A financial feasibility study: Constructing unit train capabilities to access the Pacific Northwest export market

by

Kevin Horn

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Dr. Keith Harris

ABSTRACT

This study focuses on export grain merchandising opportunities for an upper Mississippi River barge terminal (MRBT) centrally located to corn and soybean (grain) production areas in Wisconsin and Minnesota. The main channels for exporting grain from the U.S. are the Pacific Northwest (PNW) and New Orleans, Louisiana (NOLA). Presently, MRBT only has capability to transport grain by barge to NOLA for export. There are a number of challenges associated with relying on barge transportation and having a single export channel. Building another form of transportation to access a secondary export market could mitigate return associated with the first channel and create additional revenue. The purpose of this study is to examine the financial feasibility of adding shuttle train loading capabilities to MRBT. This paper analyzes grain cost indicators, compares NOLA and PNW grain export prices with respect to MRBT, and compares MRBT competitive logistics with respect to barge and shuttle rail transportation methods. The findings indicated there was a positive net present value and identified several synergies from upgrading MRBT to be shuttle capable. Expanding access to the PNW could provide long-term economic advantages for future growth in a low margin industry.

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CHAPTER I: INTRODUCTION

The U.S. plants approximately 178 million acres per year in corn and soybeans, which yields 19.2 billion bushels (USDA, 2020a). Domestic usage consumes 65% of the crop while the surplus grain is exported into a highly competitive global market. Asian countries, specifically China, are the most significant importers, while Brazil and Argentina are the main export competitors. To gain market share of the world grain market, the U.S. must transport its surplus grain from inland farm origins to export channels using several modes of transportation that include trucks, barges, and rail. The two primary U.S. grain export terminals are in New Orleans, Louisiana (NOLA) and Portland, Oregon (PNW). The most cost-effective mode of transportation to NOLA is by truck to river grain terminals, and then by barge to export terminals in the Gulf of Mexico. Grain is shipped to PNW by truck, stored in grain elevators, and then transported by rail cars to export terminals in Washington and Oregon. The Mississippi River Barge Terminal (MRBT) is a privately-owned LLC which sells 95% of its grain to NOLA export terminals. MRBT sources grain from Minnesota and Wisconsin farms, and western Minnesota grain elevators on the Canadian Pacific (CP) and Twin Cities Western (TCWR) rail lines, then ships that grain by barge downriver to NOLA. MRBT competes with six other river terminals, three ethanol plants and two shuttle rail grain terminals within a 30-mile radius.

1.1 Company Background

MRBT has been in business for over 50 years. The company historically has sourced 25 - 35 million bushels of corn and soybeans by truck and rail per year and loads grain on barges to the NOLA export market. In addition to grain, MRBT has a fertilizer hub for wholesale fertilizer such as monoammonium phosphate (MAP), diammonium phosphate (DAP), urea, ammonium sulfate (AMS) and potash. MRBT handles 300,000 tons of fertilizer per year shipped from

NOLA upriver on barges. The fertilizer is unloaded at MRBT and stored before shipping outbound on trucks and rail. MRBT is a terminal for bulk commodities such as potash, dry distiller grains (DDGS), gypsum, rebar, pig iron, and rice hulls. The highest volume is potash which accounts for 300,000 tons per year. It is shipped to the terminal by rail from Canadian mines. The potash is transloaded from rail to barge, and then shipped south on the Mississippi River before unloading at various river terminals. The company charges a handling fee to unload, store, and re-load bulk commodities.

A recent change to MRBT's business is that corn purchased by truck has decreased by 10 million bushels per year. This is a result of competition from ethanol plants, a new shuttle train elevator in Randolph, MN, and competing river terminals investing in capital improvements to improve truck unloading capabilities. MRBT to some degree has offset this loss of inbound truck volume with 10 – 15 million bushels of soybeans sourced using inbound rail from the Canadian Pacific Railroad (CP) and Twin Cities Western Railroad (TC&W). The company purchases soybeans from elevators in SE North Dakota, NE South Dakota, and NW Minnesota along the CP rail network, and from west central Minnesota along the TCWR short line railroad. The soybeans are available in spring and summer months when barge shipments from MRBT to NOLA is a more profitable route than railcar shipments from grain elevators to PNW.

MRBT offers grain bids that attract a potential 45 – 65 million bushels per year from nearby farms that are transported by truck. Grain that originates from southeastern North Dakota, west central Minnesota, and northeastern South Dakota are transported by rail. The conversion margin (selling price of grain to the NOLA export terminals less the grain purchase price plus barge transportation costs down the Mississippi River to New Orleans) has averaged \$0.14/bushel. MRBT has been profitable each of the past five years.

The company has the grain handling capacity to unload 325 grain trucks per day (300,000 bushels) plus a 110-railcar unit train (300,000 bushels). The facility can load seven grain barges per day (370,000 bushels). The MRBT facility operates 215 days per year, due to the limited barge shipping season, MRBT has the capacity to sell 80 million bushels of grain per year. Growth is limited to the lack of access to profitable export markets, transportation disruptions, barge loading capacity, and the seasonality of barge shipping. Growth has not been constrained by either the amount of grain available within the sourcing area or grain unloading capacity.

1.2 Company Growth

Between 2013 and 2020, the quantity of grain handled has been inconsistent, as shown in Table 1.1, which is largely attributable to river seasonality and local production. This was especially apparent in 2019 when flooding shut off barge traffic for 40 percent of MRBT's shipping season. The Mississippi River, north of St. Louis, was shut down until the middle of July 2019, and total grain volume dropped to 26 million bushels. MRBT has identified potential growth opportunities in rail markets, while truck markets have been relatively flat. Record grain shipment volumes in 2016 and 2017 were the result of a favorable short-term rail contract.

Table 1.1: MRBT Grain Sold to NOLA Export Terminals (Million Bushels)

	2013	2014	2015	2016	2017	2018	2019	2020
Corn	25.8	15.0	16.2	26.5	22.1	19.4	8.2	15.5
Soybean	8.4	5.8	13.8	16.7	22.4	10.1	18.0	14.5
Total Grain	34.2	20.8	30.0	43.2	44.5	29.5	26.2	30.0

Source: MRBT Accounting Statement 2020

1.3 Company Historic Grain Purchasing Area

Grain sales from 2013 to 2020 averaged 30 million bushels/year, with a mix of 55% corn and 45% soybeans. MRBT purchases local (100-mile radius) grain from farms using trucks, and rail from secondary draw areas (250 mile radius) utilizing CP and TCWR rail shipments. Twenty-five million bushels of grain are purchased and transported by truck to MRBT from a large soybean (27 million bushels) and corn (152 million bushels) growing area in Southeastern Minnesota and Western Wisconsin. Appendix A gives a breakdown of MRBT's current market share of the local area, which, in summary, is 44 percent of soybeans and 12 percent of corn. MRBT has a 50-year history of developing strong supply relationships with the local farmers to establish market share.

MRBT sources and transports five million bushels of soybeans from a 40 million bushel area in south central Minnesota along the TC&W short line which is shown in Appendix B. Additionally, MRBT sources and transports by rail 10 million bushels of soybeans from a 50 million bushel draw area along the CP rail lines in the counties of Wright, Stearns, Douglas, and Grant.

1.4 Grain Purchase Price Competition in Eastern Minnesota and Western Wisconsin

The eastern Minnesota and western Wisconsin grain sourcing area produces 550 million bushels of grain per year (190 million soybeans and 360 million corn) (USDA 2020). The largest destination for Minnesota grain shipments is NOLA (see Appendix C). Two hundred and twenty million bushels of grain are transported by barge on Mississippi River barges. The second largest market is PNW and is shipped by rail. MRBT faces competition to purchase grain from grain terminals on the river, grain elevators on rail lines, ethanol plants processing corn, and soybean processors. Appendix D identifies specific local competitors and how many million bushels they each purchase per year.

1.5 Selling Price Competition

MRBT sells the majority of its grain handled to the U.S. export terminals at NOLA. The selling price quoted by NOLA is "delivered the gulf" which does not include freight costs. The seller (MRBT) would then pay barge freight costs to transport grain to reach NOLA. The NOLA price determines MRBT pricing to its customers by adding barge freight cost from shipping from Minnesota to NOLA plus MRBT's conversion margin. The company directly competes on price with the other river terminals for sales to NOLA.

