
</tr>
<tr>
<td>80,000+</td>
<td>Cape</td>
<td>N/A</td>
<td>$14.00</td>
</tr>
</tbody>
</table>
Appendix G

2000 Global Grains Industry Survey

Introduction
During the summer of 2000, the Transport Institute conducted a global survey of grains industry participants with the objective of identifying companies amicable to participating in trial shipments of containerized grain. Although the parties involved with this project (Transport Institute, CWB and grain companies) were unable to move forward with trial shipments during the timeline of the project, valuable information about the global grains industry was gathered in this exercise. The following discussion offers a summary of survey findings and also offers some insight on the varied operations of the participants.

Objectives
The primary aim of the survey was to locate international grain buyers to participate in trial shipments of containerized grain. A secondary objective was to assess the global demand for containerized grain by exploring several issues such as: the types of grains purchased, storage capacities, logistical problems and product quality considerations.

Methodology
A questionnaire was faxed to potential respondents in order to gather information about the global grains industry. Survey participants were identified through various sources, including the Canadian International Grains Institute, Canadian Consular offices abroad and many internet websites. The target population included processors of wheat, durum, barley or their derivatives outside of North America. Approximately 2500 companies were solicited for information. Among the numerous responses, only 53 companies provided meaningful replies. A high self-selection bias makes statistical inferences about the global grains industry unwise, although some useful insights and anecdotal observations were obtained.

After data collection, the dataset was checked for internal consistencies and entered into machine-readable form for analysis through SPSS (Statistical Package for the
Social Sciences). Many discussion-oriented or open-ended responses differ only in jargon rather than meaning. A post-field collapsing process was necessary to group together these responses. In the case of this analysis, a heterogeneous response base is expected. Global grains industry participants come from “all walks of life” with many differences including industrial activity, global location, size, language, etc.

Survey Results

Sample Description
Figure G1 identifies the regions represented in the sample. The Middle East and Africa comprise only 8 percent. For that reason, in regional analyses only responses from Europe, South America and Asia-Pacific will be discussed in detail. Table 1 groups the 25 countries represented in terms of their more aggregate identification.
The survey attempted to target those companies involved either in milling, baking, malting, brewing or some combination of these. Figure G2 illustrates the industrial activity of the 53 companies included in the sample. Almost three quarters of respondents process wheat into flour products. One European company manufactures dried pasta products. The rest process barley into either malt or beer (or both). One Japanese beer manufacturer also produces roasted barley tea and is included in the brewing category.
Figure G3 to G5 disaggregates industrial activity by region. A variety of food products are made by these companies and this variety is presented in Figure G6.

**Figure G3: Primary Industrial Activity**  
**Europe**

- Brewing: 23%
- Milling: 46%
- Baking: 15%
- Malting: 12%
- Manufacture of Dry Pasta: 4%

**Figure G4: Primary Industrial Activity**  
**South America**

- Brewing: 7%
- Milling: 79%
- Malting: 7%
- Baking: 7%

**Figure G5: Primary Industrial Activity**  
**Asia-Pacific**

- Brewing: 13%
- Milling: 74%
- Malting: 13%
Grain Purchasing Practices

While the companies in the sample use a variety of means to source grain, just over half of the sample use only 1 method to source grain (Figure G7). About one third indicated they use two methods, with fewer than 20 percent using 3 or more methods.

The grain sourcing methods are illustrated in Figure G8.
Figure G9 illustrates that two thirds of the sample are users of wheat (excluding durum) and/or flour. Users of durum/semolina and barley/malt comprise 28 and 26 percent, respectively. The majority of the survey’s participants source grain from North America, Europe, South America and Australia.

Factors in the Grain Purchase Decision
Respondents were asked to rank factors that influence their grain purchasing decisions. The results are illustrated in Figure G10. Among the features presented, grain quality is
reported to be the most important influence on purchasing decisions, with 64 percent of respondents giving quality the number 1 rank. Only 6 percent of respondents identified service as the most important influence on grain purchasing decisions. Other influential factors receiving a lower rank included storage abilities and supply guarantees.

![Figure G10: Most Important Influence on Purchasing Decisions](image)

A minority of companies that participated in the survey (34 percent) utilize just-in-time inventory practices. This is illustrated in Figure G11.

![Figure G11: Just-In-Time (JIT)](image)

**Plant Consumption and Storage Capacity**

Daily plant consumption rates were estimated by dividing reported average storage capacity by delivery frequency. Figure G12 summarizes the daily plant consumption rates for the sample. Almost 45 percent of these companies reported low plant
consumption rates (i.e. less than 200 MT/day). Figures G13 to G15 summarizes the findings for respondents based in South America, Europe and Asia-Pacific, respectively.

Figure G12: Daily Plant Consumption

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Figure G13: Daily Plant Consumption
South America

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Figure G14: Daily Plant Consumption
Europe

---

86
Average storage capacity of the survey’s participants is illustrated in Figure G16. Fewer than half (46 percent) have a storage capacity greater than 10,000 MT. Thirty-five percent have storage capacities less than 2,500 MT.

Figures G17 to G19 illustrate storage capacities for Europe, South America and Asia-Pacific, respectively. Just over ¼ of European respondents reported storage capacities of greater than 10,000 MT. Over half have storage capacities less than 2,500 MT. The mean storage capacity for European processors is approximately 10,000 MT. The mean storage capacity for South American processors is higher at 29,000 MT, with 64 percent
of respondents in this group reporting storage capacities of greater than 10,000 MT. Only 7 percent of South American processors have storage capacities less than 2,500 MT. Asia-Pacific processors have the greatest amount of storage with a mean capacity of 40,000 MT. Fifty-seven percent of this group have storage capacities greater than 10,000 MT, while 29 percent have storage capacities less than 2,500 MT.

Figure G17: Average Storage Capacity
Europe

Figure G18: Average Storage Capacity
South America
Supply Chain Performance
Half of the respondents indicated deficiencies with their current supply chain. This is illustrated in Figure G20. Figures G21 to G23 identifies the supply chain problems in Europe, South America and Asia-Pacific, among respondents reporting supply chain problems.
One third of European grain processors reported experiencing difficulties with their current supply chains. Grain impurities and loose grain specifications create the biggest problems. When shipments arrive with loose specifications, recipes and production systems must be adjusted, creating delays and adding to costs. One Spanish brewer indicated that when the specifications are not adhered to by suppliers, the shipment must be returned. When this happens, there is no inventory to continue production and the plant must shut down. A Norwegian miller claimed that bulk Canadian grain is occasionally blended with bulk U.S. grain in the grain terminals at the Port of Rotterdam, creating inaccurate grain specifications. Grain impurities also add to delays and costs as the shipment must be cleaned before production can begin.

A Norwegian brewer indicated that they would like to reduce stock levels and develop a more responsive supply chain. In addition, they would like to maintain large varieties of grain origins. This causes them tremendous difficulty because the transport system is unable to keep costs low with smaller consignments of varied products.
The leading supply chain problem reported by South American respondents is bulk ship coordination. For small consignments of grain, it appears to be difficult to locate suitable ships. At the time of the survey, one Brazilian miller was in the process of developing a buying consortium amongst other grain importers to reduce logistics costs.

A miller in Venezuela revealed that only one berth for unloading bulk grain exists at the port and is shared by all parties. Frequently, ships must wait for the berth to become available, adding costly demurrage charges.

Lack of consistency between shipments and loose grain specifications also create significant problems for South American grain processors. Occasionally, grain arrives at the port with different quality specifications than what was originally ordered. A miller in Peru indicated that a shipment of grain was transshipped through a third country where it was commingled with other grain varieties. Costs are added when time is needed to adjust production practices between each shipment.

Although loose grain specifications does add to time and costs, having advanced warning from suppliers of the correct specifications of grain that is en route can give the users time to adjust recipes and practices. Seven percent of processors claim that
communication with suppliers is inadequate, creating lost opportunities and increased costs.

Poor storage capability in South America creates opportunities for containerized grain shippers. A Brazilian miller indicated severe infestation problems from January to October. This could be alleviated with containerization.

Finally, a few South American grain processors complained about the effects of Mercusor. Mercusor countries pay stiff duties on grain imported from other regions, limiting the available grain origins to choose from. Additionally, they criticize Argentina’s inferior classification system, saying grain identity is frequently unknown and grain specifications are repeatedly inaccurate.

In Asia-Pacific, half of the respondents indicated problems with their current supply chains. A miller in Japan complained that the Japan Food Agency limits the choice of grains available to processors. The JFA sets standards and purchases grain from exporters based on these standards. Consequently, it is difficult for some Japanese specialty processors to obtain unique or distinctive product specifications required for their needs.
Finally, loose grain specifications, lack of consistency between shipments and moist grain all add to costs when time and resources are spent to adjust recipes and production systems between shipments.

The logistical problems identified by the survey’s participants were also viewed in the context of plant size (as proxied by daily plant consumption). All respondents reporting between 201 and 400 MT also reported at least some supply chain problems (Figure G24).

**Figure G24: Reports of Supply Chain Problems**

<table>
<thead>
<tr>
<th>Plant Size (MT/day)</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 400</td>
<td>62%</td>
</tr>
<tr>
<td>201 - 400</td>
<td>100%</td>
</tr>
<tr>
<td>&lt; 200</td>
<td>54%</td>
</tr>
</tbody>
</table>

The various supply chain problems reported across the three main plant size strata are presented in Figures G25 to G27.

Companies with low daily consumption rates (200 MT/day and less) experience significant problems with bulk ship coordination. This is likely because locating bulk ships suitable for small grain consignments is difficult and can be expensive. This data suggests that this problem seems to be exclusively a South American one.

Loose grain specifications, lack of consistency and grain impurities seem to be problems that are experienced across the board in all regions with all plant sizes. Lack of choice however, seems to be significant only for small to medium sized plants (200 – 800 MT/day) in South America and South-East Asia. It would appear that small amounts of specialty grains for niche-market production are more difficult to secure, either
because local producers are not niche market producers or because variations in grain specifications are difficult to procure from local sellers.

**Figure G25: Logistical Problems**

*Less than 200 MT/day*

- Moist/Mouldy Grain: 8%
- Lack of Choice: 8%
- Grain Impurities: 23%
- Poor Coordination of Dull Ships: 23%
- Lack of Consistency Between Shipments: 15%
- Loose Grain Specs: 23%

**Figure G26: Logistical Problems**

*201 - 400 MT/day*

- Poor Communication With Suppliers: 20%
- Lack of Choice: 20%
- Grain Impurities: 20%
- Loose Grain Specs: 40%
Survey respondents were asked whether they would like to see specific supply chain improvements, and if so, were they willing to pay more for its improvement. The results are illustrated in Figures G28 and G29.
Half of the respondents would like to see some sort of supply chain improvement. Respondents’ willingness to pay for a specific supply chain improvement provides an indication of the severity of a problem. Sixty-three percent of those respondents perceiving a need for improvements indicate that the risks of contamination are a serious problem.

**Conclusions**

The global grains industry exhibits significant variations in both input markets and industrial activity. Millers, bakers, maltsters, and brewers in various regions around the world possess differing plant sizes and storage capacities and use different supply sourcing methods. The survey results suggest that the current system of bulk shipping is proving inadequate in satisfying all the needs of these grain processors.

Many processors serve smaller niche markets. They require more specific quality attributes and more secure supply chains to guarantee the consistency of their products. While not all grain importers appear to be willing to pay higher prices for such service, a significant minority has indicated that they would.

Logistical and product quality problems threaten the profitability of some processors who operate with tight timelines and narrow margins. Vessel demurrage is a
preventable expenditure, but can be a significant component of cost structures. For example, about one third of the respondents indicating supply chain problems cited poor coordination of bulk ships. In addition, time and resources are spent planning each production run. When grain deliveries do not meet expected specifications, further costs are incurred in adjusting recipes, equipment, etc. Many of these problems could be avoided with containers because the shipping lines adhere to tighter schedules.

A container system could provide importers with temporary storage that could be desirable. A small amount of Canadian grain shipped in containers can be blended with domestic stocks without tying up limited storage space. This may be useful for millers with storage capacities less than 10,000 MT. It may also serve the needs of millers with daily plant consumption less than 200 MT/day.

The desirability of containers depends upon the container facilities and bulk service at the ports. For example, two importers complained that U.S. grain is mixed with Canadian grain at their ports because of transshipping. In addition to loss of identity, importers complained about impurities and moldy grain. These problems could likely be avoided by containers and indicate a feature that could be employed to enhance sales.