NORTH DAKOTA STRATEGIC FREIGHT ANALYSIS

Item I. Intermodal Highway/Rail/Container Transportation and North Dakota

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EXECUTIVE SUMMARY

One of the greatest challenges facing rural communities is limited transportation options. Many small companies do not produce quantities sufficient to ship in unit trains or even full truckloads Intermodal shipping should provide companies and identity-preserved producers with truck trailer and container convenience while taking advantage of lower costs provided by rail shipping. Presently North Dakota has no intermodal facility. Short line railroads may enhance their own traffic base and customer service by adding an intermodal option.

A survey of North Dakota businesses' outbound/inbound transportation was conducted to identify containers now being shipped by truck/rail intermodal into and from the state. Results showed that the Southeast portion of North Dakota represented some 63 percent of all traffic. This is due to a combination of business density and willing respondents. A Commodity Flow Survey (CFS) was used to estimate potential container truck/rail intermodal traffic generated in North Dakota. The increased shipments identified in the CFS and previous study estimates of potential intermodal traffic indicate that the railroads view of intermodal is dependant on other variables.

This study provides a snapshot of truck/rail container intermodal shipping into and out of North Dakota. The study revealed the benefits of intermodal transportation including: lower overall transportation costs, increased economic productivity and efficiency, reduced congestion and burden on over-stressed highway infrastructure, higher returns from public and private infrastructure investments, reduced energy consumption, and increased safety.

The truck/rail container intermodal shipping problem in North Dakota is circular in nature. Problems exist in the form of rates and service. Rates are high and service levels low because there is no volume, and there is no volume because rates are high and service levels are low.

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INTRODUCTION

Throughout agricultural history North Dakota has been known for supplying high quality raw agricultural commodities. Throughout the agricultural history of the area, and more recently on a larger scale, economic forces have encouraged North Dakota producers to add value to their commodities either through processing or producing a commodity to fit the specifications of a customer.

The challenge facing value-added and identity-preserved producers is distance to markets. Producers and suppliers in the region must transport products long distances and most have few options. In today's competitive business environment, getting the product to the right place when the customer needs it is increasingly important. Producers must deliver high quality product at a competitive price when the competition often is located closer to the source of final demand.

Value-added agriculture has been an economic development tool used to diversify the economic base of rural communities. One of the greatest challenges communities face is limited transportation options. The primary means for freight transportation in the rural regions is truck and rail. Many small companies do not produce quantities sufficient to ship in full truckload or unit trains, nor do their customers demand these large quantities.

Rural agricultural communities' inbound procurement and outbound distribution options are limited to local trucking companies and rail. Few communities generate enough truck traffic through existing businesses to offer evidence of excess or available truck capacity. Where rail is available, Class I carriers are reluctant to make short, less-than unit train movements, and offer limited options for products other than grain originating or terminating in rural areas.

North Dakota's rail service is made up of two Class 1 railroads, a regional railroad and two short lines. The ideal intermodal freight for Class 1 railroads is a large unit train loaded at one facility and shipped to another and off loaded. This provides the most economical and profitable scenario for Class 1 railroads. Smaller less than trainload traffic generated is viewed by the Class1 railroad as a train of way and the rate charged is more and service is less than that of a designated train.

The purpose of container on flat car (COFC) or trailer on flat car (TOFC) intermodal shipping is to take advantage of the economics of each different mode used. Intermodal provides for truck trailer and container convenience while taking advantage of the lower costs provided by rail shipping.

Currently in North Dakota there is no intermodal facility. Shippers desiring intermodal shipping either have to use all truck, or dray the container or trailer to an intermodal facility. Depending on distance, this may provide a distinct disadvantage for North Dakota shippers. The closest existing intermodal facilities are located in Dilworth, MN.; Minneapolis/St. Paul, MN.; and Billings, MT. Possibilities for siting intermodal facilities on short lines in rural areas may provide rural communities with an opportunity to diversify their infrastructure, transportation rates, and transportation equipment resource base for attracting and growing value-added ventures. Cooperation from Class I railroads and the short line carriers systems may provide opportunities for an intermodal shipping alternative to rural areas of the state.

Intermodal facilities usually are operated by a third party and the railroads serve only as the transportation provider. At present, large intermodal freight volumes are necessary for an economically viable facility. An intermodal facility can range from a simple and relatively inexpensive loading facility using circus ramps, to a sophisticated high cost operation involving gantry or overhead cranes allowing for fast train loading and offloading. The cost of the facility is in direct proportion to the equipment needed, trackage, amount of land, and labor associated with the size and volume of the facility. Another advantage to intermodal is removing some truck traffic from the state highway system. Increased truck traffic may impact the road system to and from the facility, but overall impact on state highways may be lessened.

Objective

The main objective of this project was to evaluate the current truck/rail container intermodal transportation system in North Dakota. This included traffic, rates, and service and facilities. The secondary objective was to determine costs associated with start-up and operating an intermodal facility.

Methodology

This report describes truck/rail intermodal, short line railroads, motor carriers, and the Class I railroads. A survey of shippers was performed to determine the intermodal traffic in the state. Analysis of the Commodity Flow Survey (CFS) also was performed, along with an examination of BNSF's rates out of North Dakota. Cost comparisons were made among modes to determine least cost mode.

Implications

Container intermodal shipping is not an option for many businesses in North Dakota. Many shippers may not know the total landed cost. Landed costs include all logistics costs including transportation to the final customer. This cost may be complicated with multi-modal and or international shipments. There are markets for many North Dakota products, but many times transportation options and costs are the barrier. Intermodal shipping should reduce shipping costs and provide opportunity for competition in domestic and international markets.

Without competitive truck/rail container intermodal service North Dakota shippers remain at a logistical disadvantage. Many industries are affected by lack of intermodal service including: agricultural processors; manufacturers; identity-preserved commodity producers; building suppliers; and retailers, negatively impacting the entire state economy through higher shipping costs.

Container truck/rail intermodal implications to the North Dakota trucking industry would be evident in the case of a modal shift. Diverting freight volume away from truck to rail may be advantageous to shippers, but may be negative to the trucking industry. Where the rail system seems reluctant to accept low volume freight it may be the backbone of many trucking firms.

Report Organization

This report is organized into four sections. The first section is the introduction and background and the next section is the literature review. The report discusses short line railroads, Class I railroads, truck/rail container intermodal, shipping methods or procedures. A shipper survey also is discussed and analyzed. Shipping modes and costs are compared, and finally the conclusions of the report finding.

LITERATURE REVIEW

Characteristics of Intermodal Transportation

Intermodal freight transportation is the seamless and continuous door-to-door transportation of freight on two or more transportation modes, for example, truck-rail or truck-ocean (Muller, 1995). Intermodal transportation growth has been aided by deregulation of U.S. transportation, global business growth, and changes in the business environment (Coyle, Bardi, and Novack, 1994). In 1997, intermodal marketers reported that loadings of trailers and containers increased by 18.7 percent after climbing 23.5 percent in 1996 and revenue grew at 14.5 percent, more than double the 7.1 percent rise in 1996 (WWD, 1998). Service issues, including the Union Pacific network problems, were listed as one reason for the drop in the percentage increase in intermodal loadings from 1996 to 1997.

According to Spraggins (1997) benefits of intermodal transportation include:

- lower overall transportation costs
- increased economic productivity and efficiency
- reduced congestion and burden on over-stressed highway infrastructure
- higher returns from public and private infrastructure investments
- reduced energy consumption
- increased safety

Lower transportation costs are realized by using each mode for the portion of the trip for which it is best suited. For example, rail could be used on the long-distance haul and truck on the short-distance haul to and from the intermodal facility, using the door-to-door service of truck and the economies provided by rail. Using rail for the long-haul portion of the trip may result in improved environmental conditions including improved air quality because of reduced energy consumption. Using fewer trucks for the long-haul portion of the trip lessens congestion in major metropolitan areas and also lessens damage to the roadway.

Intermodal is used in domestic and international shipments. The domestic movement usually is truck-rail while internationally it can be truck-rail-ocean, or rail-ocean, or truck ocean. Containers have increased in popularity in international trade. “It is likely that containers will replace trailers in North American cross-border movements and even in domestic intermodal movement” (Spraggins, 1997). Trailers will remain important in the short haul and low volume loads. Some bulk commodities now are moving by containers. These commodities mostly are food commodities, such as bananas and coffee and other fresh fruits. Demand for identity-preserved (IP) commodities also is on the rise. Identity-preserved may be simply providing a customer with a specific product origin, or as complex as guaranteeing and ordering specific agronomical practices (Vachel, 2000). Organically grown wheat or soybeans for export are examples of identity-preserved commodities. Although identity-preserved could be a train of 110 cars of 14 percent protein spring wheat weighing 60 pounds per bushel and having 12 percent moisture with less than 1 percent dockage, most identity-preserved shipments tend to be small quantities, and of higher value. Containerization ensures the shipper and receiver integrity of the product being shipped. Identity-preserved market demands may increase demand for container shipments in rural settings where commodities are grown.

Many farmers are seeking ways to add value to their farming operations and many are exploring the possibility of exporting IP grain in small lots. Rural North Dakota identity-preserved grains need the containers and the economies of shipping by rail long distance for this concept to work. Without an intermodal loading facility within a reasonable distance, any premium negotiated for the IP shipment may be lost to transportation costs.

Intermodal facilities vary in size, equipment used, and type of facility. Increases in intermodal freight has led to the development of intermodal hubs, or terminal locations, where trains are gathered and cars are exchanged or switched to form new trains. “These ‘hub-and-spoke’ operations take advantage of reducing the number of point-to-point operations when the volume is not large enough to make them cost efficient" (Muller, 1999).

Consolidation in the rail industry created duplicate services and many times the remaining carrier consolidated duplicate services into one. The rail industry targeted less profitable inefficient intermodal facilities in smaller cities where less-than-unit trains delivered and picked up containers and trailers, which were loaded through the use of circus ramps. This service has been reduced from approximately 1,500 operations in 1970 to less than 370 in 1998 (Muller, 1999). This reduction in facilities has limited transportation options for many shippers in smaller cities or rural areas. Reliable, timely, cost competitive intermodal service is not available in many rural areas.

Shippers cite that improvements in timeliness and price competitiveness are important enhancements that would cause them to shift to intermodal usage (Spraggins, 1997). A survey reported by Spraggins (1997), reaffirmed that the service gap between intermodal and truckload services is the greatest barrier to improving intermodal's share of the North American freight market. Intermodal generally is thought of as a practical alternative for general freight (non-bulk) that moves in full trailerload or containerload lots (Spraggins, 1997). In general, intermodal usage varies by the size of the company, products being shipped, and distance from an intermodal hub.

The largest barrier to many companies using intermodal shipping is the location of intermodal hub facilities. An intermodal loading facility located within a reasonable distance is essential to justify using intermodal as a viable transport mode. As distance to an intermodal facility increases, it becomes uneconomical to use the intermodal option as transit times and distance costs increase. This explains why many small, rural companies simply continue to use trucks to transport product.

Intermodal Transportation Facilitators

Transportation facilitators serve shippers and carriers by arranging the transportation of the cargo. Some facilitators perform transportation functions, including consolidation, palletizing or containerizing of freight for shippers (Muller, 1999). Facilitators also may use their own documentation for the movement. Facilitators include many categories of participants: 1) domestic freight forwarders; 2) international freight forwarders; 3) import brokers; domestic air freight forwarders; 4) air cargo agents; 5) shipper councils, associations, and cooperatives; 6) intermodal marketing companies; 6) transportation brokers; 7) perishable brokers; 8) consolidators; 9) transloaders; 10) distribution carriers; 11) customshouse brokers; 12) export management companies; and 13) third-party logistics firms (Muller, 1999).

Intermodal marketing companies can provide door-to-door services tailored to specific customer needs. Third-party logistics companies also perform door-to-door service have been growing in popularity. Intermodal marketing companies or third-party firms provide many of the functions provided by the groups listed above. Most intermodal loading facilities are not operated by the railroad that services the facility. Third party providers act as a liaison between shippers and the railroads providing customer service, access to equipment, and attractive rates because of volumes associated with the third-party provider.

For an intermodal terminal to provide efficient effective service, close cooperation among all parties is necessary. Muller (1999) identified the requirements of a successful intermodal terminal as follows:

- Furnish necessary personnel and container-handling equipment to receive, store and deliver intermodal trailers and containers.
- Prepare all necessary documents for receiving and delivering intermodal containers and trailers, ensuring that all port, airport, and other terminal charges, customs duties, and freight charges have been paid.

- Maintain a status report of all trailers and containers received, delivered, and on hand in the terminal for submittal to carriers involved.

- Maintain accurate inventory and locations of all intermodal trailers, containers, and equipment.

- Preplan all loading and unloading operations from data supplied by carriers and their agents.

- Provide necessary personnel and equipment to service loading and unloading operations between modes.

- Prepare all cargo plans, hazardous cargo manifests, and related documents for delivery to the carrier and its vehicles.

- Maintain security for all containers and equipment in the terminal.

- Prepare all reports relative to terminal functions

- Furnish adequate supervision to ensure proper performance of all operations.

If a sole carrier uses the terminal, all functions can easily conform to the needs of that carrier. If more than one carrier is served, all carriers' operational requirements must be met without interfering with other carriers. Other characteristics of a good terminal include a convenient location, access, and adequate infrastructure.

Motor Carriers

Although the trucking industry is perceived as a competitive homogenous industry, many characteristics segment the industry into sub-industries. The trucking industry is classified as either local or intercity. There are vast differences between these two segments. Local carriers include intercity delivery services such as dump trucks, garbage trucks, and other services (Titus, 1994). Intercity trucking is classified between less-than-truckload (trucks hauling less than 10,000 pounds) and the truckload sectors.

Many small truckload (TL) firms operate in the motor carrier industry. An estimated 590,000 trucking companies operate in the United States (Coyle, Bardi, and Novak, 1994). Of the regulated carriers in the trucking industry, it is estimated that more than 95 percent are companies with less than $1 million in gross revenue (Coyle, Bardi, and Novak, 1994). Many of these smaller companies are owner/operators or small firms with a few trucks.

Trucks have an important role in moving commodities to market in and out of North Dakota. Grain shipments by truck declined from 34 percent in 1978 to a low point of 21 percent in 1987 (Dooley, Bertram, and Wilson, 1988). Since 1987, the truck portion of the grain shipments have been on the increase; and in 1999, the truck portion of grain movements was 31 percent (Vachal, 2000). This increase is associated with the increasing proportion of commodities that are shipped to locations in the state. In-state shipments in the 1983-84 crop year were 8 percent of the crop compared to 1999-00 where 18 percent of the crop was shipped to in-state locations (Vachal, 2000).

The increase in satellite elevator facilities, associated with the changes in the elevator industry, and value-added processing plants in North Dakota give the trucking industry a larger role to play in grain movement in North Dakota. Shuttle trains and heavier grain cars may put short line railroads and smaller elevators at a disadvantage resulting in longer farm-to-market movements for grain by truck. Even though most of the bulk grain still will leave the state in a unit train, the transportation cost saving that may be provided by shuttle's will provide incentive for longer movements by truck.

Changes in manufacturing and supply chain management have lowered inventories and created a move toward just-in-time inventory management. These new changes have increased the need for quality on-time transportation. Trucking is a large part of the product movement in the supply chain. The service that trucks can provide, in many instances put rail at a disadvantage. Using a combination of trucks and rail for long movements, takes advantage of the economies of rail, while providing for the convenience of door-to-door service provided by trucks.

Short Line Railroads

Short line railroads are an important component of the North Dakota and U.S. transportation system. Short lines, although many times limited by infrastructure and equipment availability, provide an added link between rural communities and the world.

Although the current rail system will continue to be the mode of choice for origination of the regions' commodity shipments, it is important to investigate alternatives for enhancing transportation services that can be used to attract business ventures. Because the agriculture community is pursuing value-added ventures and exploring the value of identity-preserved products, having the option of shipping less-than-trainload quantities with reasonable transportation rates is increasingly critical. Short line railroads may provide the avenue of reasonable rates for shipping smaller quantities. North Dakota's three short line railroads account for 32 percent of the rail track in the state, serving the northern tier, western, south central, and southeastern regions of the state.

There are three events tied to the formation of the current short line rail industry (Dooley, 1991). First, legislation establishing Conrail in 1973 provided initial stimulus for the formation of new railroads. Second, reorganization of the Milwaukee Road and the liquidation of the Rock Island creating opportunities for short line. Third, federal railroad deregulation leading to opportunities for short line creation. The deregulation legislation of the 1970s included provisions of operational subsidies and rehabilitation funds for light density branch lines (Dooley, 1991). The Staggers Act of 1980 provided communities and shippers with opportunities to purchase or support rail lines identified for abandonment by Class I carriers (Dooley, 1991).

Intermodal freight transportation growth has been increasing by double digit gains, except for 1996 where there were problems because of Class I railroad mergers. Mergers by Class I railroads has led to larger railroads, but a reduction in the total track controlled by the Class Is. Class I railroads have abandoned or sold off light density rail lines. The 4-R Act and the Staggers Act eased the abandonment process requiring the Interstate Commerce Commission to speed approval of abandonment (Keeler, 1983). The deregulation designed to streamline Class I railroads has paved the way for the formation of short-line railroads. Short line railroads serve as the bridge between rural communities and the larger railroads leading to markets. Short line railroads also serve as low-cost feeder lines for Class I railroads. Dooley (1991) recognized three reasons for the creation of feeder lines, or short lines:

1. A desire to eliminate the burdens of ownership (high operating and maintenance costs),
2. An expectation to recover some economic value from the line (sales revenue),
3. A desire to preserve the benefits associated with ownership (access to traffic originated or terminated on the lines).

Babcock, Russell, Prater, and Morrill (1993) evaluated the viability of short line versus abandonment. The study revealed strengths and weaknesses of the short line industry. The advantages short lines have over Class I include lower labor costs, superior shipper service, and reduction in truck shipments reducing highway maintenance and rehabilitation. Disadvantages to short line include their inability to make large capital expenditures resulting in deferred maintenance. Many times short line are dependent on limited business sources or customer base, and they also are dependent on the Class Is railroads for equipment and access.

Additional factors determining a short line railroad's success or failure are many. Possibilities exist through economic development and by increasing density or customer base by establishing an intermodal facility would increase volume on a short line, creating revenue, and adding a transportation option for shippers in the surrounding area. Another important benefit includes reduced highway maintenance because of less truck traffic.

Babcock, Russell, Prater, and Morrill (1993) identified components associated with a short line's success. These components include anticipated components such as traffic and efficiency and others unique only to the short line railroad industry. The components associated with profitable short line include:

Traffic Components

- Adequate density
- Non-seasonal traffic
- Diversified traffic base
- Product mix with high valued product

Management and Labor

- Motivated, skilled workforce
- Experienced management
- Skilled marketers (understand customer needs)
- Management close to shippers
- Cost controls

Relationship to Class I

- Multiple connections
- Guaranteed access
- Reasonable switching costs
- Set rates
- Mutual benefits

Financial

- Equity investment
- Realistic business plan
- Realistic purchase price

- Adequate capital
- Rehabilitate track

Track Quality

- Track maintenance and investment

State Assistance

- Financial assistance
- Information
- Economic development
- Financial insurance plan

It would be intuitive that many of the factors that make for a successful short line also could be the same factors that would make a successful truck/rail container intermodal loading facility. Moreover, the relative importance of a single value-added venture is much greater for a short line carrier than for a large Class I railroad. Partnering rural communities, producers, producer-initiated value-added processors, rural manufacturers, and a local short line carrier in the start-up and operation of a rural intermodal loading facility may present opportunity for economic expansion of rural communities and the surrounding area.

North Dakota is well-versed in the importance of short-line railroads as an alternative for continuing rail service on lines deemed unprofitable by Class I railroads. Intermodal facilities on short lines would provide rural business and communities alternative transportation options for those desiring expansion of their economic base. Moreover, short line railroads may enhance their own traffic base and customer service by adding an intermodal option.

Intermodal and Class I Railroads

Intermodal transportation has been hailed as the savior of the railroads, but the rapid growth of the 1980s and 1990s has slowed. This does not mean that the intermodal business is declining for the railroads. The expedited high reliability, low transit time ground transportation for freight is a 400 billion dollar market. Of this large pie the railroad only has about a two billion dollar share. The growth potential for rail is huge (Ellis, 2000). For the railroad to gain market share from the trucking industry, service and transit time must improve.

Even though intermodal is the fastest growing sector for the rail industry the Class Is face lowered revenue per car than other enterprises. Historically, intermodal produces the least revenue, but generates the most traffic. Financial statements for the Union Pacific (UP) and the Burlington Northern Sante Fe (BNSF) show the intermodal revenue problem. In 1999, the UP moved 2,738,000 intermodal carloads, an 8 percent increase over 1998 (1999 UP Annual Report). However, comparing carload revenue among shipment types, it generated approximately one-half of the next lowest revenue source. The intermodal freight generated $630 per car compared to $1,158 for the next lowest revenue commodity (1999 UP Annual Report).

BNSF moved 3,203,000 cars in 1999, up from 3,080,000 in 1998. This intermodal traffic resulted in $2,507,000,000 in revenue. The revenue per car was $783, compared to the next lowest revenue per car at $1,049 (1999 BNSF Annual Report). Industry analysts view the low revenue per car for intermodal freight as a potential pitfall for the financial health of Class I railroads. The concern is that the growth potential for the railroads is only in intermodal freight and most other commodities have limited potential. Because of service problems historically associated with rail, many shippers are reluctant to switch to rail because of the service levels and timeliness of trucking. Improved service levels or excellent service may provide railroads an avenue for increasing rates on intermodal traffic.

Fixing service problems is the number one comment from most rail shippers (Ellis, 2000). BNSF is working toward improved service by providing a performance guarantee on intermodal service on five lanes. On-time performance still may not provide the service desired by many shippers. A truck legally can transport from coast to coast in about 100 hours. The best rail intermodal service is just under that of trucks, but the actual delivery time is not consistent because of congestion in intermodal yards and other problems. For rail intermodal to meet truck delivery time head to head, railroads would have to raise speed restrictions to between 80 and 90 miles per hour. Because of costs and safety issues this is not a practical approach.

Interchange problems also exist for many urban rail yards. For instance, in 1995 a car was traced from Los Angeles to Chicago, about 2,200 miles. The main trip was 48 hours, but it took another 40 hours to move the next 40 miles through Chicago and get to the final destination. Again in 2000 this same route was timed and dramatic improvement was made, but it still took over 24 hours to move the last 40 miles. One reason for the large dwell times in many cities is that each rail carrier uses a separate intermodal facility, which results in slow exchanges (Wallace, 2000). Sharing facilities could provide improved service levels. Sharing facilities among different railroads mitigates the space problem and may increase efficiency. Other ways of improving performance is to bypass bottlenecks. An example is Kansas City Southern's "Meridian Speedway," which connects the BNSF and Norfolk Southern, while bypassing major bottlenecks in urban areas (Wallace, 1997).

Fixing the service problems could contribute to successful intermodal operations. Management could reorganize and streamline operations. In the early 1990s the Santa Fe railroad turned intermodal from their least profitable segment to a level comparable to carload traffic. Santa Fe modeled their management after motor carriers, viewing intermodal operations as "profit centers." Santa Fe created an intermodal business unit to run independently, creating a new organizational structure. The main advantage of the new department was a complete picture of the business. Previous responsibilities were spread out among many departments. Santa Fe focused heavily on intermodal marketing companies (IMC). Santa Fe found 20 percent of IMC customers produced 80 percent of the business, so they dropped the number if IMCs used from 260 to 55 (Giblin, 1996). Santa Fe aggressively invested in new longer 48-foot containers, compared to the old 45-footers. The next move is to 53-foot containers, another efficiency move for shippers (Lang, 1998). In 1994 Santa Fe offered six levels of service with six different prices. Santa Fe found that premium traffic provided the most profit and customers were willing to pay for guaranteed service (Giblin, 1996).

Another efficiency gain for Santa Fe was improved lane balance. Lane balance is the ratio of full to empties moving in any given direction. Trucks usually operate with a ration of 95 percent full and 5 percent empty, while Santa Fe was 55 percent full and 45 percent empty. Through aggressive pricing Santa Fe improved the ratio to about 95 percent full. Santa Fe also exited from all lanes were they did not see a clear competitive advantage.

Intermodal growth has brought about capacity questions. Intermodal loadings increased rapidly during the 1990s. Intermodal loadings are terminal intensive, which may provide bottlenecks for delivery. Container loadings increased some 32 percent in the 1990s and trailer loadings decreased slightly. The shift to containerization has brought three changes for international shipping to and from the United States. First the ships have grown much larger demanding that many more containers be stored at the port facility. Second, railroads are hauling large amounts of intermodal containers creating higher infrastructure costs. Third, the land bridge traffic has increased with higher rail and ship efficiencies; thus Asian traffic is being shipped across land and sea (Luberoff and Walder, 2000).

These larger ships force extensive upgrading at port facilities to handle the large ships and remain viable. The ports of Los Angeles and Long Beach have granted $394 million for the Alameda rail corridor. This corridor is a $2.4 billion 22-mile long depressed grade with separated rail and will connect the port facility with the rail facilities of the BNSF and UP. Other ports like Tacoma and Oakland are considering similar projects (Luberoff and Walder, 2000). Other technology like remote controlled cranes and new smart gates that send draymen directly to loads, should help improve port and other facilities.

If the rail capacity exists, intermodal transportation has room for growth. Chemical shipping has only begun to use intermodal. Over the past decade the world's tank fleet expanded about 10 percent a year. In Europe the tank container has captured a large share of tank truck traffic. The intermodal tank, or tanktainer, offers many advantages over tank trucks. Intermodal tanks can be shipped overseas easily, placed on ships or railcars quickly and easily, used for temporary storage on site, and offer more structural protection than the tank truck. Currently there are an estimated 100,000 tank containers in service worldwide, most common being the 20- foot International Organization for Standardization (ISO) tank. The chemical industry is the leading user of tank containers but many industries including food, beverage, oil, gas, and electronics also use them (Corkhill, 2000). The intermodal usage currently is most cost effective on moves over 350 miles, but the Hoyer Corporation of Germany has proved the success of the short haul. Hoyer runs a 75-mile intermodal tank container shuttle that runs five times a day with up to 14 tank containers. The service is highly used and is profitable (Corkhill, 2000).

In the United States about two-thirds of chemical manufacturers rely on a single rail carrier in tank cars. The chemical industry uses rail to ship bulk commodities because they can be handled safer and more efficiently by rail than by truck (Corkhill, 2000). This provides a large potential market to ship chemicals domestically and internationally. The ISO tanktainers are well-suited for international use. They fit existing slots on container ships and carry the maximum volume of product allowed under the road regulations of various countries around the world. Some reasons that these tanks have not been adopted by U.S. manufacturers include companies are unfamiliar with the method, changes would have to be made to loading facilities, and companies may be unwilling to make the necessary investment to change to a country wide container infrastructure (Corkhill, 2000).

Beside tanktainers, there is a potential to move non-bulk finished chemical goods by intermodal container. Du Pont began using some intermodal in the early 1990s and plans to continue to expand because it provides a measure of safety and also has a cost advantage.

Another system with possible growth potential is the RoadRailer. RoadRailers first started in 1964 with the Chesapeake & Ohio Railroad. RoadRailers can be used as a truck trailer, or train freight car. RoadRailers captured attention in the 1980s when they began being used extensively on the East Coast by Northfolk Southern and its Triple Crown service. However RoadRailers have been slow to catch on for long distance moves. Amtrak is now using RoadRailers to move mail for the U.S. Post Office. The RoadRailers are bi-directional and can run at speeds up to 114 miles per hour, so there is potential for long distance, high-speed transfers. The new RoadRailer has half the capacity of a regular sized boxcar, but weighs 75 percent less and saves on fuel. The RoadRailer can be added or taken off a train most anywhere saving on infrastructure costs and may reduce drayage.

This technology is used on a limited basis but may provide opportunity. Other technological advances also provide new possibilities and efficiency to the transportation industry.

Transportation Technology

Communication technology has revolutionized the transportation decision-making process for shippers, carriers, facilitators, and government agencies. Information technology provides users with better control over operations and for carriers, control results in efficiency gains. Muller, 1999, identified the current uses for electronic information:

- Identify the best rates and service levels available from carriers and facilitators.
- Book, issue, account for, and generate reports on freight shipments.
- Track and manage assets, especially containers and chassis.
- Plan, trace, and confirm routing of intermodal equipment and their cargoes.

- Examine the sequence of intermodal operations, especially at terminals.
- Manage documentation.
- Respond quickly to emergencies or change of opertional orders.
- Confirm specific operations associated with the entire shipment including pickup and delivery.
- Measure performance of carriers and facilitators.
- Budget and manage costs.

Total software solutions also are being touted for all businesses. SAP and Oracle promote enterprise software that provides EDI capablities and offers a company other software. Software technology reduces errors by eliminating re-keying of data.

The rail industry was first in EDI applications because so much of the traffic is handled on more than one railroad. Railroads now use EDI in many applications including: bills of lading, shipment status, weights, equipment and cargo weights, yard management, waybill retrieval, freight claim submissions, interline tracing, rate requests, logistics costs evaluation, fleet management, and other modules to meet specific customer needs (Muller, 1999).

EDI provides trucking firms with many of the same applications of rail. These technology tools help trucking companies improve services offered to customers. EDI provides trucking companies with the ability to partner with customers and develop initiatives, such as “quick response” and “just-in-time” strategies. Trucking companies also employ “satellite tracking” systems for load and equipment tracking. These technologies support trucking company goals of increased efficiencies and provide better customer service resulting in better relations with customers and other carriers.

EDI communications systems at port facilities benefit terminals with accelerated gate movements, greater security, better data entry, and total better overall facility management. Ocean carriers have more international transactions and prefer EDI. Most modes find it necessary to employ

EDI technology to communicate with exporters, customs brokers, freight forwarders, port authorities, and government agencies.

Many carriers are adopting and enjoying the use of financial EDI. This provides for better cash flow and easier payment methods for customers. Many large retailers and manufacturers are using the technology. Electronic funds transfer (EFT) and electronic payment remittance advice are being used widely. Using these technologies are labor savings and provide for error free transactions. Given the number of transactions a large company may have daily the savings may be substantial.

Other technologies that provide efficiencies and peace of mind for customers are tracking and routing. Satellite technology uses two-way messaging service, provides for improved customer service, helps with measuring performance, and provides for better overall customer relations. Carriers can use a combination of Global Positioning System (GPS) and EDI to provide customers with real-time status information about their shipments. Other tracking technoligies include cellular phone communications. UPSs system uses cellular and the software system called MaxiTrac, which customers can aquire and install on their own computer systems.

Terminals, often use barcoding to keep track of equipment or shipments. Transponders or transmitters are located at the yard entrance and other places within a yard or warehouse. As products are moved, these transmitters read the barcode and transfer information to a computer and reporting location of the product. Technological changes also occur in the trucking industry. Motor carrier technology changes in trailers and combinations of trailers continue to change the cost structure of the trucking industry. Safety technology, such as anti-lock brake systems and air ride suspension for tractor and trailer, improve trucking quality with less freight damage.

The use of cell phones, satellite tracking, on-board computers, and other technological changes also have improved efficiency in the trucking industry. Cell phones can be used to locate loads, thereby reducing search time. Automatic billing and electronic data interchange (EDI) may reduce time spent billing and doing accounting procedures. EDI is direct computer-to-computer communication that can be processed by the receiver without re-keying information. EDI facilitates the move toward efficiency in the supply chain (Crum, Premkumar, and Ramamurthy, 1996).

North Dakota's Outbound/Inbound Intermodal Survey

A survey was conducted of North Dakota businesses. Chosen from a combination of the Department of Economic Development and Finance list of manufacturers in Bismarck and the Manufacturers Register of the State of North Dakota. A total of 457 businesses were surveyed, with 195 responding.

The survey identified 8,999 containers now being shipped by truck/rail intermodal from North Dakota (Table 1). This survey did not include elevators or individual farmers or groups of farmers now shipping identity-preserved grain. Respondents identified that the majority of shipments were from the Southeast portion of the state. The Southeast portion of the state represented some 63 percent of all traffic. The Southcentral area of the state identified the next most traffic. There were many more respondents from Southeastern and Southcentral North Dakota than from the rest of the state. Of the 195 respondents, 85 were from Southeastern North Dakota and 28 were from Southcentral North Dakota.

Table 1. Intermodal Survey: State Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	100	0%	100%
Trucks	2954	61%	39%
Containers	8011	65%	35%
Domestic			
Rail Car	1416	55%	45%
Trucks	32162	57%	43%
Containers	988	50%	50%

Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	104	50%	50%
Trucks	2064	61%	39%
Containers	813	50%	50%
Domestic			
Rail Car	1034	50%	50%
Trucks	19162	64%	36%
Containers	0	0%	0%

The respondents in the northwest region identified 17 containers — outbound and inbound. This may represent problems associated with the distance to an intermodal loading facility. The northwest region represented a balance for inbound and outbound trucks and containers. The northwest region of North Dakota includes the city of Minot. The number of businesses responding in Ward County was only 10, which does not provide an adequate representation of the northwest region of North Dakota.

Table 2. Intermodal Survey: Northwest Region Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	4	0%	100%
Trucks	277	50%	50%
Containers	14	58%	42%
Domestic			
Rail Car	0	0%	0%
Trucks	838	59%	41%
Containers	0	0%	0%

Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	0	0%	0%
Trucks	293	69%	31%
Containers	3	50%	50%
Domestic			
Rail Car	0	0%	0%
Trucks	1150	64%	36%
Containers	0	0%	0%

The survey identified only truck traffic for the North-central region of North Dakota. Respondents identified no container traffic. The survey results are based on respondents and business density, therefore some areas of the state with low volume may not be a true representation of actual freight flows to and from an area.

Table 3. Intermodal Survey: North Central Region Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	0	0%	0%
Trucks	36	80%	20%
Containers	0	0%	0%
Domestic			
Rail Car	0	0%	0%
Trucks	1154	53%	48%
Containers	0	0%	0%

Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	0	0%	0%
Trucks	212	75%	25%
Containers	0	0%	0%
Domestic			
Rail Car	0	0%	0%
Trucks	268	40%	60%
Containers	0	0%	0%

No containers were identified in the northeast region of North Dakota. There were only five respondents from Grand Forks County. A previous feasibility study for locating an intermodal facility at Grand Forks indicates a much larger freight flow from northeast North Dakota.

Table 4. Intermodal Survey: Northeast Region Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	0	0%	0%
Trucks	182	50%	50%
Containers	0	0%	0%
Domestic			
Rail Car	0	0%	0%
Trucks	249	63%	37%
Containers	0	0%	0%

Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	0	0%	0%
Trucks	53	50%	50%
Containers	0	0%	0%
Domestic			
Rail Car	0	0%	0%
Trucks	204	62%	38%
Containers	0	0%	0%

The southeast region of North Dakota represents the largest freight flow volumes from any areas in the state. This is a combination of business density and willing respondents. The southeast region also is closest to an intermodal loading facility, which is located in Dilworth, MN. The southeast region identified more than 8,000 outbound containers and more than 800 inbound containers. This represents a ratio of about 10 to 1. For every 10 containers leaving the state, only one returns loaded. There is a cost associated with moving empty containers to shippers in the state. The southeast region also identified more than 20,000 trucks originating freight annually.

Table 5. Intermodal Survey: Southeast Region Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	100	0%	0%
Trucks	1436	50%	50%
Containers	7946	65%	35%
Domestic			
Rail Car	50	0%	0%
Trucks	19164	60%	40%
Containers	780	50%	50%

Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	104	50%	50%
Trucks	1426	75%	25%
Containers	810	87%	13%
Domestic			
Rail Car	30	100%	0%
Trucks	14114	68%	32%
Containers	0	0%	0%

Table 6 shows that respondents reported 208 containers originating in south central North Dakota. The second highest response also was from the south central region of the state. This traffic represents a long drayage movements for empty and full containers to reach an intermodal loading facility.

Table 6. Intermodal Survey: South Central Region Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	0	0	0
Trucks	4	100%	0
Containers	0	0	0
Domestic			
Rail Car	1260	60%	40%
Trucks	7413	56%	44%
Containers	208	50%	50%

Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	0	0%	0%
Trucks	52	50%	50%
Containers	0	0	0
Domestic			
Rail Car	1004	25%	75%
Trucks	2558	59%	42%
Containers	0	0%	0%

Respondents from the southwest region of the state reported no container shipments. Outbound truck traffic was significant, but the long distance to an intermodal loading facility makes intermodal shipping impractical because of the high cost of drayage.

Table 7. Intermodal Survey: Southwest Region Total

OutboundBusines	Number	Eastbound	Westbound
Export			
Rail Car	0	0%	0%
Trucks	36	67%	33%
Containers	51	75%	25%
Domestic			
Rail Car	156	50%	50%
Trucks	3084	49%	51%
Containers	0	0%	0%
Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	0	0%	0%
Trucks	28	50%	50%
Containers	0	0%	0%
Domestic			
Rail Car	0	0%	0%
Trucks	868	78%	22%
Containers	0	0%	0%

The survey provides some insight into the shipping patterns for North Dakota. The low response rate in some areas of the state may not result in true representation of actual freight movements.

The survey revealed 8,999 outbound shipments by container. The factor most often identified by respondents in making shipping mode decisions was price or rate. The next factor respondents identified that determined transportation mode was availability. Third on the list was time or service.

Economic Census Commodity Flow Survey

Comparisons can be made using the Commodity Flow Survey within the Economic Census that is compiled every five years covering years ending in two and seven by the United States Department of Commerce. The economic census is the major source of facts about the structure and functioning of the United States economy. The census furnishes an important framework for such composite measures as the gross domestic product estimate, input/output measures, production and price indexes, and other statistical series that measure short-term changes in economic conditions.

Some of the tables from the Commodity Flow Survey have been replicated here to provide information as to the type and quantity of freight moving from North Dakota. Some inferences and estimates can be made about truck rail intermodal freight movements from the data in the CFS.

North Dakota Commodity Flow Analysis

North Dakota entities face difficulty in determining the flow of goods to and from the state. Partial data is collected by different organizations, but no clear picture exists on the flow of either manufactured, or value added agricultural products. The Upper Great Plains Transportation Institute tracks grain shipments out of the state by mode, type, and destination. The Commodity Flow Survey data collected by the Department of Commerce provides a snap shot of freight movement in out of the state every five years.

Economic Census Commodity Flow Survey

The following section uses data from the 1997 Commodity Flow Survey from the economic census to compare transportation trends for North Dakota with National trends. Using

Commodity Flow Survey (CFS) information provides for estimates in the types of transportation flows for North Dakota versus National flows and evaluate differences in trends. In this survey, framework data are not used that would disclose the operations of an individual firm or establishment.

CFS Inclusions

Modes identified in the CFS are:

1. Parcel delivery/courier/U.S. Postal Service
2. Private truck
3. For-hire truck
4. Railroad
5. Shallow draft vessels
6. Deep draft vessels
7. Pipeline
8. Air
9. Other mode
10. Unknown

Within the tables of the CFS they used eight different classifications or modes. They include:

1. **Air** (includes truck and air)

2. **Single modes**. Shipments using only one of the above-listed modes, except parcel or other and unknown.

3. **Multiple modes.** Parcel, U.S. Postal Service or courier shipments or shipments for which two or more of the following modes of transportation were used:

   Private truck
   For-hire truck
   Rail
   Shallow draft vessel
   Deep draft vessel
   Pipeline

The CFS did not allow for multiple modes in combination with “parcel, U.S. Postal Service or courier,” “unknown,” or “other.” By their nature these shipments may already include various multiple mode activity.

4. **Other multiple modes**. Shipments using any other mode combinations not specifically listed in the tables.

5. **Other and unknown modes**. Shipments for which modes were not reported or were reported by the respondents as “other” or “unknown.”

6. **Truck**. Shipments using for-hire truck only, private truck only, or a combination of for-hire truck and private truck.

7. **Water**. Shipments using shallow draft vessel only, deep draft vessel only, or Great Lakes vessel only. Combinations of these modes, such as shallow draft vessel and Great Lakes vessel are included as “Other multiple modes.”

8. **Great Lakes**. In the tables “Great Lakes” appears as a single mode because mileage calculations are done for only the lakes portion of the movement.

The CFS identified shipping within and out of the state of North Dakota. Three different modes are truck, rail, and air, or some combination of two or more modes. In the Commodity Flow Survey (CFS) Economic Census, respondents are ask which modes are used for shipments. Table 8 uses data from the CFS and shows shipments by mode from 1993 and 1997 for the whole U.S. The most notable figures are for all modes where tons increased by 14.5 percent. Examining truck rail multimode, the tonnage increased 33.5 percent while value decreased almost 9 percent (Table 8).

Comparing U.S. statistics with the state of North Dakota statistics shows that freight shipments for North Dakota grew at a much higher rate than that for the average of the U.S. All categories increased more than the national average. Tons of freight originating in North Dakota increased over 44 percent from 1993 to 1997. Comparing North Dakota to the National average where tons increased by 14.5 percent. This should indicate a growing economy, however the latest statistics on economic growth show that North Dakota lags behind most of the rest of the nation in many areas. This becomes problematic in drawing a conclusion about what is happening in North Dakota. Census Bureau data reveals that the North Dakota economy grew at an average annual rate of 4.1 percent in the same time period.

There also are gaps in the Commodity Flow data for North Dakota in the multi-modal section. The data is missing because of the nature of the survey where there are few respondents and the results may not be statistically valid.

Table 8 compares the changes in freight shipments from 1993 to 1997. Percentage change in U.S. freight shipments are compared to the percentage change in North Dakota shipments by mode, value, weight and average miles per shipment according to the CFS.

Table 8. Comparison of United States and North Dakota Shipments

Mode of transportation	Value		Tons		Average Miles Per Shipment	
	Percent Change U.S. Shipments	Percent Change North Dakota Shipments	Percent Change U.S. Shipments	Percent Change North Dakota Shipments	Percent Change U.S. Shipments	Percent Change North Dakota Shipments
All Modes	18.8	44.4	14.5	44.5	11.4	54.
Single modes	15.7	46.5	17.0	24.6	-6.4	35.3
Truck	13.1	48.8	20.6	44.8	-.1	5.5
For-hire truck	10.5	63.7	21.2	54.2	2.9	-14.7
Private truck	16.0	38.0	16.8	30.7	2.1	10.9
Rail	29.2	59.9	.4	17.3	.3	54.2
Water	23.1	-	11.5	-	S	-
Air (includes truck & air)	64.7	351.0	42.6	294.2	-2.5	37.3
Pipeline	26.3	S	27.8	S	S	S

On average, the value of U.S. shipments grew at a faster rate than tons shipped. This would indicate growth in the shipping of value-added products. The largest value increases were in rail and truck/rail parcel. This would indicate that the growth in less-than-load (LTL) shipments are using truck/rail intermodal. The package companies like UPS or Fed X and other large package use the railroads to reduce costs for long haul shipments. LTL trucking firms also use the railroads to reduce shipping costs. With large volume and consistent business the railroads strive to meet the rate and service needs of these large customers.

Table 9. U.S. Shipments by Mode, Value, Weight, and Weight-Distance

Mode of transportation	Value			Tons			Ton-miles		
	1997	1993	percent change	1997	1993	percent change	1997	1993	percent change
All Modes	6943988	5846334	18.8	11089733	9688493	14.5	2661363	2420915	9.9
Single modes	5719558	4941452	15.7	10436538	8922286	17.0	2383473	2136873	11.5
Truck	4981531	4403494	13.1	7700675	6385915	20.6	1023506	869536	17.7
For-hire truck	2901345	2625093	10.5	3402605	2808279	21.2	741117	629000	17.8
Private truck	2036528	1755837	16.0	4137294	3543513	16.8	268592	235897	13.9
Rail	319629	247394	29.2	1549817	1544148	.4	1022547	942897	8.5
Water	75840	19749	23.1	563369	505440	11.5	261747	271998	-3.8
Air	229062	139086	64.7	4475	3139	42.6	6233	1415	55.5
Pipeline	113497	89849	26.3	618202	483645	27.8	S	S	S
Multiple modes	945874	662603	42.8	216673	225676	-.4	204514	191461	6.8
Parcel	855897	563277	51.9	23689	23689	25.4	17994	13151	36.8
Truck & Rail	75695	83082	-8.9	54246	54246	33.5	55561	37675	47.5
Truck & Water	8241	9392	-12.3	33215	33215	-51.2	34767	40610	-14.4
Rail & Water	1771	8636	-51.3	79275	79275	.1	77590	70219	10.5
Other multiple modes	4269	3216	32.8	26248	26248	38.6	18603	S	S
Other & Unknown modes	278555	242279	15.0	436521	436521	-19.2	73376	92581	-20.7

The CFS statistics that stand out for North Dakota shipments are increases in shipments originating in North Dakota. Shipments increased in value by 44 percent and by 45 percent in weight (Table 8). This indicates that the nature of the shipments may have remained relatively constant. The most noticeable change from 1993 to 1997 in types of shipments was that in 1997 coal was recognized to make up an estimated 38.8 percent of all shipments originating in North Dakota.

Table 10. Shipment Characteristics by Mode of Transportation for North Dakota 1993 and 1997

Mode of transportation	Value			Tons			Average Miles Per Shipment		
	1997 (millions dollars)	1993 (millions dollars)	Percent Change	1997 (thousands)	1993 (thousands)	Percent Change	1997	1993	Percent Change
All Modes	15999	10527	44.4	87831	60763	44.5	244	158	54.0
Single modes	13647	9315	46.5	52689	42301	24.6	151	112	35.3
Truck	9915	6663	48.8	25213	17417	44.8	102	97	5.5
For-hire truck	4021	2457	63.7	13410	8698	54.2	289	339	-14.7
Private truck	5793	4200	38.0	11392	8716	30.7	70	63	10.9
Rail	3284	2053	59.9	25446	21692	17.3	853	553	54.2
Water	-	-	-	-	-	-	-	-	-
Air (includes truck & air)	70	15	351.0	1	-	294.2	1946	1417	37.3
Pipeline	S	S	S	S	S	S	S	S	S
Multiple modes									
Parcel	850	603	41.	29	36	-18.8	632	349	81.1
Truck & Rail	60	S	S	75	S	S	1305	1996	-34.6
Truck & Water	-	S	S-	-	S	S	-	2294	-100.0
Rail & Water	-	S	S	-	S	S	-	1584	-100.0
Other multiple modes	-	-	-	-	-	-	-	-	-
Other & Unknown modes	642	555	15.8	35038	18356	90.9	34	S	

Analysis

Using the CFS to estimate potential container truck/rail intermodal traffic generated in North Dakota provides valuable insight into potential intermodal traffic. It may only be necessary to use the national average of intermodal shipments to estimate potential North Dakota intermodal traffic. Because North Dakota's freight types do not mirror the United States, because of the large natural resource base in raw agricultural commodities and coal, some adjustment must be made.

The CFS survey displayed that North Dakota shipped an estimated 88 million tons in 1997. The Commodity Flow Survey estimated that nationally, the portion of all freight that was truck/rail intermodal was 1.1 percent. If North Dakota's truck/rail intermodal freight potential was the same as the national trend then it could be estimated that North Dakota could have potential of more than 48,000 TEUs or 20-foot containers for truck/rail intermodal shipments. Factors that determine the shipments include the type of freight, distance to an intermodal facility, rates for shipments, lift costs, or total landed costs of shipments. However, because North Dakota's farmers are searching for new ways to market, larger portions of the agricultural products are being shipped direct from the farmer or marketing company in much smaller lots in container.

Because of North Dakota's natural resource-based economy, some adjustments must be made to the CFS numbers. An estimation of potential shipments should eliminate the coal and petroleum-based and other shipments. A large portion of North Dakota shipments are large volume, low value raw agricultural products. However, there is some evidence that consistently larger portions of raw agricultural commodities are being shipped as identity-preserved product in smaller lots to a final market for processing. Because of this, it now is impossible to rule out raw agricultural commodities for truck/rail container intermodal movements. An estimation of potential container movements was made eliminating the previously mentioned commodities. When ruling out this freight, only 53.3 percent of the freight was eligible for truck rail intermodal leaving North Dakota. The next step was to use only the portion of identified freight movements that were shipped adequate distance to best use the economies of rail. Only movements more than 500 miles were used, which was 17.5 percent. Using this method it was estimated that more than 490,000 tons of freight potentially could move in containers as truck/rail intermodal. The estimated shipments could equate to more than 24,500 containers annually if an intermodal loading facility and acceptable rates and service levels were available.

Past studies conducted in North Dakota have indicated smaller results. Estimates for a potential traffic at a proposed site in Casselton, N.D., estimated that current traffic would generate 13,628 containers and within five years from completion of an intermodal loading facility business volume would grow to more than 47,000 containers provided a competitive rate structure and adequate service levels were met.

Leeper, Cambridge, and Campbell (1996) contacted individual companies to determine interest in intermodal shipping from a potential Grand Forks intermodal facility. The study estimated the number of lifts in first, third, and fifth year of operation. Table 11 is adapted from Leeper et. al. The report estimated an increase from 7,857 containers, and 1,500 trailers in year one to 18,663 containers and 3,563 trailers in year five. This represents a 138 percent increase in business in the first five years. The report failed to explain existing versus new intermodal shipments. However, the Leeper, et. al., study did list one company anticipating using 4,000 to 5,000 containers and the study identified 1,000 of these would be new business.

Table 11. Anticipated Number of Lifts

Anticipated Number of Lifts Grand Forks Intermodal Facility		
Year 1	Year 3	Year 5
Container/Trailers	Container/Trailers	Container/Trailers
7857 1500	15,714 3,000	18,663 3,563

Adapted from Leeper et al. (1996).

The increased shipments identified in the CFS along with previous study estimates of potential intermodal traffic indicate that the railroads' view of intermodal may depend on variables other than traffic volume. The literature review identified reasons for Santa Fe's successful container truck/rail intermodal venture. These reasons included shutting down all questionable intermodal facilities and concentrating on markets that provide consistently large volumes resulting in better use of equipment and the best return on investment.

Transportation Cost Comparisons

Export freight rates have been on the decline. During the last part of the 1980s the cost of moving a $250 VCR overseas was $30, or 12.5 percent of the cost of the product (Muller, 1999). In 1997 the cost of moving that same 250 dollar VCR was $3 or one percent of the cost of the VCR. Similarly rates for refrigerated products have decreased along with identity-preserved agriculture products (Vachal & Reichert, 2000). These rates vary directly on transportation demand and the balance of shipments.

Vachal and Riechert, 2000, concentrated on IP grain and discussed freight rates and logistics costs from the field to the final destination. The actual cost of shipping by container may be higher than traditional bulk systems, but the logistics of containerized shipping actually offer ways to reduce costs by taking advantage of services that may be available. Containerization also provides for shippers of smaller lots of grain to be shipped and guarantee integrity of the product from point of loading to the final destination. This product may bring a premium to the seller or producer as the product meets the criteria specified by the final user. Using rail for the domestic movement may reduce transportation costs and eliminate reloading expense at a port facility while guaranteeing product quality and quantity.

In comparing different transportation methods Vachal and Rieckert used a logistics model which included storage, handling, transportation from the field to the farm, farm to elevator, and to the final destination. Therefore the transportation model involved cost components including inland drayage, inland truck freight, ocean freight, and inland/ocean freight. The spreadsheet model simulated delivery of food-grade soybeans from Iowa to Japan. This was packaged in bags and delivered. The illustration in the report used those logistics costs associated with marketing soybeans, truck, rail, and ocean freight rates and those costs associated with both containerization and bulk delivery options.

Figure 1 illustrates cost per ton of containerization, truck, and bulk shipments. For this study, the important comparison is among truck and containerization. Trucking to the coast and transloading into a container is a costly endeavor and many products would not be competitive in any market because of transloading costs. Moreover, trucking costs are related directly to a backhaul. Transporting small quantities of relatively low valued products long distances by truck requires that the commodity only be charged for its loaded portion of the trip. If there is no backhaul because of specialty equipment or other reasons than the round trip is covered by the fronthaul and this almost doubles the trucking costs. Vachal and Reichert used no backhaul in their example, which attributes total trip cost to the commodity. Figure 1 displays a simulation from their model and shows cost relationships. Bulk grain in unit trains is the least costly, followed by single car, then container, and finally truck.

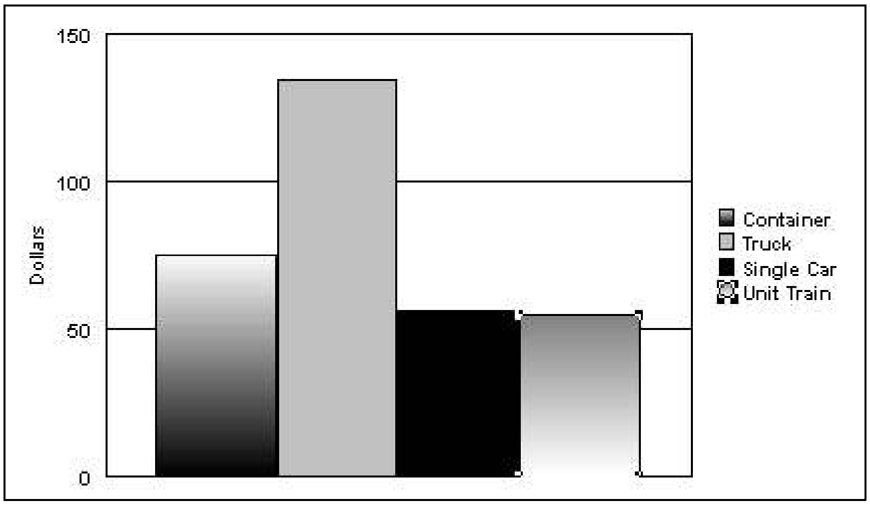

Figure 1. Estimated Freight Rates Per-Ton from Central Iowa to Japan (Reichert and Vachal, 2000)

Using Burlington Northern Santa Fe's published tariffs moving soybeans to the coast is a practical method of determining differences in transportation rates. Rail rates are available on-line and can be used to determine costs associated with different methods of transporting goods. Figure 2 illustrates a combination of BNSF's rates and truck costs associated with moving soybeans to Tacoma from Fargo, N.D. Truck costs were developed from a model developed by the Upper Great Plains Transportation Institute and provide a reasonable estimate of truck rates. Because the trucking industry in many ways replicates a perfectly competitive industry, truck costs are a good proxy for truck rates.   Rates were obtained from the Internet to compare costs shipping by truck, by container, single rail car rate, and unit train rail car rate from Fargo, N.D., except for the container, which originates in Dilworth, Minn. Comparing Vachal and Reichert's costs and BNSF public rate estimates the relative cost differences are similar however Vachal and Reichert attempted to capture total logistics costs. Considering trucking to the coast in any other truck equipment type other than a container that can be transloaded as a unit on to a cargo ship leads to other expenses, which increases the difference between container truck/rail intermodal costs and trucking costs. Comparing the Vachal and Reichert method with only inland freight costs to the port it only may be necessary to capture inland freight costs to determine the least cost method of shipping. Total costs of shipping soybeans to Japan using Vachal and Reichert's total cost method determined that trucking to the coast was almost 130 percent more costly than using a container on the rail. If there is no backhaul for the truck then the costs for the entire trip is attributable to the fronthaul which may occur with specialty equipment.

Using only inland freight costs, and if no loads are available on the return trip, the costs of transporting soybeans by truck is $112 per ton. This is similar to Vachal and Riechert's estimation. Truck is 80 percent more costly than the rail portion of shipping the container to the port. However, other costs do exist with obtaining the container including, moving the container to the loading point, drayage to the intermodal facility, lifting the container off the truck, lifting the container onto and off of the train and drayage to the final destination or transloading onto the cargo ship, transloading the container off the cargo ship, and load it either onto a train or truck, and transport it to the final destination. Vachal and Riechert estimated costs other than transporting at more than $12 per ton. They also estimated the ocean portion of the container move to Japan at $13 per ton, and total costs using truck at just more than $134 per ton. Using their estimation of $25 per ton for ocean freight and other costs added to the truck cost estimates of $112 for the truck portion of the movement at $137 it is close to their estimate of $134.

Figure 2 shows land cost comparisons shipping from Fargo to Tacoma. The truck costs represent a 100 percent backhaul. This means the cost is only attributable one way. Trucking is still more costly by 42 percent at $68 per ton. Considering the transloading charges would increase it another $12 per ton, the intermodal option is much less costly.

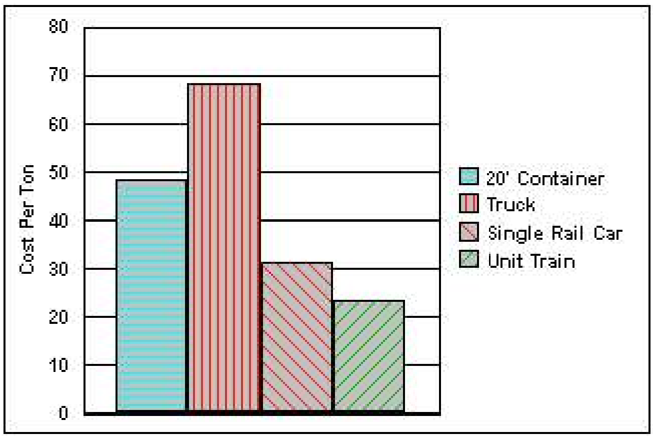

Figure 2. Transportation Cost Comparisons of Soybeans from Fargo, ND to Tacoma

However, shipping east to Chicago using BNSF rates it is less expensive to use a truck, not including transloading. Comparing truck costs to Chicago from Dilworth compared with container truck/rail intermodal from Dilworth to Chicago. The one-way truck costs estimate would be $28 per ton compared to the rail only portion of the movement at almost $34 per ton. Adding drayage at both ends of the movement, makes the truck/rail intermodal movement an unlikely option on the 600-plus mile movement.

Examining BNSF rates out of Chicago and Dilworth to Tacoma, it was discovered that the published rate from Chicago to Tacoma is less than the published rate from Dilworth to Tacoma even though from Chicago to Tacoma is more than 600 miles farther. BNSF's Intermodal Public Rate Retrieval also exposed that their rate from St. Paul to Tacoma for the same equipment is the same as from Chicago to Tacoma, even though St. Paul is about 400 miles closer to Tacoma then Chicago (June 2001).

Actual rates are negotiated between the transportation provider and the shipper. Many times shippers use third parties such as a logistics company, freight forwarders or brokers to provide total transportation services. These providers may prepare all documentation, arrange all transportation, and may provide these services at less cost because of the volume they represent.

Shipper associations are another avenue worth exploration by shippers. Shipper associations are viewed as a shipper and must be granted the same rights as shippers and cannot be discriminated against by transportation providers. Because they represent volume they may have the leverage to negotiate better rates and service levels than an individual shipper. Many times shippers' associations do not provide services such as export documentation, or regulation guidance so it may be important to use other third party providers for those services (Vachal and Reichert, 2000).

Containerization of specialty grains and oil seeds is increasing because of the demand for smaller shipments with specific specification or characteristics. In 1998 sunflowers were transported by container 88 percent of the time and hops went by container 100 percent of the time. Also large quantities of soybeans move in containers. Reasons for containerization is that the bulk transportation system has inadequately transported the product resulting in co-mingling of product with unwanted product and or the quantities demanded were small and therefore the shipment did not meet the requirements of bulk movements.

Impact on North Dakota

It is difficult to determine the impact on North Dakota the limited truck/rail container intermodal freight option has. Quantifying intermodal traffic is difficult, and potential intermodal traffic is even more illusive. Determining the impacts on North Dakota businesses, communities, and the entire state is an impossible task.

Economic factors influence freight rates, which in-turn affect the competitive nature of industry in North Dakota. The senario may be that with a competitive freight rate businesses could become more competitive domestically and internationally, which would generate more business creating more volume causing more economic activity and freight volume creating more competition etc. Therefore it is difficult to quantify the economic impact not having a competitive intermodal loading facility in North Dakota may have on businesses, communities, and the state.

Problems are apparent when comparing products moving domestically by truck or truck/rail container intermodal, and distance is the key for rate savings out of North Dakota. BNSF published rates for truck/rail container intermodal to Tacoma are the same using either Chicago, or St. Paul as an origin even though it is much closer to Tacoma from St. Paul than Chicago. The published rate from Dilworth to Tacoma is more than the rate from Chicago to Tacoma.

Model

Truck/Rail Container Intermodal Terminal Costs

Bierman, Bonini, and Hausman (1991) describe a model as a "simplified representation of an empirical situation." Variables are classified as decision variables, exogenous variables, intermediate variables, policies and constraints, or performance measures (Bierman, Bonini, and Hausman, 1991). Decision variables are under the control of the decision maker. Other types of variables affect the model, but their values cannot be determined by the decision maker.

Exogenous or external variables are outside the decision maker's control. Intermediate variables are used to relate decision variables and exogenous variables to performance measures (Bierman, Bonini, and Hausman, 1991). Exogenous and intermediate variables are represented in various places throughout the model.

Using the previously discussed modeling principles a spread sheet model was developed to simulate costs for an intermodal facility. This model was developed to provide decision makers with an estimate of start-up and annual costs.

Intermodal Facility Costs

Variables represented on sheet one of the model include the initial capital investment. The model is changeable and can be used to estimate costs from a proposed business plan, which includes the size and type of facility. Sheet two has performance measures that are the total investment costs and annual operating costs. Sheet three includes sensitivity analysis to evaluate the costs associated with different levels of investment.

Firm Characteristics

The spread sheet model was developed to evaluate costing options for an intermodal facility. A facility could vary in size, equipment configuration, accommodations (reefer, etc.), and different options require different levels of investment. Different levels of investment require different traffic volumes to cover expenses or costs.

The model consists of changeable fixed and variable cost sections to replicate different sizes and configurations of facilities allowing for scenario analysis purposes. This provided a range of investment levels for decision making purposes.

Costs and Sensitivity Analysis

The spreadsheet model was developed to estimate costs associated with a particular intermodal facility. The strength of using a spreadsheet model is its flexibility for a decision maker. The user has options over a wide range of data for different operational characteristics and input prices reflecting a specific business plan. A determination may be made as to the feasibility of a particular facility by using the model.

A second strength of the model is its ability to run sensitivity analysis over a wide range of variables. This allows a decision maker the options of changing investment decisions at the outset. The model was developed using initial assumptions with the use of sensitivity analysis to determine investment costs by changing these initial investment decisions.

Base Case

Assumptions for the base case scenario were developed. The base case is based on an 80 acre facility with 5,000 feet of track, two powered switches, and two internal switches. To fence the perimeter of 80 acres on three sides requires 3,960 feet of fence. It is assumed that 40 acres of the 80 would be paved. There is a need for six work lights and six reefer hookups. A 1,500 square foot building would be built for office and storage space. This facility would need one lifter, one hustler, two chassis, and no forklifts. There would be a manager and four yard employees. Table 12 shows the initial assumptions along with possible options.

Table 12. Assumptions and Options for the Base Case Scenario from Sheet One of the Intermodal Feasibility Costing Model

Land acres	80	Cost per acre	$2,000.00
Feet of track	5,000	Cost per foot of track	$100.00
No. of powered	2	Cost of powered	$130,000.00
No. of fence feet	2,640	Cost of fence per foot	$10.00
Acres of pavement	40	Cost per acre	$10,000.00
No. of work lights	6	Cost of lights	$10,000.00
No. of reefer hookups	6	Cost of reefer hookup	$2,000.00
Square feet of building	1,500	Cost per square foot	$50.00
Feet of water line	1,000	Cost per foot	$10.00
Feet of sewer line	1,500	Cost per foot	$20.00
No. of lifters	1	Cost of lifter	$500,000.00
No. of hustlers	1	Cost of hustlers	$50,000.00
No. of forklifts	0	Cost of Forklifts	$25,000.00
No. of Chassis	2	Cost of Chassis	$5,000.00
Facility Estimated	20	Equipment Estimated	15
Tax rate	5%	Insurance	.5%
Interest rate	8%	Estimated Facility Life	20 Years
Maintenance and repair	Variable		

The quantitative expressions of objectives that managers are trying to achieve are performance measures. (Bierman, Bonini, and Hausman, 1991). Sheet two of the spreadsheet model provides a cost summary, which is the performance measures for the model. The model provides performance measures in the form of a total investment estimates and estimated annual costs.

Table 13. Investment for the Base Case Intermodal Facility

Land	$160,000.00
Track	$500,000.00
Powered Switches	$260,000.00
Internal Switches	$160,000.00
Fence	$39,600.00
Building	$75,000.00
Office Equipment	$6,000.00
Lighting	$60,000.00
Reefer Hookups	$12,000.00
Water Line	$15,000.00
Sewer Line	$30,000.00
Total	$1,477,600.00

Total equipment cost is the next portion of the model. In the base case there is one lifter, one hustler, and two chassis. Total equipment estimated investment is $560,000. The total estimated investment for the base case scenario is $2,037,600.

The model has a section with depreciation formulas both for the facility, which includes, track, switches, and the building; and also a section for equipment depreciation. The yard or facility expense portion of the model includes taxes, insurance, maintenance and repair, and return on investment (Table 14). The section also lists variable costs including direct and indirect labor costs, accounting, and fuel costs. The last two categories are building expenses, and management and sales expense.

The next portion of the model shows the performance measures in annual fixed, variable, and total costs (Table 14). Annual operating costs provide a decision maker estimates of business volume needed to be successful.

Table 14. Annualized Costs for the Base Case Intermodal Facility

Fixed Costs	
Land and Track Depreciation	$51,104.00
Equipment	$29,867.00
Taxes, Insurance, Maintenance and Repair, Return on Investment	$207,156.00
Management	$45,800.00
Building Expense	$7,365.00
Variable Costs	
Wages	$91,600.00
W.C. and SS	$10,992.00
Benefits	$6,412.00
Accounting	$2,500.00
Fuel	$20,800.00
Total	$470,596.00

The base case facility assumptions include 80 acres of land with 40 acres paved, one container lifter, two chassis, and one hustler, and a 1,500 square foot building. The base case included 5,000 feet of track, four switches, work lights, and electrical hookups for reefer units. The annual costs of operating the facility estimated by the model are $470,596.

Return on investment (ROI) is a large portion of annual costs. ROI can be considered as interest on debt capital, or return on equity investment (Casavant, 1993). This may be reduced depending on the type of facility required. Used equipment may be purchased, however repair costs would increase, or a short line railroad could use existing track and eliminate the need to invest in switches and track. The rest of this chapter will be devoted to sensitivity analysis of investment variables.

Sensitivity Analysis

Sensitivity analysis displays the change in the performance measures by varying a decision or exogenous variable (Bierman, Bonini, and Hausman, 1991). Lotus 123 has a function for performing "what-if analysis," which determines the model's sensitivity to a given variable. "What-if tables" can be developed providing performance measures as one or two variables are changed over a range of values. The intermodal facility costing model's sensitivity analysis shows the decision maker cost relationships in the model. Understanding cost relationships may help a manager minimize total annual costs. Variables chosen for sensitivity analysis include equipment investment, building investment, track and switch investment, labor costs, and the number of lifts required to meet costs.

Lifts Costs and Volume

It is estimated that lift costs at Dilworth, Minn., are in a range from $10 to $15 per lift (Leeper et al, 1996). This is only an estimate, lift costs are dependent on other factors. Other factors associated with intermodal transportation costs are the drayage costs and rail costs.

Drayage is the trucking costs associated with moving the container or trailer to and from the intermodal facility. These costs vary depending on several factors, and are not considered within the model.

Drayage costs, or trucking costs are estimated at $1.13 per mile (Berwick and Dooley, 1996). The farther from the source increases costs associated with drayage and total transportation charges. A tradeoff exists among the economies associated with intermodal freight transportation and drayage distance. At some point drayage costs, switching, transloading of the container overcome the economies of rail transportation.

Changing costs for the facility will change the number of lifts needed to cover costs. Table 15 shows the relationship of volume and costs associated with the base case intermodal facility and assumptions.

Table 15. Number of Lifts and Fixed, Variable, and Total Costs

Lifts/YR	Fixed Costs/lift	Varible Cos/lift	Total Costs/lift
2000	$169	$66	$235
4000	$85	$33	$118
6000	$56	$22	$78
8000	$42	$17	$59
10000	$34	$13	$47
12000	$28	$11	$39
14000	$24	$9	$34
16000	$21	$8	$29
18000	$19	$7	$26
20000	$17	$7	$24
22000	$15	$6	$21
24000	$14	$6	$20
26000	$13	$5	$18
28000	$12	$5	$17
30000	$11	$4	$16
32000	$11	$4	$15

As volume increases costs per lift decrease as a result of economies associated with utilization of resources (Table 15). Costs vary depending on the initial investment.

Total Investment and Annual Costs

The model performs well over a wide range of different scenarios. Varying investments in equipment results in much small increases in annual costs. Figure 3 shows the difference in total costs with the different levels of equipment investment.

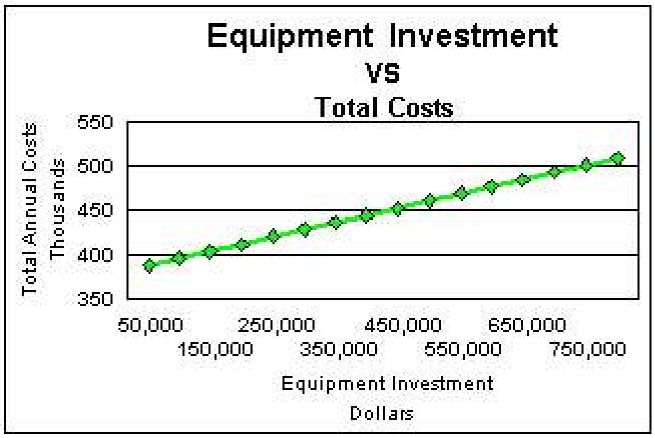

Figure 3. Equipment Investment versus Total Costs

A similar relationship exists between investment in track and annual cost estimates. Varying track investment from $50,000 to $800,000 increases annual costs by $111,150 (Table 16).

Table 16. Change in Annual Cost with Different Levels of Track Investment

Track Investment	Annual Operating Costs
$50,000	$403,905
$100,000	$411,725
$150,000	$418,725
$200,000	$426,135
$250,000	$433,545
$300,000	$440,955
$350,000	$448,365
$400,000	$455,775
$450,000	$463,185
$500,000	$470,595
$550,000	$478,005
$600,000	$485,415
$650,000	$492,825
$700,000	$500,235
$750,000	$507,645
$800,000	$515,055

This scenario analysis reports relationships that exist between input variables and costs. The equipment and track scenario show that with large increases in capital investment there is a relatively smaller increase in annual costs. Increasing track investment from $50,000 to $100,000 only increases total annual costs by 1.5 percent and as $50,000 investment increments are added the percentage of increase is reduced.

Table 17 shows the model's response in varying track and equipment variables. The table is read by seeking investment for equipment and investment for track and aligning the column and row.

Table 17. Equipment and Track Investment Decisions and Total Annual Cost

Equipment →	$50,000	$100,000	$150,000	$200,000	$250,000	$300,000	$350,000	$400,000	$450,000	$500,000	$550,000
Track ↓	Total Annual Costs										
$50,000	$321,524	$328,934	$336,344	$343,754	$351,164	$358,574	$365,984	$373,394	$380,804	$388,214	$395,624
$100,000	$329,601	$337,011	$344,421	$351,831	$359,241	$366,651	$374,061	$381,471	$388,881	$396,291	$403,701
$150,000	$337,677	$345,087	$352,497	$359,907	$367,317	$374,727	$382,137	$389,547	$396,957	$404,367	$411,777
$200,000	$345,754	$353,164	$360,574	$367,984	$375,394	$382,804	$390,214	$397,624	$405,034	$412,444	$419,854
$250,000	$353,831	$361,241	$368,651	$376,061	$383,471	$390,881	$398,291	$405,701	$413,111	$420,521	$427,931
$300,000	$361,907	$369,317	$376,727	$384,137	$391,547	$398,957	$406,367	$413,777	$421,187	$428,597	$436,007
$350,000	$369,984	$377,394	$384,804	$392,214	$399,624	$407,034	$414,444	$421,854	$429,264	$436,674	$444,084
$400,000	$378,061	$385,471	$392,881	$400,291	$407,701	$415,111	$422,521	$429,931	$437,341	$444,751	$452,161
$450,000	$386,137	$393,547	$400,957	$408,367	$415,777	$423,187	$430,597	$438,007	$445,417	$452,827	$460,237
$500,000	$394,214	$401,624	$409,034	$416,444	$423,854	$431,264	$438,674	$446,084	$453,494	$460,904	$468,314
$550,000	$402,291	$409,701	$417,111	$424,521	$431,931	$439,341	$446,751	$454,161	$461,571	$468,981	$476,391

The relationship between equipment investment and total annual costs and track investment and total annual cost is that as investment increases in these items, total annual costs increases at a relatively smaller rate. This may provide insight into under investing in a facility. Lack of capacity because of fear of overexposure or overinvesting may handicap the operation and prevent performance needed with increased volume and result in less than desirable customer service. However, increasing track investment from $50,000 to $800,000 does increase annual costs by $111,150 or more than $9,000 per month.

CONCLUSIONS

This study provides a snapshot of truck/rail container intermodal shipping in and out of North Dakota. Cost estimates for an intermodal facility also are presented. The study revealed the benefits of intermodal transportation including: lower overall transportation costs, increased economic productivity and efficiency, reduced congestion and burden on over-stressed highway infrastructure, higher returns from public and private infrastructure investments, reduced energy consumption, and increased safety.

The Commodity Flow Survey conducted by the Commerce Department was analyzed to estimate possible container shipments from North Dakota. The CFS survey displayed that North Dakota shipped an estimated 88 million tons in 1997. The Commodity Flow Survey estimated nationally that the portion of all freight that was truck/rail intermodal was 1.1 percent. If North Dakota's truck/rail intermodal freight potential was the same as the national trend then it could be estimated that North Dakota could have the potential of more than 48,000 TEUs or 20-foot containers for truck/rail intermodal shipments. Factors determining the shipments include the type of freight, distance to an intermodal facility, rates for shipments, lift costs, or total landed costs of shipments. However, because North Dakota's farmers are searching for new ways to market and demand for identity-preserved commodities, larger portions of the agricultural products are being shipped direct from the farmer or marketing company in much smaller lots in container.

Because of North Dakota's natural resource-based economy some adjustments must be made to the CFS numbers. An estimation of potential shipments should eliminate the coal and petroleum-based and other shipments. A large portion of North Dakota shipments are large-volume low-value raw agricultural products. However, there is some evidence that consistently larger portions of raw agricultural commodities are being shipped as identity-preserved product in smaller lots to a final market for processing. Because of this it is now impossible to rule out raw agricultural commodities for truck/rail container intermodal movements. An estimation of potential container movements was made eliminating the previously mentioned commodities. When ruling out this freight, only 53.3 percent of the freight was eligible for truck rail intermodal leaving North Dakota. The next step was to use only the portion of identified freight movements that were shipped adequate distance to best use the economies of rail. Only movements of more than 500 miles were used, which was 17.5 percent. Using this method it was estimated that more than 490,000 tons of freight potentially could move in containers over truck/rail intermodal. The estimated shipments could equate to more than 24,500 containers annually if intermodal loading facilities were available along with acceptable rates and service levels.

Lower transportation costs are realized with container intermodal shipping by using each mode for the portion of the trip for which it is best suited. However, it was discovered that the BNSF published rates for shipping a container out of Dilworth to Tacoma were higher than shipping that same container out of Chicago. It also was discovered that BNSF published rates to Chicago from Dilworth would cost more than trucking the 600-plus miles. With the convenience and time factors associated with trucking or unless a reduced rate could be negotiated with the railroad, trucking would be the less expensive mode.

A survey developed for this study identified containers now being shipped in and out of the state. This survey asked about a companies freight and expected growth. The survey results estimates that 8,999 containers leave the state annually. The Southeast portion of the state represented some 63 percent of all traffic and more than 90 percent of all truck/rail container intermodal traffic. The two main factors contributing to the majority of container traffic originating in the Southeast are location of an intermodal loading facility, and the size and number of businesses located in Fargo and surrounding areas. The Southcentral area of the state identified the next most traffic. There were many more respondents from Southeastern and Southcentral North Dakota than from the rest of the state. Of the 195 respondents, 85 were from Southeastern North Dakota and 28 were from Southcentral North Dakota.

A spreadsheet model was developed to estimate costs associated with starting an intermodal loading facility in North Dakota. The model in this study has many useful features. Costs can be estimated for different equipment configurations and sizes of facilities. The base case estimated and investment of more than $2 million and operating expense at more than $400,000 annually. Sensitivity analysis provided insight into investment decisions where the proportions of annual operating costs increased at a much lower rate than proportionately larger investment costs. This leads to the conclusion that underinvesting may limit capacity of the loading facility limiting potential of handling larger volumes.

The truck/rail container intermodal shipping problem in North Dakota is circular in nature. Problems exist in the form of rates and service. Rates are high and service levels low because there is no volume and there is no volume, because rates are high and service levels are low.

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APPENDIX A — Explanation of Intermodal Equipment

Intermodal Equipment

This section gives brief descriptions of intermodal equipment. An intermodal facility could have all or part of the equipment listed below. There are many different intermodal options that could be used for a facility depending on volume, infrastructure needed, and product characteristics. The intermodal equipment listed below comes from Gerhardt Muller's *3rd Edition of Intermodal Freight Transportation.*

Cranes

Cranes of all types are used to move containers from ship-to-shore, or truck-to-train etc. The most widely used is the rail mounted gantry crane. It is built in the form of a bridge, supported by a trestle at each end. This is used mostly at ports to load and unload ships and has wheels so it can be moved from one pier to the other. A hinged boom crane is mounted so it can pivot at its base.

Straddle Carriers

Straddle carriers lift heavy loads to a minimum height for short-distance travel and are used to transfer containers to and from cranes. These straddle cranes also can be used to stack containers. Some straddle carriers are equipped with computer control systems used for direction and control of the straddle carrier and identification of containers.

Stacking Cranes

The rubber-tired gantry crane is a hybrid, falling between the gantry crane and straddle carrier. It is fashioned after the ship loading gantry without the boom and its purpose is to stack containers on the ground. It has the ability to stack containers higher and wider than the straddle carrier.

Forklift trucks

Forklifts come in many sizes and varieties and these machines perform many tasks. These machines can move palletized freight or containers themselves, depending on their size. Forklifts have given way to roadstakers, which are similar to forklifts, but have the ability to reach over obstacles such as chassis, tracks, railcars, etc.

Container Handlers

Container handlers move, stack and load containers like forklift trucks, but use an overhead boom, rather than the underlift principle.

Yard Hostels

There is a variety of chassis-moving container handling equipment. This equipment is referred to by different names including: yard horses, hustlers, mules or terminal tractors. This equipment is mainly used at a terminal or port, but closely resembles an over the road tractor or truck.

Lifting Wheels

This device is attached to a hostel and allows for the operator to raise, lower, attach, and detach trailers without changing the trailers' dolly wheels. The lifting wheel gives the hostel a unique advantage over ordinary tractors and allows for quick attach and detaching expediting trailer movement.

Intermodal Transfer Point

Line-haul intermodal equipment container-handling equipment enters the intermodal terminal where containers are transferred between terminal equipment and line-haul equipment. This is the intermodal interchange.

Container Chassis

A chassis is rail, marine, and over-the-road equipment. This equipment is designed to handle containers and trailers. Chassis come in sizes compatible with containers, however there are adjustable chassis. These slide to accommodate the size container needing to be transported.

Chassis Flipper

Because of valuable space at terminals, chassis are stacked. The chassis flipper stands the chassis vertically. Chassis take up only 10 percent of the space stacked versus not stacked.

Containers

Containers are the vehicle of choice used to encase the product for an intermodal movement. The number of container boxes have been growing at an increasing rate. The number of containers grew from 8.2 million in 1994 to 10.8 million in 1997. Ocean carriers account for 52 percent of ownership, leasing companies some 47 percent, and the rest are split among private and container transport companies.

Containers come in many sizes and types. Dry freight containers are either 20 or 40 feet long. There is also a 40-foot high cube container, refrigerated containers. The estimated cost of a 20-foot dry freight container is between $2,000 and $3,000 and a 40-foot container is between $3,100 and $4,500.

For low volume users' leasing the container may be less costly than purchase. Muller reported that high costs are associated with empty container movements. This problem exists for some North Dakota shippers with less inbound freight than outbound and desiring to use the intermodal shipping options.

APPENDIX B — Model Explanation

Truck/Rail Container Intermodal Terminal Costs

Bierman, Bonini, and Hausman (1991) describe a model as a "simplified representation of an empirical situation." Variables are classified as decision variables, exogenous variables, intermediate variables, policies and constraints, or performance measures (Bierman, Bonini, and Hausman, 1991). Decision variables are under the control of the decision maker. Other types of variables affect the model, but their values cannot be determined by the decision maker.

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Using the previously discussed modeling principles a spread sheet model was developed to simulate costs for an intermodal facility locating on a short line railroad. This model was developed to provide decision makers with an estimate of start-up and annual costs.

Intermodal Facility Costs

Variables represented on sheet one of the model include the initial capital investment. The model is changeable and can be used to estimate costs from a proposed business plan, which includes the size and type of facility. Sheet two has performance measures, which are the total investment costs and annual operating costs. Sheet three includes sensitivity analysis to evaluate costs associated with different levels of investment.

Firm Characteristics

The spread sheet model was developed to evaluate costing options for an intermodal facility. A facility could vary in size, equipment configuration, accommodations (reefer, etc.), and different options require different levels of investment. Different levels of investment require different traffic volumes to cover expenses or costs.

The model consists of changeable fixed and variable cost sections to replicate different sizes and configurations of facilities allowing for scenario analysis purposes. This provided a range of investment levels for decision making purposes.

Fixed Costs

The fixed cost portion of the model includes land, track and switches, fence, pavement and concrete, lighting and electrical, building options, equipment options, depreciation, insurance, repair, taxes, and interest. These costs all are changeable within the model, providing a wide range of options. Depreciation, insurance, maintenance and repair, and interest are a percentage of the investment. In the following section these costs are described individually.

Land

Within the land section of the model is the price per acre and the number of acres required. These variables are changeable to accommodate different situations. For instance a company contemplating a facility may already have usable land therefore diminishing the level of investment needed. Conversely a company may need to purchase land near a source of business, which may be a large investment along with needed improvements. For the base case, land was priced at $2,000 and the number of acres was set at 80. Eighty acres would be more than large enough for the facility at 1,742,400 square feet. This would allow for ample storage, and room for loading and unloading. This dollar amount was arbitrary, which could be less or more depending on the location and current use of the land. In rural areas land may be a small portion of the investment needed, but in an urban area, land is a large portion of the investment.

Track and Switches

This section of the model estimates the investment in track and switches. There are six entries possible shown in Table B.1. These entries need to reflect decisions made at the outset from a business plan. The estimate of track costs and distance are from a 1996 study. The Grand Forks Intermodal Study & Implementation Plan was done by Leeper, Cambridge and Campbell.

Table B.1. Track and Switch Costs from the Intermodal Facility Spreadsheet Costing Model

	Column	
Row	**A**	**B**
5	Dollars per foot of track	$100
6	Number of feet	5,000
7	Number of powered switches	2
8	Cost of powered switches	130,000
9	Number of internal switches	2
10	Cost of internal switches	80,000

The track portion of the model allows for many different scenarios. Track may already exist and switches may be in place or a new siding may be needed. This section of the model allows for flexibility and entries for different operations. The number and type of switches will vary. If the siding is new, switches will be needed. An existing siding will have switches. Powered switches may not be required. Only two switches would be needed if siding is used as the loading area. Another possibility on a short line is that loading is on a no traffic section of existing track.

Fence, Pavement and Concrete, Lighting and Electrical

Depending on the level of security and desire to keep children, animals, and other potential problems out of the site, a fence may be required. This section allows varying the length and cost of the fence. It is simply multiplying the number of fence feet times the cost per foot. This could be a rather substantial investment if it is desired to have a secure yard. The base case allows for 3,960 feet of fence. This is enough fence for the perimeter of the yard. The cost is estimated at $10 per foot (Dakota Fence).

Next is pavement and concrete. This section simply allows an entry for the number of acres and the cost of either asphalt or pavement. In some cases a gravel yard may serve instead of pavement or concrete. There also may be a combination possibility of some pavement and the rest gravel. The cost per acre is simply multiplied by the number of acres. However in some cases the entire yard may not be paved. For instance, building space would not be paved.

There is a section for lights, electrical, and reefer hookups. Electrical components will vary with size of the facility and expectations for its type of business. For instance it may be determined that no reefers will be used or no loading will occur at night, which would lessen the electrical investment. The base case estimates loading lights cost $10,000 each, while reefer hookups are estimated at $2,000 each. The base case calls for six lights and six reefer hookups.

Table B.2. Fence, Pavement, and Lighting and Electrical from the Intermodal Facility Spreadsheet Costing Model

Column		
Row	A	B
14	**Fence**	
15	No of fence feet	3,960
16	Cost of fence per foot	10
17		
18	**Pavement or Concrete**	
19	Acres of Pavement	40
20	Cost per acre of pavement	1,000
21		
22	**Lighting and Electrical**	
23	No of lights	6
24	Cost of lights	10,000
25	No. reefer hookups	6
26	Cost of hookups	2,000

Building Options

This section includes size and cost of the building, and costs of water and sewer to the building. The building cost is based on square footage times the size of the building. The building estimate is 1,500 square feet at $50 per square foot.

Water and sewer lines are cost per foot times the length of the line. Water and sewer are based on the use of city water lines and sewer. If built in a rural area, additional costs for a well and septic system would exist. The sewer is estimated at $20 per foot and water is estimated at $15 per foot. Building options are determined by the decision maker and may or may not exist. Some facilities may be able to be operated from an existing building, lowering overall costs.

Table B.3. Building Options from the Intermodal Facility Spreadsheet Costing Model

	Column	
Row	A	B
28	**Building Options**	
29	Sq ft of building	1500
30	Cost per square foot	50
31	Feet of water line	1000
32	Cost per foot	15
33	Feet of sewer line	1500
34	Cost of sewer line	20

Equipment Options

Within the equipment portion of the model the decision maker has the options of lifters, hustlers, forklifts, and chassis. The decision maker may choose the number of each and a cost factor associated with each piece of equipment. The cost factor would depend on equipment choices. New versus used equipment and if the equipment is used if reconditioning was necessary. There also is a fuel consumption entry. This cell is linked to the variable cost portion of the model. This section gives the decision maker choices of different equipment depending on the size and type of facility to be built.

Table B.4. Equipment Choices from Intermodal Facility Spreadsheet Costing Model

	Column	
	A	B
Rows	**Equipment Options**	
36	Number of lifters	1
37	Cost of container lifters	$500,000
38	Fuel consumption/hr	5
39	Number of hustlers	1
40	Cost of hustlers	$50,000
41	Fuel consumption/hr	5
42	Number of forklifts	0
43	Cost of forklifts	$25,000
44	Fuel consumption/hr	2
45	Number of chassis	2
46	Cost of chassis	$5,000

Office Equipment

Another portion of the model gives the decision maker the option of making entries for office equipment. There is a section for furniture and electronics. The decision maker can enter zero if a category is not valid. This may happen where a short line railroad or third party uses existing offices or office equipment to operate the intermodal facility.

Table B.5. Office Equipment from Sheet One of the Intermodal Spreadsheet Costing Model

	Column	
Rows	**A**	**B**
1	Computer	$2,500
2	Fax Machine	$300
3	Phones	$1,000
4	Communication Equipment	$1,000
5	Desk	$500
6	Chairs	$200
7	Counter	$500

Depreciation, Equipment, Taxes, Insurance, Interest, and Maintenance and Repair

This section of the model uses percentages and time to determine costs associated with different levels of investment. The method allows a decision maker to adjust percentages or the time factor for different interest, insurance, or depreciation rates.

Depreciation is divided into facility and equipment to allow for different estimated useful life (EUL). The decision maker can adjust time for different types of equipment or facilities. Depreciation is the cost of using up capital and should reflect the portion of useful life used during a specified time period (Fess and Warren, 1990). Equipment and the facility were depreciated on the straight-line basis. Depreciation was calculated by subtracting the salvage value from the purchase price and dividing this figure by the EUL. Salvage values and EULs are difficult to estimate. Salvage value primarily depends on the condition of equipment and type of maintenance performed.

Taxes and insurance are related to a percentage of value of the investment. The tax levied may vary by location and different types of taxes imposed. Insurance also may vary with location and company of issue. These variables also are adjustable by the decision maker.

Interest rates and terms vary depending on the level of investment and the risk perceived by the lender. The rate and term can be changed by the decision maker to meet different levels and lengths of financing. A rate also is used for return on investment and/or a hurdle rate. It is common for companies to set a desired return for investments, or hurdle rate, which is used to screen potential investments.

Maintenance and repair costs vary with use. With higher use there are higher costs. A percentage of the value of the equipment times a rate per hour will provide an estimate of the cost of maintaining the equipment. This is variable in the model. Higher levels of repair would be associated with older or used equipment. The maintenance and repair formula is based on new price for equipment. The farther the cost of equipment deviates from new cost the higher maintenance and repair.

Variable Cost Components

The next part of the model is the variable cost components. This includes a section for direct and indirect labor costs. Other costs included in the variable cost portion are electricity, water, sewer, building insurance, office supplies, and accounting services.

Wages and Indirect Costs

This portion allows for the number of employees, hourly rate, hours worked, and weeks per year worked. Indirect costs cover workers compensation, social security match, and benefits. Workers compensation, social security match, and benefits are based on a percentage of wages. There also is a section for management and sales staff, which is based on the cost of hourly employees. This variable is difficult to estimate and would vary according to the type of facility and the business plan of a proposed facility. If the facility is based on a few businesses or a single business, there may be no need for management or sales staff. Another scenario may include the use of existing staff to manage and sell the services of the intermodal facility. The model is set to record management and sales costs at half of total wages. This results in a manager's annual salary of $45,000.

Electricity, Water and Sewer, Building Insurance, Office Supplies, and Accounting Services

Other costs included in the variable cost portion are electricity, water, sewer, building insurance, office supplies, and accounting services. These costs would vary depending on the type of facility built, the size of the building, and if the facility was run using existing staff and facilities. If an existing facility is used, costs should be portioned equally to use.

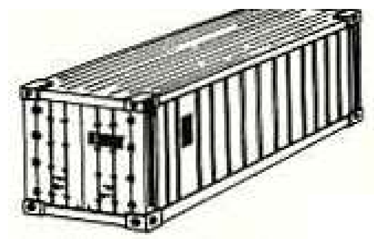
Electricity, water, sewer, office supplies, and accounting services depend on volume used. Insurance would be a percentage of value and would depend on the value of the building.

Table B.6. Variable Cost Components of the Intermodal Spreadsheet Costing Model

Column		
Rows	**A**	**B**
1		
2	**Variable Cost Components**	
3	No. of Salaried Employees	2
4	Salary	$25,000
5	No. of Hourly Employees	2
6	Hourly rate	$10
7	Hours Per Week	40
8	Weeks Per Year	52
9	Fuel Cost / Gallon	$1
10	Workman Comp	5%
11	Social Security match	7%
12	Benefits	7%
13	Management and Sales	50%
14	Electricity	$100
15	Water	$50
16	Sewer	$20
17	Insurance	.5%
18	Office Supplies	$500
19	Accounting	$2,500

APPENDIX C — Intermodal Container Survey

Shipper Survey
ND Strategic Freight Analysis



Conducted by:
Upper Great Plains Transportation Institute

December 2000

1. Shipper (Company) ____

2. Name ____

Title ____

Telephone ______________________________ Email ____________________________________

Do you arrange/manage transportation for your company (if no, who)? ______________________________

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3. Do you receive truckload, railcar or container shipments (other than grain)? Yes No

4. Do you ship truckload, railcar or container shipments (other than grain) ? Yes No

If 3 and 4 NO - No Additional Information Needed.

5. Do you use a freight forwarder or a broker for transportation? Yes No

6. Do you use containers in your freight plan? Ship: Y N Receive: Y N

5-1. If no, could containers be an option to receive/ship? Yes No

5.2. If no, why not? ____

7. Do you receive or ship internationally? Ship: Y N Receive: Y N

8. What factors affect your decision on choosing a shipment mode and carrier (eg price, time, equipment)?

____

9. What is the average distribution of annual inbound/outbound shipments, percent by quarter:

	1st Qtr of Year	2nd Qtr of Year	3rd Qtr of Year	4th Qtr of Year	Total
Traffic Distribution					100%
Service Availability Rank: 1=poor 2=good 3=excellent					

10. **OUTBOUND Business Volume:**

Export

E-1.	% Eastbound	% Westbound
#Rail Cars		
#Trucks		
#Containers*		

Domestic

DO-1.	% Eastbound	% Westbound
#Rail Cars		
#Trucks		
#Containers*		

*Container Traffic in TEU

11. **INBOUND Business Volume:**

Import

I-1.	% Eastbound	% Westbound
#Rail Cars		
#Trucks		
#Containers*		

Domestic

DI-1.	% Eastbound	% Westbound
#Rail Cars		
#Trucks		
#Containers*		

*Container Traffic in TEUs

12. **Expected Business Growth by 2005 ___________%**