The price that NOLA is willing to bid for U.S. grain depends on competition from South American exporters to Asia. NOLA must factor in the purchase price paid for U.S. grain, its ocean freight, and conversion margin to determine if it will be competitive in Asian markets. MRBT selling price also keeps NOLA competitive with the grain export terminals in Santos, Brazil delivered to China.

1.6 Research Problem

MRBT is facing an increasingly competitive environment, seasonality, and challenges associated with only having access to one grain export market (NOLA). In the past 5 years, a shuttler loader was built within 30 miles of MRBT which took away 17% of MRBT volume. In 2018, a nearby ethanol plant doubled in size resulting in another 8% of MRBT volume. Lastly, two local river terminals upgraded their facilities to access PNW markets which also took away 8% of MRBT volume. Access to the PNW market and logistic diversification is a competitive advantage for each competitor. These competitors have limited MRBT's market share. Second, seasonality has hindered MRBT's capability to access export markets. The barge shipping season is often shortened by flooding, freezing, and delays from an aging river infrastructure. Lastly, 95% of sales are currently transported by barge to NOLA. While NOLA is the single biggest exporter in the U.S., supply and demand factors along with varying rail and barge freight costs can at times make shipments to other markets profitable.

Currently, MRBT is considering adding rail capability to reach the PNW export market. The research question guiding this study was: Is it financially feasible to add shuttle train loading capabilities to MRBT? The purpose is to determine whether building another form of transportation to access a secondary export market could limit risk associated with reliance on one export market and create additional revenue.

1.7 Objectives

In order to examine financial feasibility, this study will:

1. Analyze grain cost indicators.
2. Compare and contrast profit between the ports of NOLA and PNW.
3. Conduct a financial feasibility analysis.

1.8 Importance of Current Study

The reputation of MRBT has suffered in the last decade as the competition has gotten stronger while little has been done to improve customer experience, increase competitiveness, and promote growth. Profitability has slowly increased for MRBT but has been met by escalating fixed and variable costs, and capacity and seasonality constraints. An investment in grain shuttle train loading capabilities at MRBT has potential to improve export marketing opportunities by 30% and increase facility profit by 35%. Additionally, the project has potential to increase the number of bushels handled by 10 million per year, improve return on invested capital by 17%, provide stable employment for grain terminal workers, and strengthen relationships with customers by providing year-round marketing for grain.

CHAPTER II: LITERATURE REVIEW

2.1 Global Grain Importers

PNW and NOLA export prices fluctuate based on the demand of global importers. PNW, as a result of its geographic location, sells exclusively to Asian countries, while NOLA can export grain to Asia, Europe, Africa and South America. Irregular yearly demand from global importers can create inconsistent pricing spreads between NOLA and PNW, depending on logistics. Japan, Mexico, South Korea and Taiwan are the largest importers of corn while China followed by Mexico are the largest importers of soybeans. In 2005, China's soybeans imports coming from Brazil, U.S., and Argentina were 41 percent of the world's total demand (Song, Marchant, & Xu, 2006). Song developed a U.S.-China partial equilibrium soybean trade model and discovered that Chinese soybean state buying companies have stronger market power over U.S. soybean exporters. Despite that market power, China still needs both South American and North America soybeans because their growing seasons historically are opposite. These regions thus complement each other in terms of pricing and supply.

The per capita grain consumption from 1980 to present day has been relatively unchanged if Chinese demand and ethanol usage are not taken into account (Westhoff & Thompson, 2017). According to Westhoff and Thompson (2017), between 2002 and 2020, Chinese demand for pork and poultry feeding has dramatically increased grain demand, while ethanol's emergence has substantially increased corn demand. Global grain consumption rose by 52 kilograms per capita or 15 percent between 2002 and 2014. To meet this higher demand, the area harvested for grains increased by 14 percent or 114 million hectares. These authors identify four leading indicators which affect grain prices: growth in yields, world population, Chinese demand, and biofuel production (Westhoff & Thompson, 2017).

2.2 Global Grain Exporters

Similar to global importers, global exporters can affect PNW and NOLA pricing spreads as a result of surplus and deficit production areas, which fluctuate yearly based on weather patterns. The more ideal the weather (plenty of sunshine and rain) the better the crop will do in that production area. According to the National Corn Growers Association and American Soybean Association, in 2011 the U.S. produced 38.7 percent of the worlds corn and 35 percent of the world's soybean needs (Ohio's Country Journal, 2012). In South America, corn is planted in November and harvested in March. The U.S. crop year is just the opposite with planting in May and harvesting in September. Soybeans are harvested in South America in April while the U.S. harvest occurs in October. The U.S. produces 2.5 times more corn than South America but 25 percent less soybeans (see Appendix E) (Coronnier, 2017).

Brazil's state of Mato Grosso is the largest production area for grain, but the farthest from the shipping port of Santos. The Parana growing area, while smaller today, is the lowest cost production area due to proximity to the export terminals. More land is thus being devoted to grain crop production in Parana. Argentina's grain production area is in the Northern Heartland region (LaForge, 2017).

The U.S. is the leading exporter of corn and soybeans in the world. However, Brazil and Argentina have recently been challenging that position with continued agriculture growth. While the U.S. grows 250 percent more corn than South America (see Appendix E), it trails in corn exports because U.S. devotes more of its' corn crop to livestock feeding and ethanol production than other countries. Total South American soybean exports equal U.S. exports. South America exported 25 percent of its soybean production and the U.S. 35 percent in 2019.

2.3 U.S. Grain Producing Areas

The flow of U.S. export grain historically has gone to four major ports: New Orleans (NOLA); Pacific Northwest (PNW); Houston, TX; and Duluth, MN. According to the USDA (2020a) NOLA is the largest exporter at 67 million metric tons/year, followed by PNW with 25 million metric tons/year, Houston with 12 million metric tons/year, and Duluth with 4 million metric tons/year. Appendix F provides a map of these U.S. grain export terminals. Minnesota is a unique state which acts like a pivot point where grain can be shipped to NOLA or PNW markets depending on freight costs as illustrated by the map of source areas for grain export terminals in Appendix G. According to Fruin and Tiffany's (2002) "Where Does Minnesota's Grain Crop Go?," the Mississippi River terminals are the main destination for grain produced in Minnesota, at 28 percent. Following in order of importance are PNW at 18 percent, and Minnesota grain processors at 17 percent. Interestingly, 67 percent of grain shipments in Minnesota involved rail transportation (Fruin & Tiffany, 2002). The authors go on to share that state that 100 percent of the grain shipments to PNW were by rail.

2.4 U.S. Grain Exports

The largest markets for grain exports from the U.S. are in Asia. PNW has a $21 per metric ton (MT) ocean freight advantage over NOLA to reach this market. Mexico is reached primarily by rail. The Foreign Agricultural Service of the USDA reported in September 2020 that China is expected to surpass Mexico to become the number one global importer of corn in 2020/21 (USDA, n.d.). China's increased demand for U.S. grain is driven by a January 2020 trade agreement with the U.S., a poor growing season for corn, and expanded need for animal feed. Increased demand from China would disrupt current international trade, as corn exports to China have been relatively nonexistent prior to the trade agreement. Appendix H shows the current leading importers of U.S. corn, who would be also impacted by a U.S.-China trade agreement.

China is the largest soybean importer in the world. It uses state grain buyers Cofco and Sinograin to purchase 100 million MT. In 2017, 51 million MT came from Brazil and 33 million MT from the U.S. Due to trade sanctions, the U.S. export volume to China in 2018/19 fell 60 percent to 13.4 million MT. Brazil and Argentina have been the beneficiaries of the trade dispute between China and the U.S. (LaForge, 2017). The table in Appendix H highlights the dominance that China has in soybean imports from the U.S. in comparison to the four other top importers of U.S. soybeans.

Wheat is sourced in the central and north central U.S., then shipped by rail to PNW. Appendix H also shows the dominance of Asian markets for wheat imports, which correlates with PNW being the major exporter in the U.S. due to a competitive advantage of being closer to wheat production in Montana, North Dakota and South Dakota.

2.5 U.S. Barge Infrastructure and Costs

US waterways are an invaluable resource to transport low cost agricultural commodities to export markets via New Orleans (NOLA). The Mississippi river has seven river segments: Upper Mississippi, Lower Mississippi, Illinois, Ohio, Arkansas, Tennessee and Missouri. According to Yu, Sharma, and English (2019), the Upper Mississippi River, which is comprised of 28 lock and dams, suffers from an aging infrastructure system. The American Society of Civil Engineering (ASCE) gave the river infrastructure system a rating of “D”, as the locks and dams are well over their intended life expectancy. The 28 locks and dams were constructed 50 years ago during the World War II era.

Combining yearly dredging costs, lock maintenance and increased weather events, the upper Mississippi River delays have sharply increased: “At lock 25, the annual average delay time for delayed vessels has increased from around 122 hours in 2005 to more than 267 hours in 2015” (Yu, Sharma, & English, 2019). In 2019, flooding prevented the Upper Mississippi River from opening until July 15, a four-month delay over a normal year. According to the National Oceanic and Atmospheric Administration, the 2019 flood accounted for $20 billion in damage and was the second wettest year in the lower 48 states for the last 125 years.

Even considering these mounting issues, barges are the cheapest mode of transportation. The Iowa Department of Transportation said that barge cost on the upper Mississippi River is $11 per short ton cheaper than rail or truck (HD Engineering, Inc., 2013). A river barge can carry 1500 tons of grain, which is 15 times as much as a 100-ton jumbo hopper railcar and 60 times as much as a truck trailer with 25 ton carrying capacity (Grand View Research, 2018). Barge transportation also consumes significantly less fuel than rail or truck. One gallon of fuel enables one ton of freight to travel 514 miles, while only 202 miles for rail, and 58 miles for truck (Tong, 2014). Even with the current weather risks and deteriorating infrastructure, the river system will continue to be a major transportation mode because of its inexpensive transportation network.

2.6 U.S. Rail Infrastructure and Costs

U.S. agriculture relies heavily on railroads to efficiently ship grain to multiple destinations. Currently, there are 7 Class I railroads in the U.S., which operate in 44 states, Canada, and Mexico (USDA Agricultural Transport). These railroads, which occupy 69 percent of track milage in the U.S. are: Union Pacific, Burlington Northern, CSX, Canadian National, Norfolk Southern, Canadian Pacific, and Kansas City Southern. Prater and Klindworth’s (2000) “Long-term trends in Railroad Service and Capacity for U.S. Agriculture” states that post deregulation in 1980, due to the Staggers Rail Act, railroads were determined to lower their fixed costs. According to these authors, the railroads lowered their costs by incentivizing customers through reduced rates, encouraging longer distance routes, consolidating rail network trackage, upgrading car capacities from 70 ton to 100 tons and increasing train length from 50 to 130 total cars in order to gain economies of scale.

The movement of grains by unit trains has increased rapidly since 1994. The percentage of rail-hauled grains moved by 100 car shuttles has increased from 13 percent in 1994 to 50 percent in 2011, with a peak of 51 percent in 2010. Currently US grain transportation is divided 32 percent rail, 16 percent barge and 53 percent truck (Prater, Sparanger, & O'Neil Jr, 2013).

The efficiency of shuttle trains benefits the railroad as well as agricultural producers who are close to shuttle loading facilities. Shuttle train railcars cycle 2.5 times faster than non-shuttles which result in shuttle trains cycling up to 36 times per year. This asset turnover provides motivation for railroads to utilize shuttle trains (Prater & Klindworth, 2000). This efficiency results in lower costs to the railroad, and a portion of that savings is passed along to the shipper. The shipper can then offer higher prices to the farmer to maximize value for the entire supply chain. A USDA publication points out that one drawback to shuttle facilities is that local elevators without shuttle capabilities or resources to afford upgrades could go out of business (Prater, Sparanger, & O'Neil Jr, 2013). A result of closing of non-shuttle facilities is truck traffic increasing around shuttle facilities resulting in road wear and significant maintenance. Appendix I illustrates the divergence and growth of shuttle trains in comparison to smaller trains between 1994 and 2011.

2.7 Trade Policy and Tariffs

U.S. government trade policy on tariffs has changed export demand for U.S. produced grains. In early 2018, a 25 percent tariff was imposed on Chinese goods to the U.S. and the Chinese government retaliated with reducing the imports of U.S. grains. Agricultural exports to China reached $23.8 billion in 2017, making it the largest U.S. export market, especially for soybeans. Sales fell to $9.3 billion in 2018 as China retaliated to the tariff imposed by the U.S. (USDA, n.d.).

The tariff policy was changed January 15, 2020 when the U.S. and China signed an agreement to pause the trade war that has weighed on the global economy for nearly two years. The 86-page text contains a pledge by Beijing to purchase at least $200 billion in U.S. goods over the next two years. The planned increases in grain purchases are $12.5 billion in 2020 and $19.5 billion in 2021 (Davis & Wei, 2020). However, the agreement does contain an enforcement mechanism by which the U.S. could revive its tariff threat if China is seen as violating its commitments. Under the deal, agricultural sales to China could reach $50 billion a year.

In September 2020 Bloomberg News reported that China could become the largest importer of corn in 2020 as demand for hog and poultry feed expands (Bloomberg News, 2020). Feng Lichen, chief analyst with portal www.yumi.com.cn says that "Corn imports could hit 20 million tons if U.S. prices stay competitive" (Bloomberg News, 2020). This buying also helps meet commitments under phase one of the January 2020 U.S. trade deal (Bloomberg News, 2020)The change in export demand to China for soybeans due to tariff policy changes is shown in Appendix J.

2.8 Relevance to the Current Study

This literature review describes factors that impact MRBT’s investment decision. First, grain costs impact prices quoted in PNW and NOLA. The supply and demand requirements of importers and exporters can vary each year. For example, new markets (e.g. China population surge and U.S. ethanol) can emerge, and rapidly alter the supply chain. Other grain cost indicators can result from policy and tariffs, as demonstrated by the ongoing trade war with China, which has sharpy affected U.S. crop prices. Second, the difference in prices or price spreads between PNW and NOLA constantly fluctuates depending on yearly supply and deficit areas. These variations in prices and price spreads are largely a result of where grain surpluses or shortages are and the need to fill ocean vessels. Lastly, this literature review describes how rail and barge infrastructure play a major role in determining the volume of grain transported to PNW or NOLA. Railcar and barge supply, weather events, and the geographic location of infrastructure are key determinants of NOLA and PNW pricing, which must be considered in a financial feasibility analysis.

CHAPTER III: DATA AND METHODS

This section describes the data and analyses used to answer the research question: Is it financially feasible to add shuttle train loading capabilities to MRBT? Initial research was conducted to identify the grain cost indicators that could affect the PNW and NOLA price relationship. Next, a comparison matrix was derived from five years of historical data (2015-2019) on PNW, NOLA, rail, and barge prices and costs in order to find a common denominator for comparison. Volume and margin goals were then forecasted based on historical market analysis. Finally, financial analyses for three return scenarios were conducted using net present value (NPV). These analyses will provide the input to show effects on overall facility profitability, business risk, and return on capital investment.

3.1 Definition of Terms

3.1.1 Basis

Basis is the difference between the cash price of grain delivered to the destination point subtracted or added from the Chicago Board of Trade (CBOT) futures price. MRBT uses basis as the pricing mechanism to trade grain. Basis differentials represent the cost advantages or disadvantages a grain terminal has with respect to freight costs to reach a preferred market.

3.1.2 Conversion Margin

The conversion margin encompasses grain trading margin, grain position, mix and blend variance, freight variance, arbitrage, and grain storage carry. Trading margin is the difference between the basis sold and the basis purchased. Trading margin is the major component of conversion margin and will be used in the cash flow projections for the rail project. Table 3.1 gives historical conversion margin for corn and beans at MRBT between years 2013 and 2020.

Table 3.1: Historical Conversion Margin at MRBT

	Conversion Margin							
$.01 / bushel	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Corn	3.1	9.3	6.9	12.0	11.1	14.0	9.4	10.0
Soybeans	9.1	19.7	8.9	10.7	13.1	14.8	9.1	9.0
Spring Wheat	N/A	N/A	N/A	10.0	28.4	20.5	31.1	N/A

Source: MRBT Financials 2020

3.1.3 Company Weighted Average Cost of Capital

The weighted average cost of capital (WACC) is a weighted average of the cost of debt and the cost of equity. The cost used in the project analysis is 7.5%. Cost of Capital = 60% * .055 debt rate + 40% * (average market return of 8.5% + risk free rate of 2%)

WACC = cost of equity * %Equity + Cost of Debt * %Debt * (1-Tax Rate)

3.1.4 EBITDA Contribution

Earnings before interest, taxes, depreciation, and amortization is the cash flow used in the return on investment calculation for the project. The contribution is calculated by multiplying the total grain volume gained by the project, both incrementally and through substitution, multiplied by the conversion margin.

3.1.5 Unit Shuttle Trains

Unit shuttle trains typically carry the same product from an origin to a destination without being split up. These trains range from 100 to 134 railcars per "unit" (The Western Producer, 2016). The MRBT analysis will be assuming 100 to 134 railcar unit trains with 8000 feet of track space. As a result of economies of scale gained, unit trains have lowered railroad costs, which allow reduced rail rates and increased volume. Time and money are saved by avoiding the complexities and delays that would otherwise be involved with assembling and disassembling trains at rail yards near the origin and destination. In an effort to further reduce costs and gain efficiencies, Canadian Pacific Railroad is in the process of converting their entire rail fleet to high efficiency hopper cars which will add 15% more volume and use 5% less trackage (Canadian Pacific, 2018).

3.1.6 Secondary Rail Market

Railroads auction domestic rail shuttles in the primary railcar auction market. The auction requires merchants to forecast and contract rail cars approximately a year in advance. However, it is difficult for merchants to accurately forecast their needs for rail freight so far in advance, because crop size often varies from original predictions depending on weather. A secondary rail market thus exists to respond to rail car needs within the current year of logistical execution. In this market, merchants can buy additional rail cars and pay above or below the standard rail tariffs.

3.1.7 Designated Train Program

Designated Train Program (DTP) is a marketing tool railroads use to better utilize shuttle freight and increase economies of scale. Each year an auction is held to auction off shuttle sets for the year. These shuttle sets typically make 2-3 trips per month. That set of cars is kept together for the entire year which provides the customer a more reliable source of transportation while also typically providing a better price compared to ordering cars in open distribution.

3.1.8 Net Present Value

Net Present Value is a financial evaluation tool that can help indicate if a project might be profitable given time and return required. NPV uses the present value of cash flows over a specific time period with respect to the discount rate or return required.

$$NPV = {}_{n}\sum{}_{T}\ R_t/(1+i)^t$$

Rt = Net cash inflow during time period t

i = Discount rate or return required

t = time/number of years

T = Final year.

3.2 Analysis of Grain Cost Indicators

To identify relevant grain cost indicators, data were retrieved from the USDA and primary data from MBRT. These data were used to define limitations in both rail and barge transportation.

3.2.1 Local Competitors

The main competition for corn within MRBT sourcing area comes from ethanol plants (90 million bushels/year), shuttle rail shipments to Mexico (17 million bushels/year), and soybean processors (80 million bushels/year). To source grain, MRBT must offer a price that is competitive to these locations, usually within 10 cents per bushels to prevent customers from delivering their grain elsewhere.

3.2.2 Barge Transportation Disruptions

Barge transportation disruptions are major disruptions in supply for the exporters in NOLA, which rely on a constant supply of barges. When various segments of the Mississippi river are curtailed by man-made or natural events it effects the flow of grain, which can drastically affect prices in NOLA. Man-made disruptions consist of lock closures for repairs, traffic delays at the locks, or vessel accidents on the river. Most locks built in the 1930's were 600 feet in length with the capacity to hold only 9 barges. Since a modern tow pushes 15 grain hopper barges, it now requires disassembly, double lockage, and re-assembly before resuming its trip, resulting in up to two-hour delays.

Natural disruptions can trigger late river opening, unscheduled season delays, and early river closures of the Upper Mississippi River (UMR). The causes of these disruptions can be from flooding, early river freeze, and droughts of the upper Mississippi. Over the past ten years barge shipments have been curtailed due to one or more of these events. In 2012, the Mississippi River suffered record breaking low water level and barge traffic was restricted (Tong, 2014). Freezing caused early river closures in 2017, and the river opened up late due to flooding in 2018. In 2019 a 100-year flood stalled more than 500 barges on the Mississippi River. The river season was shorted by 40% as shipping season did not open until July 10.

Flooding in the U.S. is more frequent and severe, driven by climate change. In some parts of the Midwest, extreme rain has already increased by more than 50 percent since the early 1900s. During the flood of 2019, the economic impact to MRBT was over $2.5 million in lost profit as grain delivery contracts had to be fulfilled from other locations and by alternate modes of transportation.

3.2.3 Barge Freight Rates Along Mississippi River System to NOLA

The U.S. Inland Waterway System utilizes a percent of tariff system to establish barge freight rates. To calculate the rate in dollars per ton, multiply the percent of tariff rate by the 1976 benchmark tariff. Benchmark tariffs for 7 river terminal locations are presented in Table 3.2. As an example, a 435 percent tariff for Minneapolis-St. Paul barge (average for 2019) would equal 4.35 times the benchmark tariff of $6.19, or $26.93 per ton to reach NOLA. The most northern cities have the highest benchmark tariffs since they are furthest from NOLA (USDA, 2020b).

Table 3.2: 1976 Barge Tariffs on River System

CITY	RIVER SEGMENT	TARIFF (dollars/ton)
Minneapolis, Savage MN	Mississippi River	$6.19
Davenport IA	Mississippi River	$5.32
Illinois River ports	Illinois River	$4.64
Cincinnati OH	Ohio River	$4.69
Lower OH	Ohio River	$4.46
St. Louis	Mississippi River	$3.99
Cairo – Memphis	Mississippi River	$3.14

Source: USDA, 2020a.

3.2.4 Rail Freight Rates Along Rail Lines to PNW

Rail freight rates (tariffs), are public information and follow a relationship to miles travelled. Table 3.3 shows how the closer the shipper is to PNW export markets, the lower the costs. The secondary rail freight market allows merchants to buy and sell additional trips (right to ship one-unit train) for a higher or lower price of tariff depending on supply and demand. The weakness of railroads is that they are not always prompt or reliable. While railroads are regarded as oligopolies, they have monopolistic characteristics once businesses have invested infrastructure on their rail network. These businesses end up relying solely on the railroad for supply of railcars, giving customers little negotiating power post investment.

Table 3.3: Rail Freight Rates to PNW

	Carrier	Miles	$/Car	Soybeans	Corn	Wheat
St Paul MN	CP	1443	5455	$ 1.51	$ 1.30	N/A
Savage MN	UP	1420	5843	$ 1.59	$ 1.40	N/A
St Cloud MN	BNSF	1358	5376	$ 1.60	$ 1.28	N/A
Enderlin ND	CP	1138	5089	$ 1.51	$ 1.27	$ 1.30
Jamestown ND	BNSF	1072	5010	$ 1.56	$ 1.25	$ 1.28

Source: MRBT transportation 2020

3.3 Comparison of the NOLA and PNW Grain Export Terminals

To identify the PNW and NOLA historical spread in relationship to MRBT, data was retrieved from the USDA, primary data from MBRT, and data from 3rd party brokers. This data was used to create a matrix, which later helped frame the financial analysis.

3.3.1 Basis Sold MRBT to PNW and to NOLA

Primary monthly data was collected from 2015-2019 for PNW and NOLA basis price points. These data points were then graphed in Figure 3.1 to show the relationship between the two markets, with respect to corn and beans, and identify the spread differences. From 2015 through 2019, PNW paid an average of $0.41/bushel more for corn and $0.32/bushels more for soybeans than NOLA.

Table 3.4: Difference in Basis Sold between PNW and NOLA

Basis Sold	**$/bushel**				
	2015	**2016**	**2017**	**2018**	**2019**
PNW Corn	$ 0.89	$ 0.87	$ 0.72	$ 0.88	$ 1.04
NOLA Corn	$ 0.56	$ 0.49	$ 0.34	$ 0.50	$ 0.48
Basis Spread Corn	**$ 0.33**	**$ 0.39**	**$ 0.38**	**$ 0.38**	**$ 0.56**
PNW Soybeans	$ 0.90	$ 0.95	$ 0.77	$ 0.73	$ 0.80
NOLA Soybeans	$ 0.79	$ 0.60	$ 0.37	$ 0.38	$ 0.39
Basis Spread Soybeans	**$ 0.11**	**$ 0.36**	**$ 0.41**	**$ 0.35**	**$ 0.41**

Source: MRBT primary data 2020

3.3.2 Freight from MRBT to PNW and to NOLA

A similar comparison of PNW and NOLA values was made using barge and rail transportation rates from 2015 through 2019. Table 3.5 illustrates the transportation rate comparison. Using the calculation that freight spread equals the average rail freight to PNW minus the average barge freight to NOLA, this analysis identified that PNW rail markets paid $0.56/bushel more for corn than barging to NOLA during this time period. Soybeans were found to have a $0.65/bushel higher cost to PNW than using barges to reach NOLA.

Table 3.5: Difference in Freight between PNW and NOLA

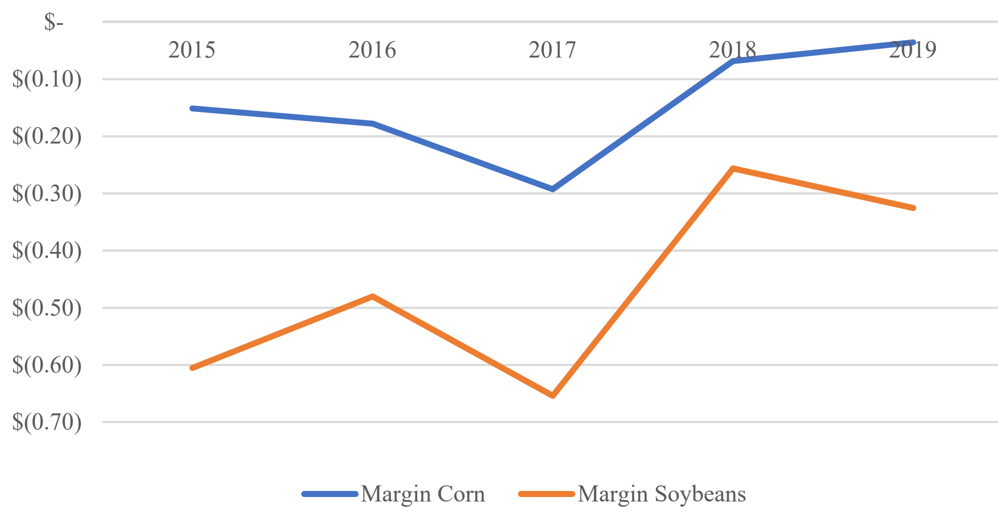
Freight	$/bushel				
	2015	2016	2017	2018	2019
PNW Corn Rail	$ 1.28	$ 1.30	$ 1.33	$ 1.36	$ 1.38
NOLA Corn Barge	$ 0.79	$ 0.73	$ 0.65	$ 0.90	$ 0.78
Freight Spread Corn	**$ 0.49**	**$ 0.57**	**$ 0.68**	**$ 0.46**	**$ 0.60**
PNW Beans Rail	$ 1.41	$ 1.44	$ 1.47	$ 1.50	$ 1.53
NOLA Beans Barge	$ 0.85	$ 0.78	$ 0.70	$ 0.96	$ 0.83
Freight Spread Soybeans	**$ 0.56**	**$ 0.66**	**$ 0.77**	**$ 0.54**	**$ 0.70**

Source: MRBT primary data 2020

3.3.3 PNW and NOLA conversion margin comparison

When comparing yearly averages for MRBT margins, PNW has negative margins versus NOLA. In Figure 3.1, NOLA margins for MRBT are held constant at zero, whereas PNW margins for corn and soybeans are illustrated with respect to NOLA. The figure shows that PNW and NOLA spread narrows as PNW trends higher. Second, corn shipments to PNW are preferred over soybean shipments as their margins are less negative. Finally, when comparing yearly averages for margins, neither corn nor soybean PNW margins for MRBT are advantageous over NOLA.

Figure 3.1: Comparing Margins Between PNW and NOLA



Yearly averages shown in Figure 3.1 do not reflect an accurate depiction of when to sell to PNW. The matrix analysis will examine the basis sold and freight spreads for specific months during the year to determine selling opportunities to the PNW. The rail business will be preferred in months when the spread in basis sold is greater than the spread in freight values.

3.3.4 Future Trends in NOLA and PNW

NOLA and PNW make up 85% of the 125 million MT U.S. export grain shipments. PNW has been gaining market share over NOLA, except for 2019 when the impact of China closing grain imports from the U.S. was felt. With the resumption of grain shipments to China and the expanding export market in Asia, PNW's market share should continue to expand. Virtually all PNW exports arrived at the terminals by unit trains (U.S. Department of Agriculture, 2020).

3.3.5 NOLA and PNW Conversion Margin Matrix

To determine opportunities, the data was analyzed monthly between 2015-2019. The conversion margin is a combination of export price less freight.

3.4 Financial Analysis

The financial analysis primarily relied on MRBT primary data. The analysis consisted of three return scenarios: low, intermediate, and high. The scenarios assumed a 7.5% MRBT's weighted cost of capital for all capital projects. Conversion margins were determined using 2015-2019 historical margins, PNW and NOLA MRBT comparison matrix, assumed $0.45 per bushel carry margin from new storage, and incremental revenue from arbitrage opportunities. Similarly, projected volumes were derived from historical volumes with respect to the local supply and demand.

Total investment costs associated with adding shuttle train loading capabilities were derived from MRBT's internal engineer estimates as of July 2020. Those costs were estimated at $3.425 million. This cost includes the following:

- $1.8 million - 350,000-bushel storage bin and conveyance
- $800,000 - 30k bushel/hour leg
- $750,000 - for a rail scale
- $75,000 Diverter Type (DT) Grain Sampler

A grain bin is needed to hold a unit train worth of grain prior to loading to meet time incentives, conveyance is needed to transport grain in and out of the grain bin, an elevator leg is necessary to elevate the grain into the grain bin as well as into rail cars, a rail scale will be used to figure the correct weight of bushels loaded in each rail car, and finally a grain sampler is required to quickly and accurately obtain certified grain quality for each rail car loaded.

CHAPTER IV: RESULTS

The purpose of this study was to answer the question: “Is it financially feasible to add shuttle train loading capabilities to MRBT?” This chapter will discuss the findings from the financial analysis that was conducted to answer the research question. The chapter will focus on a MRBT comparison matrix for PNW and NOLA and a financial analysis using NPV to formulate three return scenarios.

4.1 MRBT comparison matrix of NOLA and PNW

The purpose of the comparison matrix was to: 1) define MRBT monthly data points between 2015-2019 where PNW was a preferred market over NOLA, 2) determine incremental margin in months identified favorable to PNW, and 3) identify trends and potential risk or opportunities. The matrix consists of corn and soybeans to identify preferred shipment periods per specific commodities.

Table 4.1: MRBT Corn PNW/NOLA Matrix Comparison

Comparison	FOB MRBT PNW Basis	FOB MRBT NOLA Basis	FOB MRBT Janesville	NOLA/PNW Spread
Corn	**2015**			
Jan	$ (0.32)		$ (0.38)	$ 0.06
Feb	$ (0.29)		$ (0.33)	$ 0.04
Mar	$ (0.14)	$ (0.18)		$ 0.04
Apr	$ (0.22)	$ (0.13)		$ (0.09)
May	$ (0.17)	$ (0.13)		$ (0.04)
Jun	$ (0.29)	$ (0.25)		$ (0.04)
Jul	$ (0.42)	$ (0.29)		$ (0.13)
Aug	$ (0.42)	$ (0.15)		$ (0.27)
Sep	$ (0.40)	$ (0.40)		$ (0.00)
Oct	$ (0.41)	$ (0.40)		$ (0.01)
Nov	$ (0.32)	$ (0.15)		$ (0.17)
Dec	$ (0.37)		$ (0.47)	$ 0.10

Comparison	FOB MRBT PNW Basis	FOB MRBT NOLA Basi	FOB MRB Janesville	NOLA/PNW Spread
Corn	**2016**			
Jan	$ (0.39)		$ (0.46)	$ 0.07
Feb	$ (0.42)		$ (0.45)	$ 0.03
Mar	$ (0.47)	$ (0.16)		$ (0.31)
Apr	$ (0.37)	$ (0.15)		$ (0.22)
May	$ (0.37)	$ (0.15)		$ (0.22)
Jun	$ (0.37)	$ (0.26)		$ (0.11)
Jul	$ (0.25)	$ (0.21)		$ (0.04)
Aug	$ (0.16)	$ (0.21)		$ 0.05
Sep	$ (0.23)	$ (0.33)		$ 0.10
Oct	$ (0.38)	$ (0.37)		$ (0.01)
Nov	$ (0.47)	$ (0.30)		$ (0.17)
Dec	$ (0.39)		$ (0.54)	$ 0.15

Comparison	FOB MRBT PNW Basis	FOB MRBT NOLA Basi	FOB MRB Janesville	NOLA/PNW Spread
Corn	**2017**			
Jan	$ (0.38)		$ (0.52)	$ 0.14
Feb	$ (0.44)		$ (0.59)	$ 0.15
Mar	$ (0.49)	$ (0.18)		$ (0.31)
Apr	$ (0.47)	$ (0.15)		$ (0.32)
May	$ (0.52)	$ (0.23)		$ (0.29)
Jun	$ (0.54)	$ (0.28)		$ (0.26)
Jul	$ (0.65)	$ (0.37)		$ (0.28)
Aug	$ (0.59)	$ (0.35)		$ (0.24)
Sep	$ (0.70)	$ (0.58)		$ (0.12)
Oct	$ (0.66)	$ (0.45)		$ (0.21)
Nov	$ (0.46)	$ (0.32)		$ (0.14)
Dec	$ (0.50)		$ (0.58)	$ 0.08

Comparison	FOB MRBT PNW Basis	FOB MRBT NOLA Basi	FOB MRB Janesville	NOLA/PNW Spread
Corn	**2018**			
Jan	$ (0.44)		$ (0.56)	$ 0.12
Feb	$ (0.47)		$ (0.56)	$ 0.09
Mar	$ (0.47)		$ (0.62)	$ 0.15
Apr	$ (0.29)	$ (0.49)		$ 0.20
May	$ (0.34)	$ (0.34)		$ (0.00)
Jun	$ (0.37)	$ (0.38)		$ 0.01
Jul	$ (0.35)	$ (0.35)		$ 0.00
Aug	$ (0.36)	$ (0.43)		$ 0.07
Sep	$ (0.53)	$ (0.49)		$ (0.04)
Oct	$ (0.56)	$ (0.44)		$ (0.12)
Nov	$ (0.37)	$ (0.24)		$ (0.13)
Dec	$ (0.29)		$ (0.54)	$ 0.25

Comparison	FOB MRBT PNW Basis	FOB MRBT NOLA Basi	FOB MRB Janesville	NOLA/PNW Spread
Corn	**2019**			
Jan	$ (0.22)		$ (0.53)	$ 0.31
Feb	$ (0.24)		$ (0.47)	$ 0.23
Mar	$ (0.14)		$ (0.38)	$ 0.24
Apr	$ (0.07)		$ (0.43)	$ 0.36
May	$ (0.17)		$ (0.49)	$ 0.32
Jun	$ (0.29)	$ (0.27)		$ (0.02)
Jul	$ (0.36)	$ (0.31)		$ (0.05)
Aug	$ (0.32)	$ (0.48)		$ 0.16
Sep	$ (0.40)	$ (0.34)		$ (0.06)
Oct	$ (0.43)	$ (0.32)		$ (0.11)
Nov	$ (0.31)	$ (0.28)		$ (0.03)
Dec	$ (0.25)		$ (0.55)	$ 0.30

Table 4.1 shows the corn matrix conducted and identifies, using green highlighting, the months in which PNW had a higher margin than shipping to NOLA. PNW trends towards becoming more competitive with NOLA and it has a growing margin. It is worth noting that every year analyzed had at least four months in which PNW was favorable compared to NOLA. Margins were highest in December-March but also showed potential in August and September if trends continue. In 2019, the river was closed due to flooding until July 1. Thus, PNW margins are most likely inflated during that time.

Table 4.2: MRBT Corn Matrix 5 Year Average (2015-2019)

	MRBT FOB PNW	MRBT FOB NOLA	MRBT FOB Janesville	spread
Jan	$ (0.39)		$ (0.49)	$ 0.10
Feb	$ (0.42)		$ (0.48)	$ 0.06
Mar	$ (0.41)		$ (0.50)	$ 0.09
Apr	$ (0.35)	$ (0.21)		$ (0.14)
May	$ (0.36)	$ (0.21)		$ (0.15)
Jun	$ (0.41)	$ (0.27)		$ (0.14)
Jul	$ (0.43)	$ (0.29)		$ (0.14)
Aug	$ (0.39)	$ (0.30)		$ (0.09)
Sep	$ (0.48)	$ (0.47)		$ (0.00)
Oct	$ (0.51)	$ (0.44)		$ (0.08)
Nov	$ (0.42)	$ (0.26)		$ (0.16)
Dec	$ (0.40)		$ (0.54)	$ 0.14

Table 4.2 is a 5-year average of the corn matrix and it highlights that over the time period identified, PNW was on average a preferred market December – March. NOLA is the dominant market for MRBT corn. However, PNW does have months in which it is preferred. This scenario did not go into daily market changes, but given the data provided, it seems logical more opportunities to ship PNW would surface.

Table 4.3: MRBT Soybean PNW/NOLA Matrix Comparison

	FOB MRBT	FOB MRBT	FOB MRBT	NOLA/PNW	FOB MRBT	FOB MRBT	FOB MRBT	NOLA/PNW	FOB MRBT	FOB MRBT	FOB MRBT	NOLA/PNW	FOB MRBT	FOB MRBT	FOB MRBT	NOLA/PNW	FOB MRBT	FOB MRBT	FOB MRBT	NOLA/PNW
Comparison	PNW Basis	NOLA Basis	Mankato	Spread	PNW Basis	NOLA Basis	Mankato	Spread	PNW Basis	NOLA Basis	Mankato	Spread	PNW Basis	NOLA Basis	Mankato	Spread	PNW Basis	NOLA Basis	Mankato	Spread
Corn	**2015**				**2016**				**2017**				**2018**				**2019**			
Jan	$ (0.47)		$ (0.50)	$ 0.03	$ (0.40)		$ (0.45)	$ 0.05	$ (0.63)		$ (0.75)	$ 0.12	$ (0.71)		$ (0.85)	$ 0.14	$ (0.77)		$ (0.87)	$ 0.10
Feb	$ (0.54)		$ (0.45)	$ (0.09)	$ (0.42)		$ (0.43)	$ 0.01	$ (0.64)		$ (0.70)	$ 0.06	$ (0.77)		$ (0.80)	$ 0.03	$ (0.83)		$ (0.80)	$ (0.03)
Mar	$ (0.40)		$ (0.33)	$ (0.40)	$ (0.47)	$ 0.58	$ (0.35)	$ (0.12)	$ (0.70)	$ 0.35	$ (0.60)	$ (0.10)	$ (0.73)		$ (0.75)	$ 0.02	$ (0.86)		$ (0.75)	$ (0.11)
Apr	$ (0.62)	$ (0.03)		$ (0.59)	$ (0.64)	$ (0.12)		$ (0.52)	$ (0.73)	$ (0.34)		$ (0.39)	$ (0.61)	$ 0.45	$ (0.62)	$ 0.01	$ (0.59)		$ (0.75)	$ 0.16
May	$ (0.62)	$ (0.05)		$ (0.57)	$ (0.65)	$ (0.19)		$ (0.46)	$ (0.75)	$ (0.26)		$ (0.49)	$ (0.71)	$ (0.58)		$ (0.13)	$ (0.69)		$ (0.75)	$ 0.06
Jun	$ (0.55)	$ -		$ (0.55)	$ (0.63)	$ (0.23)		$ (0.40)	$ (0.75)	$ (0.27)		$ (0.48)	$ (0.68)	$ (0.40)		$ (0.28)	$ (0.74)		$ (0.64)	$ (0.74)
Jul	$ (0.57)	$ (0.09)		$ (0.48)	$ (0.60)	$ (0.26)		$ (0.34)	$ (0.83)	$ (0.22)		$ (0.61)	$ (0.76)	$ (0.45)		$ (0.31)	$ (0.74)	$ (0.58)		$ (0.16)
Aug	$ (0.56)	$ (0.07)		$ (0.49)	$ (0.47)	$ (0.17)		$ (0.30)	$ (0.79)	$ (0.26)		$ (0.53)	$ (0.77)	$ (0.41)		$ (0.36)	$ (0.78)	$ (0.51)		$ (0.27)
Sep	$ (0.55)	$ 0.10		$ (0.65)	$ (0.10)	$ 0.08		$ (0.18)	$ (0.59)	$ (0.18)		$ (0.41)	$ (0.75)	$ (0.79)		$ 0.04	$ (0.77)	$ (0.54)		$ (0.23)
Oct	$ (0.50)	$ (0.12)		$ (0.38)	$ (0.38)	$ 0.06		$ (0.44)	$ (0.66)	$ (0.41)		$ (0.25)	$ (0.96)	$ (0.81)		$ (0.15)	$ (0.77)	$ (0.29)		$ (0.48)
Nov	$ (0.40)	$ (0.17)		$ (0.23)	$ (0.49)	$ (0.28)		$ (0.21)	$ (0.65)	$ (0.49)		$ (0.16)	$ (0.93)	$ (0.75)		$ (0.18)	$ (0.61)	$ (0.35)		$ (0.26)
Dec	$ (0.39)		$ (0.55)	$ 0.16	$ (0.60)		$ (0.80)	$ 0.20	$ (0.60)		$ (0.90)	$ 0.30	$ (0.84)		$ (0.83)	$ (0.01)	$ (0.59)		$ (0.40)	$ (0.19)

Table 4.3 highlights the soybean matrix conducted and identifies, using green highlighting, the months in which PNW had a higher margin than shipping to NOLA. Similar to the corn matrix, soybeans were most profitable in the winter months of December – February. There were not only noticeably fewer months in which PNW was more profitable than NOLA, but also the margin spread was wider and more favorable to NOLA than corn. Similar to corn, there still was a trend towards PNW being favored more frequently, yet the margins were significantly less that what was seen in the corn matrix.

Table 4.4: MRBT Soybean Matrix 5 Year Average (2015-2019)

	MRBT FOB PNW	MRBT FOB NOLA	MRBT FOB Mankato	spread
Jan	$ (0.61)		$ (0.68)	$ 0.08
Feb	$ (0.59)		$ (0.64)	$ 0.04
Mar	$ (0.66)		$ (0.56)	$ (0.11)
Apr	$ (0.66)	$ (0.27)		$ (0.39)
May	$ (0.69)	$ (0.23)		$ (0.47)
Jun	$ (0.67)	$ (0.26)		$ (0.41)
Jul	$ (0.71)	$ (0.23)		$ (0.48)
Aug	$ (0.66)	$ (0.20)		$ (0.47)
Sep	$ (0.51)	$ (0.32)		$ (0.19)
Oct	$ (0.64)	$ (0.42)		$ (0.22)
Nov	$ (0.63)	$ (0.34)		$ (0.29)
Dec	$ (0.62)		$ (0.70)	$ 0.08

Table 4.4 is a 5-year average of the soybean matrix which shows that soybeans were profitable only in the months of December – February. The spread between PNW and NOLA was as large as $.48 per bushel, in favor of NOLA in July. The highest positive margins for soybeans over NOLA was $.08 cents per bushel in the months of January and February. The 5-year average shows that NOLA is the dominant market for soybeans. However, PNW is a preferred choice when the river is frozen in the winter, providing incremental margin and seasonality protection.

4.2 NPV Analysis on Impact of Rail Expansion Project

The purpose of the financial analysis was to determine if the capital investment to upgrade MRBT to direct shuttles to the PNW. A positive NPV would indicate the project is financially feasible and meets the weighted cost of capital required by MRBT. The NPV analysis consists of three return scenarios: low, intermediate, and high. All scenarios use the same investment of $3,425,000, time period of 25 years, and MRBT's predetermined weighed cost of capital of 7.5%. The margins and bushels forecasted are based off the PNW/NOLA matrix in section 4.1 and MRBT primary historical data.

4.2.1 Low Return

Table 4.5 low return scenario uses the average margin corn and soybean matrix for 2015 – 2017 which where the least desirable years to ship PNW. The forecast used 2.8 million bushels projected to ship to PNW and was made up of 73% corn and 27% soybeans.

Table 4.5: Low Return Scenario

					Low								
Cash flow projections:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Corn volume	825090	412545	0	0	0	0	0	0	0	0	0	825,090	2,062,725
Bean volume	386,400	0	0	0	0	0	0	0	0	0	0	386,400	772,800
Corn margin	0.09	0.07	-0.19	-0.21	-0.18	-0.14	-0.15	-0.15	0.00	-0.08	-0.16	0.11	-0.08
Bean margin	0.07	-0.01	-0.21	-0.50	-0.51	-0.48	-0.48	-0.44	-0.41	-0.36	-0.20	0.08	-0.29
Corn revenue	74,258.10	28,878.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90,759.90	193,896.15
Bean revenue	27048	0	0	0	0	0	0	0	0	0	0	30912	57960
Total Monthly Revenue	101,306.10	28,878.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	121,671.90	251,856.15
Carry Revenue	35,000.00												35,000.00
Total annual revenue	286,856.15											Bushel Total	2,835,525

Table 4.6: NPV Results: Low Return

15 year NPV	($892,886.41)
20 year NPV	($500,647.46)
25 year NPV	($227,430.03)
Discounted Payback	undetermined
Internal Rate of Return (IRR) - 25 yr	6.73%

There were only three shipping months, December – February, identified in which PNW was profitable over NOLA. Total incremental annual revenue from PNW was estimated at $286,856, which includes $35,000 of carry revenue from the new 350,000-bushel bin.

The results in table 4.6 show that NPV is negative for 15, 20, and 25-year time frames which would indicate the project does not meet the financial criteria to invest. The 25-year internal rate of return (IRR) was 6.73% with an undetermined discounted payback since the analysis stopped at 25 years.

4.2.2 Intermediate Return

Table 4.7 intermediate return scenario uses the average margin corn and soybean matrix for 2015 – 2019 which included all years analyzed in the matrix.

Table 4.7: Intermediate Return Scenario

							Intermediate						
Cash flow projections:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Corn volume	825090	825090	825090	0	0	0	0	0	0	0	0	825,090	3,300,360
Bean volume	386,400	386,400	0	0	0	0	0	0	0	0	0	386,400	1,159,200
Corn margin	0.10	0.06	0.09	-0.14	-0.15	-0.14	-0.14	-0.09	0.00	-0.08	-0.16	0.14	-0.04
Bean margin	0.08	0.08	-0.11	-0.39	-0.47	-0.41	-0.48	-0.47	-0.19	-0.22	-0.29	0.08	-0.23
Corn revenue	82,509.00	49,505.40	74,258.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	115,512.60	321,785.10
Bean revenue	30912	30912	0	0	0	0	0	0	0	0	0	30912	92736
Revenue	113,421.00	80,417.40	74,258.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	146,424.60	414,521.10
Carry revenue	70,000.00												70,000.00
Total annual revenue	484,521.10											Total Bushels	4,459,560

Table 4.8: NPV Results: Intermediate Return

15 year NPV	$851,925.77
20 year NPV	$1,514,446.17
25 year NPV	$1,975,930.47
Discounted Payback	11 years
Internal Rate of Return (IRR) - 25 yr	13.56%

The forecast used 4.45 million bushels projected to ship to PNW and was made up of 74% corn and 26% soybeans. There were four shipping months, December – March, identified in which PNW was profitable over NOLA. Total incremental annual revenue from PNW was estimated at $484,521, which includes $70,000 of carry revenue from the new 350,000-bushel bin.

The results in table 4.8 show that NPV is positive for the 15, 20, and 25-year time frames. The 15-year NPV has a positive $851,925 which would indicate the project does meet the financial criteria to invest. Additionally, the project is more desirable in 20 and 25-year forecasts assuming MRBT is comfortable using those timelines for projections. The 25-year internal rate of return was 13.56% with a discounted payback of 11 years.

4.2.3 High Return

Table 4.9 high return scenario uses the average margin corn and soybean matrix for 2017 – 2019 which included the most recent and profitable years in the matrix.

Table 4.9: High Return Scenario

							Aggressive						
Cash flow projections:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Corn volume	825090	825090	825090	0	0	0	0	0	412545	0	0	825,090	3,712,905
Bean volume	386,400	386,400	0	0	0	0	0	0	386,400	0	0	386,400	1,545,600
Corn margin	0.15	0.12	0.10	-0.14	-0.15	-0.14	-0.14	-0.09	0.05	-0.08	-0.16	0.17	-0.03
Bean margin	0.10	0.08	-0.11	-0.39	-0.47	-0.41	-0.48	-0.47	0.05	-0.22	-0.29	0.08	-0.21
Corn revenue	123,763.50	99,010.80	82,509.00	0.00	0.00	0.00	0.00	0.00	20,627.25	0.00	0.00	140,265.30	466,175.85
Bean revenue	38640	30912	0	0	0	0	0	0	19320	0	0	30912	119784
Revenue	162,403.50	129,922.80	82,509.00	0.00	0.00	0.00	0.00	0.00	39,947.25	0.00	0.00	171,177.30	585,959.85
Carry Revenue	140,000.00												140,000.00
Total annual revenue	725,959.85											Total Bushels	5,258,505

Table 4.10: NPV Results: High Return

15 year NPV	$2,983,134.53
20 year NPV	$3,975,791.42
25 year NPV	$4,667,235.14
Discounted Payback	7 years
Internal Rate of Return (IRR) - 25 yr	23.00%

The forecast used 5.3 million bushels projected to ship to the PNW and was made up of 71% corn and 29% soybeans. There were five shipping months, December – March and + September, identified in which the PNW was more profitable than NOLA. Total incremental annual revenue from PNW was estimated at $725,959, which includes $140,000 of carry revenue from the new 350,000-bushel storage bin.

Similarly, to the intermediate return analysis, in table 4.10, all three 15, 20, and 25-year NPV results analyses had positive values. The NPV ranged from $2,983,134 in the 15 year to $4,667,235 in the 25-year analysis, which indicates the project does meet the financial criteria to invest. The internal rate of return was 23.00% with discounted payback of 7 years. The high return scenario was more aggressive in margin structure and also took considered into account that September would have some opportunities to ship to the PNW with barge freight rates trending higher in response to southern harvest pressure.

Chapter V: Conclusions

This thesis set out to answer the question: "Is it financially feasible to add shuttle train loading capabilities to MRBT?" This chapter will summarize the findings with respect to the objectives: grain cost indications, comparison of the PNW and ~~/~~NOLA markets, and a financial analysis. Lastly, it will discuss limitations and additional considerations.

5.1 Grain Cost Indicators

With access to the PNW markets, MRBT would maintain its existing grain supplier base and gain new volume through availability in the winter months, as well as, enhance ~~more~~ competitive pricing enabled by economies of scale. MRBT's current grain sourcing area is sufficient to support the incremental grain volume predicted in all three~~-~~ options~~analyses~~.

Barge disruption is a major risk to MRBT's profitability during the shipping season. These disruptions caused by natural disasters and man-made factors make the PNW market even more attractive to MRBT. As one notable example, when flooding occurred on the Mississippi River in 2019, access the PNW market would have produced $3.2 million in additional conversion margin to MRBT. The risk profile of MRBT is lowered with access to multiple export markets and forms of transportation since the rail route is not subject to the same limitations associated with barge transportation, such as freezing, flooding, river closures, and high water.

5.2 Comparison of PNW/NOLA markets

PNW is the second largest U.S. grain export destination and has been slowly gaining share relative to the largest exporter, NOLA. This trend will continue as China and other emerging Asian market's demand for corn and soybeans increases. PNW's proximity to Asian markets will allow PNW export terminals to offer increasingly competitive prices to MRBT in the future.

Additionally, South America will gain share in the export grain market due to their increasing production and land dedication to soybeans and corn. Brazil and Argentina also enjoy favorable currency exchange rates versus the dollar. However, both the NOLA and PNW export markets will remain competitive on a global scale due to efficient barge and rail transportation logistics within the U.S.

5.3 Financial Analysis

The financial analyses concluded that the project is financially feasible in the intermediate and high return scenarios. The most favorable basis spreads from MRBT to the PNW are in September through March. All 11 of the unit trains in the intermediate analysis would be shipped during these seven months. The MRBT grain handling season could ~~thus~~ be extended to twelve months with the investment in outbound rail shipment capabilities to the PNW. The incremental volume of 4.5 million bushels of grain would produce gross margin of $485,000 per year. The $3.425 million investment in the unit train shipment project had a discounted payback of 11 years and would produce an IRR of 13.56% and a positive NPV of $851,925 over a fifteen-year period using MRBT's weighted cost of capital of 7.5%. Lastly, corn had a higher grain conversion margin than soybeans, which is reflected in the projections, where corn comprises 75% of the grain shipments from MRBT to the PNW.

5.4 Limitations and Addition Considerations

There are several limitations and additional considerations that must be kept in mind when considering this study's findings. The data used in this analysis have limitations related to the ~~small~~ short date range and specific dates used. The analysis relied on five years of historical data, between 2015 and 2019. This particular time frame is characterized by an ongoing trade war between the U.S. and China from 2017 - 2020, a Phase 1 trade commitment, and an historic 100-year flood in 2019. While the occurrence of the flood likely biased results in favor of the project, the trade war would in theory have biased findings against the project.

Monthly data was also exclusively used in the matrix and financial analysis. While this data was more predictive than a yearly analysis, it has some limitations compared to using daily data. It is highly likely that additional opportunities would surface if this thesis used daily data to analyze the PNW and NOLA spreads with respect to MRBT.

This analysis also assumed the weighted cost of capital as 7.5%. While this number was derived from MRBT internally, it does not take into account there is a finite amount of capital available for capital projects. For example, if there was another competing project within the company with a higher NPV, that project likely would be favored over this project. It is also feasible that the weighted cost of capital could increase with changing markets above average company returns, which could also discourage this project.

Lastly, this thesis assumed a steady cash flow return and did not forecast variability. The ability to forecast yearly changes was difficult as a result of unpredictive weather patterns, which can significantly impact profitability. Understanding the risk associated with weather patterns underscores the importance of risk mitigation. In summary, the Pacific Northwest grain market is an important and long-term market for MRBT and will continue to be a large and attractive export market for wheat, corn, and soybeans originating in the Midwest.

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APPENDIX A

Grain Sourcing Area by Truck for Mississippi River Barge Terminal

	Soybeans M Bushels	Corn M Bushels
Minnesota East Central counties*	3.1	18.8
Minnesota South East counties**	7.2	53.4
Wisconsin North West counties ***	6.3	32.3
Wisconsin West Central counties ****	10.6	47.1
Total	27.2	151.6
% share for MRBT	44%	12%

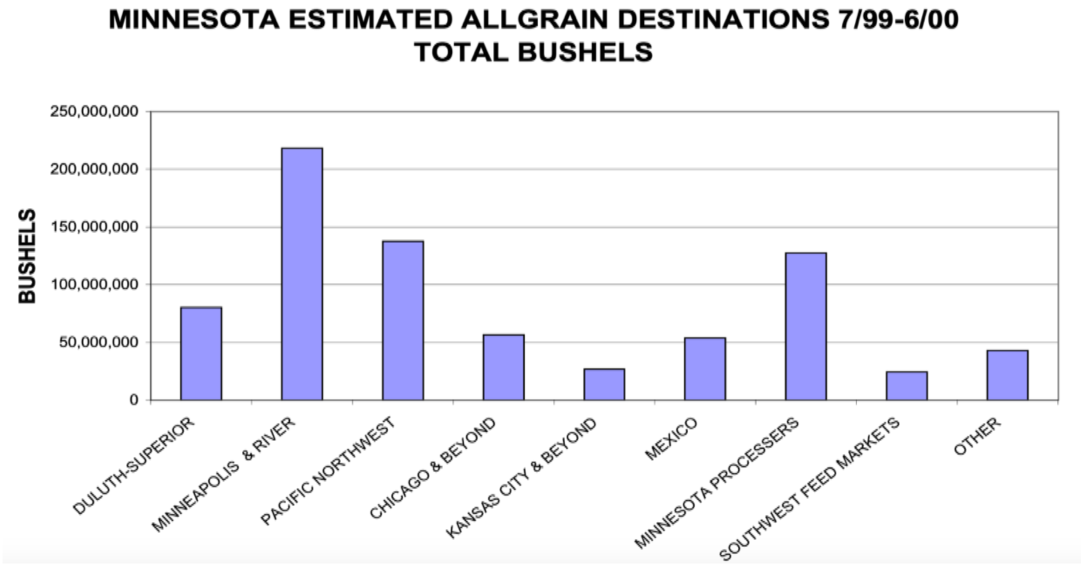
* Anoka, Atkin, Chisago, Isanti, Kanabec, Pine, Washington
** Carver, Dakota, Dodge, Freeborn, Goodhue, Hennepin, Steele, Rice
*** