Potential for Locating Intermodal Facilities on Short Line Railroads

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Disclaimer

ABSTRACT

One of the greatest challenges Upper Great Plains rural communities face in competing to attract value-added processing ventures is a lack of transportation options. Value-added ventures provide opportunities for rural America to diversify economies and manage risk. 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, hauls for grain and offer limited options for other products originating or terminating in rural areas.

An economic engineering model was developed to estimate start-up and operating costs of an intermodal facility located on a short line railroad. The model developed in this study has many useful features. Costs can be estimated for different equipment configurations and sizes of facilities. Sensitivity analysis provided insight into investment decisions where the proportions of annual operating costs increased at a much lower rate than proportionally larger investment costs. The model developed in this study provides information for shippers, short line railroads, economic developers, and Class I railroads.

Analysis of intermodal traffic originating in North Dakota through the Public Use Waybill shows decreasing volume from 1995 to 1997. Decreasing volume reveals that North Dakota shippers do not have the opportunity to participate in the intermodal growth enjoyed by most of the United States.

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INTRODUCTION

One of the greatest challenges Upper Great Plains rural communities face in competing to attract value-added processing ventures is a lack of transportation options. Value-added ventures provide opportunities for rural America to diversify economies and manage risk. 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, hauls for grain and offer limited options for other products originating or terminating in rural areas.

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 would provide rural businesses and communities alternative transportation options for those desiring expansion of their economic base. Short line railroads also may enhance their traffic base and customer service by adding an intermodal option.

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 presents opportunity for economic expansion of the rural community and surrounding area.

Although the current rail system will continue to be the mode of choice for origination of 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 as illustrated in the attached rail map (Appendix I).

The location of the short line carriers systems could allow them to offer an intermodal shipping alternative to rural areas of the state. The closest existing intermodal facilities are located in Dilworth and Minneapolis, Minn.; and Billings, Montana. Siting intermodal facilities on short lines in rural areas would provide rural communities with an opportunity to diversify their infrastructure, transportation rates, and transportation equipment resource base for attracting and growing value-added ventures.

North Dakota is 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 the 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 their proximity 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. This study will explore the needed investment and possible benefits of siting an intermodal loading facility on short line rail lines.

Objective

The main objective of this project is to evaluate costs associated with locating intermodal loading facilities in rural areas on short line railroads. A secondary objective is to analyze past and potential intermodal traffic. This economic feasibility study will be a resource for communities; identity-preserved shippers, value-added processors and rural manufacturers; and short line rail carriers to use in assessing transportation options. Diversifying transportation infrastructure also provides opportunity for rural economic development.

Research Problem and Justification

Value-added agriculture has been an economic development tool which diversifies the economic base of rural communities. One of the greatest challenges communities face is a limited transportation base. The primary means of 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.

Many shippers may not know the total landed transportation cost associated with product movement from plant to customer. This cost becomes even more complicated with multi-modal and or international shipments. There are untapped markets for many North Dakota products, and many times transportation options and costs are the barrier. Intermodal shipping may reduce shipping costs and provide opportunity for competition in domestic and international markets.

Research Method

This study will focus on determining start-up and operating costs associated with locating an intermodal loading facility on a short line railroad. This was done using an economic engineering technique. Costs were gathered from a combination of book sources, the internet, and personal interview. Scenario analysis was employed to determine costs and infrastructure and equipment options for the operation. Public Use Waybill analysis was employed to evaluate past intermodal freight movements and trends.

Report Organization

The remainder of this report is organized in six chapters. A literature review is presented in Chapter 2. Model development is found in Chapter3. Chapter 4 simulates options for different types of facilities. Chapter 5 is an analysis of intermodal traffic in North Dakota. Conclusions and a summary are reported in Chapter 6.

LITERATURE REVIEW

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

Intermodal freight transportation growth has been increasing by double digit gains except for 1996 where there were problems because of Class I railroad mergers. This chapter provides background on intermodal freight transportation and the short line rail industry.

Intermodal

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 the following:

- 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 a 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 are primarily food commodities such as coffee, bananas and other fresh fruits. Demand for identity-preserved commodities also is on the rise. Organically grown wheat or soybeans for export are examples of identity-preserved commodities. Most identity-preserved shipments tend to be small quantities and of higher value. Containers ensure the shipper and receiver the integrity of the product being shipped. This identity-preserved concept is growing and will increase demand for container shipments in rural settings where commodities are grown.

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 that were loaded through the use of circus ramps. This service has been reduced from about 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 is generally 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 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. 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 perform many tasks. These machines can move palletized freight or containers 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 are a variety of chassis-moving container handling equipment. This equipment is referred to by different names including: yard horses, hustlers, mules or terminal tractors. It is mostly 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 designed to handle containers and trailers. Chassis come in sizes compatible with containers, however there are adjustable chassis, which 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 unstacked.

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 also are 40-foot high cube refrigerated containers. The estimated cost of a 20-foot dry freight container is between $2,000 and $3,000. A 40-foot container costs 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.

Short Line Railroads

The Annual Data Profile of the short line industry was derived from an analysis of the American Short Line database. The database was used to report statistics by railroad type and region. This database has been used to separate local and regional railroads. A "Regional" railroad is identified as a line-haul railroad earning between $40 million and $255 million, and/or operating over 350 miles of track. In 1996 there were 32 regional railroads. "Local" railroads are line-haul railroads with less than $40 million in annual operating income, as well as switching and terminal railroads. Regional, local, switching, and terminal railroads that are not a division of Class I railroads, are considered to be short line railroads. There were 511 local railroads in 1996. In North Dakota there is one regional and two local railroads.

Three events tied to the formation of the current short line rail industry (Dooley, 1991). Legislation establishing Conrail in 1973 provided the initial stimulus for the formation of new railroads. Second, the reorganization of the Milwaukee Road and the liquidation of the Rock Island created opportunities for short line. Third, the federal railroad deregulation led to opportunities for short line creation. The deregulation legislation of the 1970s included provisions for 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).

Merger mania by the Class I railroads has led to larger railroads, but has also led to a reduction in the total track controlled by the Class I's. 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 ICC to speed approval of abandonment (Keeler, 1983). The deregulation designed to streamline the Class I railroads has paved the way for 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:

- a desire to eliminate the burdens of ownership (high operating and maintenance costs
- an expectation to recover some economic value from the line (sales revenue)
- 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. Advantages short line have over a Class I include lower labor costs, superior shipper service, and reduction in truck shipments reducing highway maintenance and rehabilitation.

Disadvantages to short line include its inability to make large capital expenditures resulting in deferred maintenance. Many times short line are dependent on limited business sources or customer base. They also are dependent on the Class I railroads for equipment and access.

Babcock, Russell, Prater, and Morrill (1993) identified components associated with a short line's success including 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

Factors determining a short line railroad’s success or failure are many. Economic development and increasing density or customer base by establishing an intermodal facility would increase volume on the 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.

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 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; 7) transportation brokers; 8) perishable brokers; 9) consolidators; 10) transloaders; 11) distribution carriers; 12) customshouse brokers; 13) export management companies; and 14) third-party logistics firms (Muller, 1999).

Intermodal marketing companies can provide door-to-door services tailored to specific customer needs. Third-party logistics companies, which 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:

1. Furnish necessary personnel and container-handling equipment to receive, store and deliver intermodal trailers and containers.

2. 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.

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

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

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

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

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

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

9. Prepare all reports relative to terminal functions.

10. 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.

MODEL DEVELOPMENT

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 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 that 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 the costs associated with different levels of investment.

Firm Characteristics

The spreadsheet 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

The price per acre and the number of acres required is located in the land section of the model. Both of 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 and also need to make improvements. For the base case, land was priced at $2,000. The number of acres was set at 80. Eighty acres would be large enough for the facility at 1,742,400 square feet. This would allow for ample storage, and room for loading and unloading. The dollar amount was arbitrary amount, and could be less or more depending on 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 (Table 3.1). The entries must 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 and Implementation Plan was done by Leeper, Cambridge & Campbell.

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Table 3.1. 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 the 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 and animals, and other potential hazards out of the site, a fence may be required. This section allows varying the length and cost of the fence, which is determined by 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. 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 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 simply is multiplied by the number of acres. In some cases the entire yard may not be paved, for instance, building space would not be paved.

A section also is included for lights, electrical, and reefer hookups. Electrical components will vary with the size of the facility and expectations for the 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 3.2. Fence, Pavement, and Lighting and Electrical from the Intermodal Facility Spreadsheet Costing Model.

	Column	
Row	A	B
14	**Fence**	
15	Number 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	Number of lights	6
24	Cost of lights	$10,000
25	Number 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.

The water and sewer lines are cost per foot times the length of the line. The 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 a determination of 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 3.3.	Building Options from the Intermodal Facility Spreadsheet Costing Model.	
	Column	
Row	A	B
28	**Building Options**	
29	Square feet of building	1,500
30	Cost per square foot	$50
31	Feet of water line	1,000
32	Cost per foot	$15
33	Feet of sewer line	1,500
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 whether 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 3.4.	**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/hour	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, including 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 3.5.	**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 the 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. It 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 the 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 the location and different types of taxes imposed. Insurance also may vary with location and company of issue. These variables are also 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 set a desired return for investments (hurdle rate). The hurdle rate is used to screen potential investments.

Maintenance and repair costs vary with use. With higher use the higher the 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 workman 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. The sales and management staff is based on the cost of hourly employees. This variable is difficult to estimate and would vary on 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 3.6. Variable Cost Components of the Intermodal Spreadsheet Costing Model.

	Column	
Rows	**A**	**B**
1		
2	**Variable Cost Components**	
3	Number of Salaried Employees	2
4	Salary	$25,000
5	Number of Hourly Employees	2
6	Hourly Rate	$10
7	Hours per Week	40
8	Weeks per Year	52
9	Fuel Cost per Gallon	$1
10	Workman Compensation	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

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 for a decision maker is flexibility. 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 the 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 4.1 shows the initial assumptions and possible options.

Table 4.1. 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
Feet of track	5,000	Cost per foot of track	$100
No. of powered switches	2	Cost of powered switches	$130,000
No. of fence feet	2,640	Cost of fence per foot	$10
Acres of pavement	40	Cost per acre	$10,000
No. of work lights	6	Cost of lights	$10,000
No. of reefer hookups	6	Cost of reefer hookup	$2,000
Square feet of building	1,500	Cost per square foot	$50
Feet of water line	1,000	Cost per foot	$10
Feet of sewer line	1,500	Cost per foot	$20
No. of lifters	1	Cost of lifter	$500,000
No. of hustlers	1	Cost of hustlers	$50,000
No. of forklifts	0	Cost of Forklifts	$25,000
No. of Chassis	2	Cost of Chassis	$5,000
Facility Estimated Useful Life (Years)	20	Equipment Estimated Useful Life (Years)	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 measure for the model. The model provides performance measures in the form of a total investment estimates and estimated annual costs.

Table 4.2. Investment for the Base Case Intermodal Facility	
Land	$160,000
Track	$500,000
Powered Switches	$260,000
Internal Switches	$160,000
Fence	$39,600
Building	$75,000
Office Equipment	$6,000
Lighting	$60,000
Reefer Hookups	$12,000
Water Line	$15,000
Sewer Line	$30,000
Total	$1,477,600

Total equipment cost is the next portion of the model. In the base case there is one lifter, one hustler, and two chassis. The 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 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 also includes taxes, insurance, maintenance and repair, and return on investment (Table 4.3). The section 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 4.3). Annual operating costs provide decision maker estimates of business volume needed to be successful.

Table 4.3. Annualized costs for the base case intermodal facility	
Fixed Costs	
Land and Track Depreciation	$51,104
Equipment	$29,867
Taxes, Insurance, Maintenance and Repair, Return on Investment	$207,156
Management	$45,800
Building Expense	$7,365
Variable Costs	
Wages	$91,600
W.C. and SS	$10,992
Benefits	$6,412
Accounting	$2,500
Fuel	$20,800
Total	$470,596

The base case facility assumptions include 80 acres of land with 40 acres paved, one container lifter, two chassis, 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 to provide 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., 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 in the model.

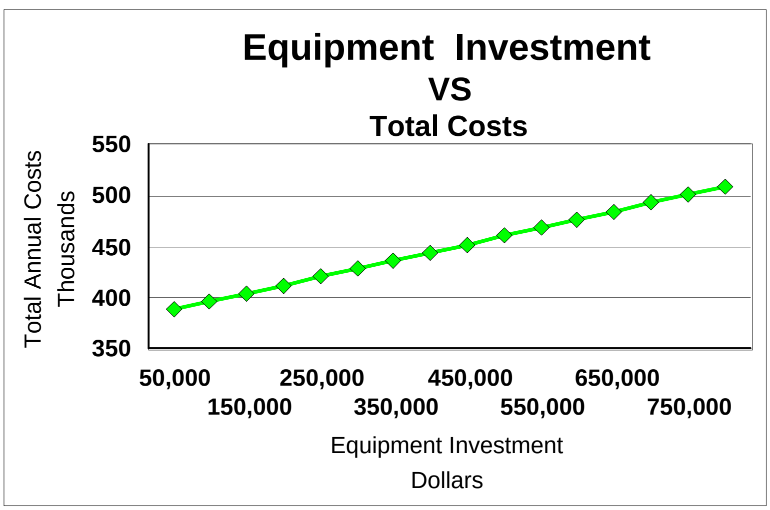
Drayage costs, or trucking costs are estimated at $1.03 per mile (Berwick & Dooley, 1996). The farther from the source increases costs associated with drayage and total transportation charges. A tradeoff exists among the economies associated with intermodal freight transportation and drayage distance. 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 4.4 shows the relationship of volume and costs associated with the base case intermodal facility and assumptions.

Table 4.4. 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 4.4). Costs vary depending on the initial investment.

Figure 4.1. Equipment Investment Versus Total Costs



Total Investment and Annual Costs

The model performs well over a wide range of different scenarios. Varying investments in equipment results in smaller increases in annual costs. Figure 4.1 shows the difference in total costs with the different levels of equipment investment.

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 4.5).

Table 4.5. 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 4.6 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 4.6. 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 underinvesting 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.

INTERMODAL SHIPPING

Demand for intermodal service is difficult to quantify. Trade-offs exist using rail versus truck including; shipping time, door to door delivery, and control of the trailer or container and the contents. Other factors that influence shipper decisions are costs of shipping and distance to an intermodal facility, performance of the facility and the railroad serving the customer.

This chapter contains Public Use Waybill analysis of intermodal shipments in and out of the state of North Dakota. A review of the Grand Fork's intermodal feasibility study of projected annual traffic collected through suvey also is presented.

Public Use Rail Waybill

Data was compiled from the Public Use Rail Waybill to estimate intermodal shipments in and out of North Dakota. The waybill is for public-use and is aggregated, non-confidential rail shipment data such as origin and destination, types of commodity, number of cars, tons, revenue, length of haul, participating railroads, and interchange locations. Movements are reported from one Bureau of Economic Analysis area to another Bureau of Economic Analysis area level and the five-digit Standard Transportation Commodity Code level. Origin and destination BEA is not included unless there are at least three freight stations in the BEA and there are at least two more freight stations than railroads in the BEA. Therefore this data may fail to capture all intermodal or TOFC/COFC (trailer on flatcar/container on flatcar) movements in and out of the state.

Data was obtained from the waybill for 1995, 1996, and 1997. Between 1995 and 1996 the BEA economic areas were re-drawn and the numbering system was changed (Appendix I Map 2). In 1995 the BEA economic areas used included 149 including the cities of Fargo, Moorhead, and Dilworth; 150 including the cities of Grand Forks, East Grand Forks, and Thief River Falls; 151 including the cities of Bismarck, Mandan, and Dickinson; and 152 including the cities of Minot and Williston. These areas include all of North Dakota, Northwestern Minnesota and a small portion of Northeastern Montana. The

1996 and 1997 BEA economic areas included are: 110 including the cities of Grand Forks, East Grand Forks, and Thief River Falls; 111 including the cities of Minot and Williston; 112 including the cities of Bismarck, Mandan, and Dickinson; and 113 including the cities of Fargo, Moorhead, West Fargo, and Dilworth (Appendix I, Map 2). Small changes were made in the re-drawing of the areas (Appendix I, Map 2).

Outbound Intermodal Shipments

Table 5.1 shows intermodal shipments out of the above mentioned areas for 1995, 1996, and 1997. The table shows the BEA area shipped from and the rate territory the commodity was shipped to. The five major rate territories in the United States are the Eastern or Official Territory or territory one, Southern Territory or territory two, the Western Trunk Line Territory or territory three, the Southwestern Territory or territory 4, including the cities of Fargo, Moorhead, and Dilworth, and the Mountain-Pacific Territory or territory five (Appendix I Map 3).

Within the table the major cities in the BEA area abbreviated for easy recognition of the approximate geographical area of the shipment origin. Also the general commodities are use instead of the commodity codes and the rate territories are given by region of the country.

Table 5.1. Public Use Waybill Intermodal North Dakota Outbound Shipments (1995)							
Year	**BEA Area Origin**	**Rate/Territory Termination**	**Rate/Ton Mile**	**Tons**	**Car Loads**	**Rail Miles**	**Commodity**
1995	Fgo/Mhd 149	North Central 3	$0.033	920	40	680	Oil Kernels
	Fgo/Mhd 149	Mountain/Pacific 5	$0.031	880	40	1,500	Oil Kernels
	Fgo/Mhd 149	Mountain/Pacific 5	$0.039	800	40	1,550	Beans
	Fgo/Mhd 149	North Central 3	$0.059	5,280	240	680	Sugar
	GF 150	North Central 3	$0.019	10,118	440	720	Potatoes
	GF 150	Southwest 4	$0.030	2,800	120	1,670	Beans
	GF 150	North Central 3	$0.038	17,920	840	710	Sugar
Total				**38,718**	**1,760**		

There were no outbound intermodal shipments recorded for the western portions of North Dakota. This would be expected as there are no intermodal terminals located in these areas. Shipments from western North Dakota are mainly raw commodities and less processed goods. However there are manufacturing facilities in Bismarck, Dickinson, and Minot and some processing plants scattered throughout the region.

Table 5.2. Public Use Waybill Intermodal North Dakota Outbound Shipments (1996)							
Year	**BEA Area Origin**	**Rate/Territory Termination**	**Rate/Ton Mile**	**Tons**	**Car Loads**	**Rail Miles**	**Commodity**
1996	Fgo/Mhd 113	North Central 3	$0.035	3,521	160	670	Sugar
	GF 110	North Central 3	$0.019	7,360	320	720	Potatoes
	GF 110	North Central 3	$0.043	1,760	80	750	Beans
	GF 110	Southwest 4	$0.030	2,760	120	1,670	Beans
	GF 110	North Central 3	$0.040	760	40	750	Sugar
	GF 110	North Central 3	$0.036	6,681	320	750	Sugar
Total				**22,842**	**1,040**		

Table 5.3. Public Use Waybill Intermodal North Dakota Outbound Shipments (1997)							
Year	**BEA Area Origin**	**Rate/Territory Termination**	**Rate/Ton Mile**	**Tons**	**Car Loads**	**Rail Miles**	**Commodity**
1997	Fgo/Mhd 113	Mountain/Pacific 5	$0.038	925	40	1,500	Oil Kernels
	Fgo/Mhd 113	Northeast 1	$0.050	1,800	120	1,380	Sugar
	GF 110	Southeast 2	$0.032	1,761	80	2,075	Field Seeds
	GF 110	North Central 3	$0.042	921	40	750	Beans
	GF 110	Southwest 4	$0.027	920	40	1,740	Beans
	GF 110	North Central 3	$0.037	17,763	840	710	Sugar
Total				**6327**	**320**		

The waybill analysis shows that the number of intermodal loads originating in eastern North Dakota decreased from 1995 to 1996, but again increased from 1996 to 1997. From 1995 to 1996 the total number of carloads originating decreased from 1,760 carloads to 1,040 carloads a 40 percent decline. From 1996 to 1997 traffic increased from 1,040 to 1,160 carloads, more than an 11 percent increase. The trend from 1995 to 1996 is a reverse of the national trend, even though container traffic grew from 1996 to 1997.

Inbound Intermodal Shipments

The Public Use Waybill also gathers data about inbound intermodal shipments into North Dakota. The same BEA Economic areas and the same years were used . There were no inbound shipments recorded in 1995, but in 1996 there were 40 cars of lumber recorded to BEA area 113 which is the Fargo-Moorhead area. In 1997 there were 40 carloads of lumber to BEA area 110 which is the Grand Forks, East Grand Forks, Thief River Falls area and 160 carloads of tractors, parts, and or attachments to BEA area 113, which again is the Fargo-Moorhead area.

The data discloses disparity between inbound and outbound shipments. A dilemma faced by North Dakota shippers and intermodal transportation providers is returning full trailers and containers to the state.

Potential Intermodal Shipping

In 1996 Leeper, Cambridge, and Campbell 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 5.2 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. Leeper, Cambridge, and Campbell (1996) failed to explain existing versus new intermodal shipments. The Leeper study listed one company anticipating using 4,000 to 5,000 containers and the study identified 1,000 of the lifts would be new business.

Leeper's estimates do not coincide with the waybill analysis performed for this study. There was no evidence to support the Leeper's estimates of intermodal traffic out of the BEA areas including all of Eastern North Dakota from 1995 to 1997.

Table 5.4. 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 3,56

Adapted from Leeper et al. (1996)

Leeper, Cambridge, and Campbell (1996) identified five conditions that afflict North Dakota shippers. These conditions are:

- Many shippers see the BNSF as being in a monopoly position because the nearest viable intermodal connection with a competing railroad, the CP/Soo, is located at Thief River Falls.

Accordingly, there is the perception that BNSF is not under pressure to lower rates or improve service.

- The region has an imbalance of origin over destination traffic. As a result, there is a chronic under supply of empty trailers and containers.
- Many North Dakota producers, supply semi-processed commodities to industrial users. Potatoes, beans, sugar, flour, and pasta often go to other firms for processing into consumer products such as frozen dinners or other forms of packaged food. As a result, many of the shippers must meet just-in-time transportation requirements. This means shipments must arrive precisely on time to meet assembly line requirements at the consignee's plant. Under these circumstances, the motor carrier mode offers an advantage of reliability and fast transit time over rail and combination rail and motor carrier modes.
- Some area shippers have sensitive products that require temperature-controlled trailers and containers. The rail mode historically has been unable to provide the same level of service for temperature controlled units that is available from motor carriers.
- BNSF continues to offer Grand Forks as an intermodal hub and subsidized the motor carrier drayage to Dilworth. There is concern that new management at BNSF may end the arrangement that would increase rates by approximately $150 a unit (Grand Forks area only).

These issues have merit for locating an intermodal facility on the BNSF mainline. Locating the intermodal facility on a short line may change the perspective of the Class I railroad . If enough volume could be generated it may be viewed as an opportunity.

CONCLUSIONS

One of the greatest challenges Upper Great Plains rural communities face in competing to attract value-added processing ventures is a lack of transportation options. Value-added ventures provide opportunities for rural America to diversify economies and manage risk. 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, hauls for grain and offer limited options for other products originating or terminating in rural areas.

Intermodal Facilities and Short Line Railroads

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 may provide rural business and communities alternative transportation options for those desiring expansion of their economic base. Moreover, short line railroads may enhance their traffic base and customer service by adding an intermodal option.

The objective of this study was to evaluate costs associated with locating intermodal loading facilities in rural areas on short line railroads. This project provides insight into the feasibility of locating intermodal facilities in rural areas providing for rural economic development.

This study first provided a cursory literature review of intermodal services and equipment, and short line railroads. The literature revealed that the use of intermodal is increasing in the U. S. Intermodal marketers reported loadings of trailers and containers increased by 23.5 percent in 1996 and 18.7 percent in 1997. The increase in container usage in the U.S. indicates the need for North Dakota shippers to have access to this successful transportation method for export and long haul domestic movements. The Public

Use Waybill analysis performed in this study shows North Dakota's inability to participate in the intermodal growth of the rest of the country.

Many smaller cities and rural areas have lost intermodal loading facilities. The low cost circus ramp approach used by lower volume loading facilities is not supported by the Class I railroads and the numbers of these facilities have dropped from 1500 in 1970 to 370 in 1998. Intermodal shipping options in North Dakota are limited by availability of loading facilities. There are no intermodal shipping facilities in North Dakota. The closest loading facilities are in Dilworth, Thief River Falls, and Minneapolis, Minn., and Billings, Mont. A reasonable distance to a loading facility was identified as an important part of making intermodal shipping economically feasible. This explains why many rural shippers continue to use trucks as their primary shipping mode.

Assumptions and the Model

An economic engineering approach was used in estimating start-up and annual costs for an intermodal loading facility. The model was developed in a Lotus 123 spreadsheet. Assumptions for the base case scenario were developed. The base case is based on a 20-acre facility with 5,000 feet of track, two powered switches, and two internal switches. To fence the perimeter of 20 acres, 2,640 feet of fence is required. It is assumed that 15 of the 20 acres would be paved. There is a need for six light poles 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, and no forklifts. There would be four employees, two salaried and two hourly. These assumptions are presented in Table 4.1 (page 26).

Costs

Cost estimates for the intermodal facility included variable and fixed costs. The cost estimates were for total investment required and also were annualized for the purpose of estimating yearly revenue requirements. It is estimated that total costs for the facility are $2,037,600. This estimate is for a new facility. These costs could be lower or higher depending on the decision makers requirements. The cost estimates were annualized and separated into variable and fixed cost categories. Fixed costs included land and track; equipment; taxes, insurance, maintenance and repair; return on investment; management; and building expense. Variable costs included wages; workers compensation and social security match; benefits; fuel costs; and accounting. However, cost categories are not absolute. Some costs may be both fixed and variable. Maintenance and repair may be fixed and variable. The fixed portion includes costs that occur over time, and the variable is those costs that occur with increased use. Within the model, maintenance and repair costs are considered fixed.

The model estimates for the base case with the above-mentioned assumptions, concluded annual operating costs at $470,596. These cost estimates assume the facility would run full time. There are possible scenarios where the facility would only operate part time with existing short line railroad employees or third-party employees. This scenario would lower labor costs and other variable cost components.

Sensitivity Analysis

Sensitivity analysis was performed to evaluate how the model reacted to changing variables and also estimate changes in annual costs using different levels of initial investment. The sensitivity analysis included break-even analysis, or costs associated with different volumes of lifts on a per lift basis. Lift estimates from 2,000 annually to 32,000 annually presented costs from $247 per lift to $15 per lift. This represents lowering costs per lift by adding volume or spreading the same fixed costs over an increasing volume of lifts.

Intermodal Traffic

Analysis of intermodal traffic originating in North Dakota through the Public Use Waybill shows decreasing volume from 1995 to 1997. Decreasing volume reveals that North Dakota shippers do not have the opportunity to participate in the intermodal growth enjoyed by most of the United States. Intermodal traffic identified by the Public Use Waybill decreased by 40 percent from1995 to 1996 and then increased by 11.5 percent from 1996 to 1997. Traffic originating in North Dakota was drayed to intermodal facilities outside North Dakota for loading adding trucking costs to the rates.

Conclusions

The model in this study has many useful features. Costs can be estimated for different equipment configurations and sizes of facilities. Sensitivity analysis provided insight into investment decisions where the proportions of annual operating costs increased at a much lower rate than proportionally larger investment costs. This leads to the conclusion that under investing may limit capacity of the loading facility limiting potential of handling larger volumes.

The intermodal volume analysis of the Public Use Waybill determined that intermodal traffic decreased from 1995 to 1997. Leeper et al. (1996) estimated more than 22,000 lifts of trailers, and containers by year five of opening a facility in the Grand Forks area. Leeper based the estimates on letters of support from area shippers.

REFERENCES

American Short Line Railroad Association and The Upper Great Plains Transportation Institute. *1994 Annual Data Profile of the American Short Line & Regional Railroad Industry*. Upper Great Plains Transportation Institute, North Dakota State University, Fargo, 1995.

Babcock, Michael W., Eugene R. Russell, Marvin Prater, and John Morrill. *State Short line Railroads and the Rural Economy* Topeka, KS: Kansas Department of Transportation, June 1993.

Berwick, Mark, and Frank Dooley. *Truck Costs for Owner/Operators*. Mountain Plains Consortium No. 97-81. Upper Great Plains Transportation Institute, North Dakota State University, Fargo, October 1997.

Bierman, H., Bonini, C., and Hausman, W. *Quantitative Analysis for Business Decisions*. 8th ed. Richard D. Irwin Inc., Homewood, IL 1991.

Coyle, J., Bardi, E., and Novak, R. *Transportation*. West Publishing Company, St. Paul, MN, 1994.

Dooley, F. *Economies of Size and Density for Short Line Railroads.* Mountain Plains Consortium No. 91-2. Upper Great Plains Transportation Institute, North Dakota State University, Fargo, 1991.

Fess, P., and Warren, W. *Accounting Principles*. South-Western Publishing Company, Cincinnati, OH, 1990.

Leeper, Cambridge, and Campbell. *Grand Forks Intermodal Study and Implementation Plan*. McLean VA, June 1996.

Martens, J. *Heavy Axle Loads: Short Line Railroads*. M.S. Thesis North Dakota State University, Fargo, 1999.

Muller, Gerhardt. *Intermodal Freight Transportation*. 3rd ed. Eno Transportation Foundation, Inc., Virginia, 1995.

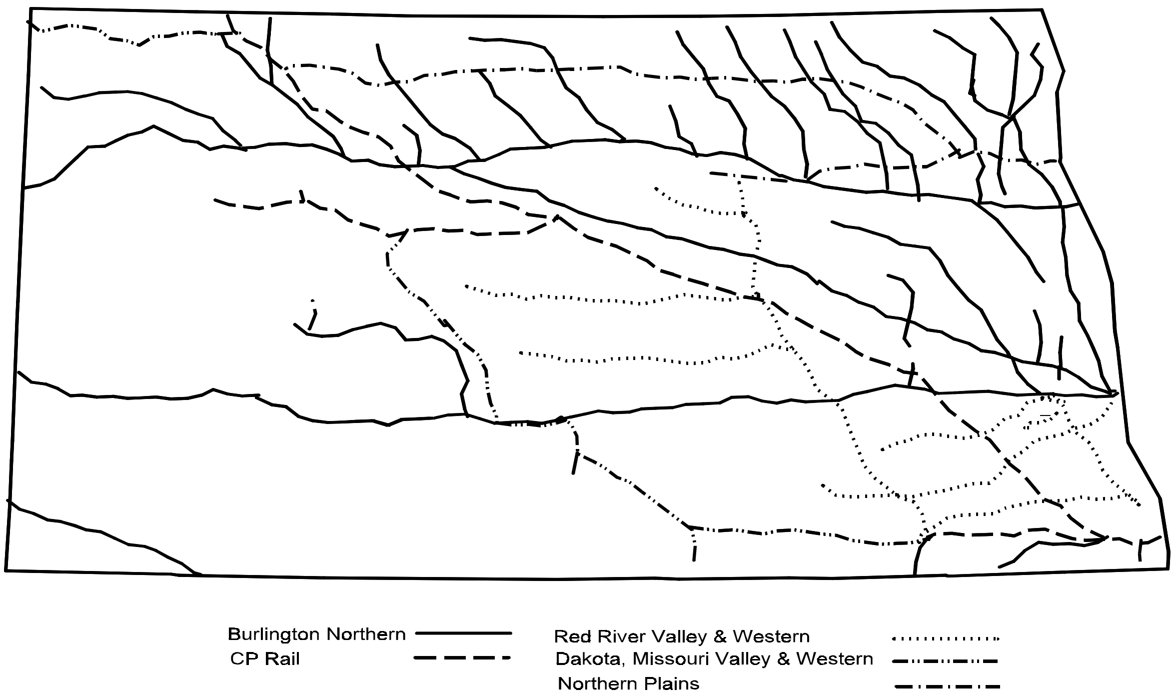
Muller, Gerhardt. *Intermodal Freight Transportation.* 4rd ed. Eno Transportation Foundation, Inc., Virginia, 1999.

Spraggins, Barry H. *"The Potential for International Intermodal Movements of Goods from Alberta to the U.S. and Mexico."* 39th Transportation Research Forum Annual Meeting Proceedings. Montreal, Canada: October 16-18, 1997.

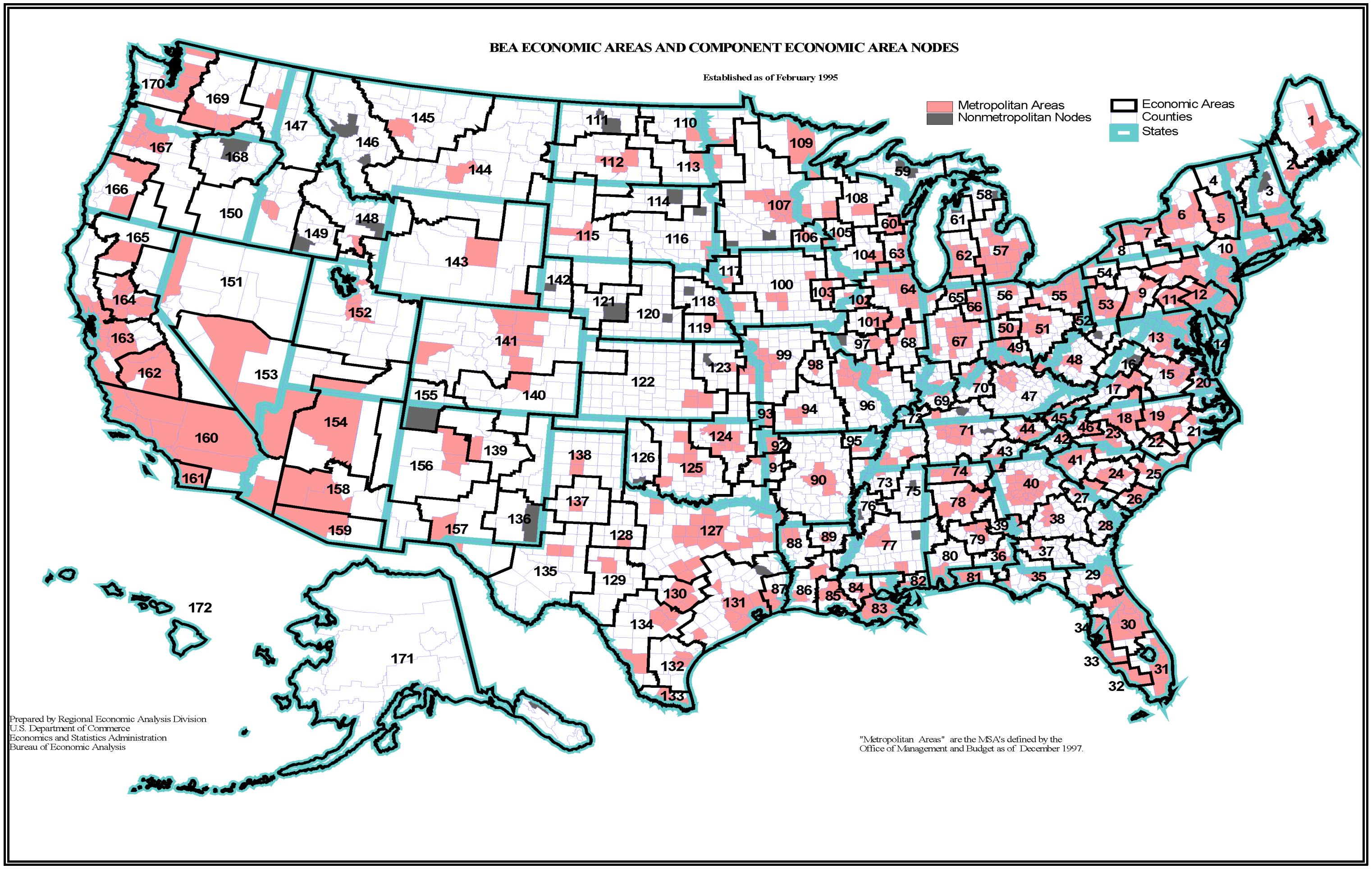
WWD. *"97 Volume Rises 18.7% for Intermodal Shipping."* 175 n.55 (March 24, 1998): 13.

APPENDIX A — MAPS

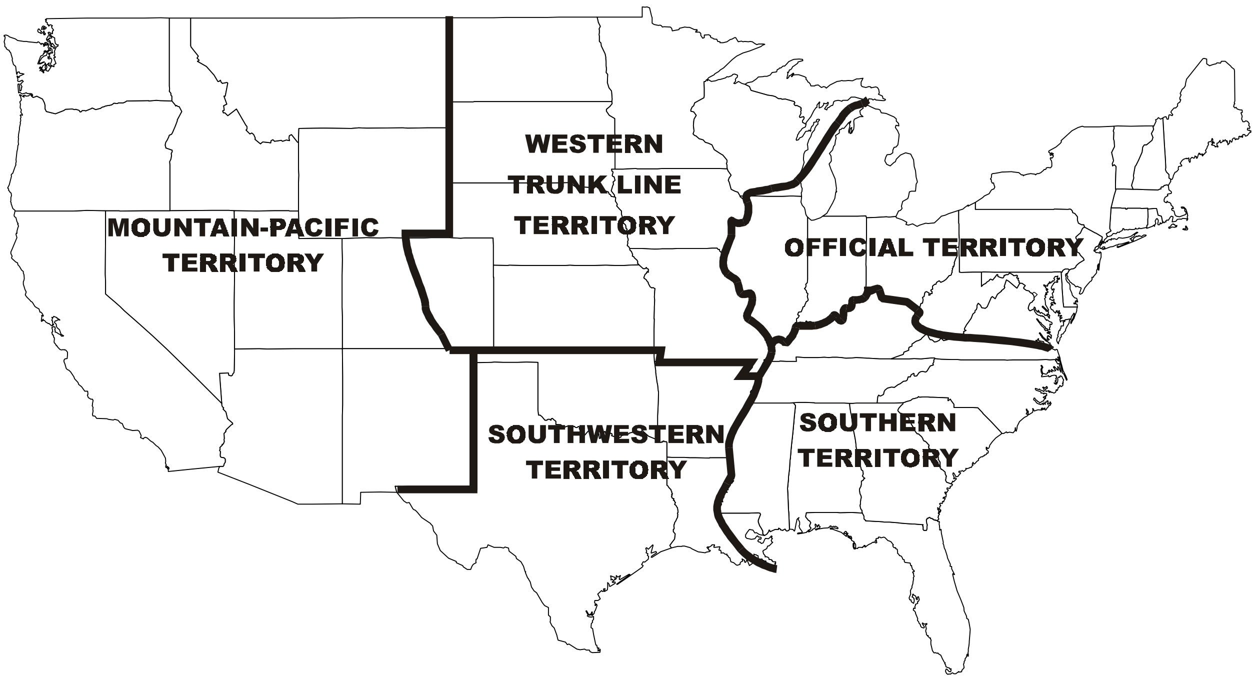
MAP 1. North Dakota Rail System, 1997



MAP 2. BEA Economic Areas



MAP 3. Major Rate Territories in the U.S.



APPENDIX B — INTERMODAL LOADING FACILITY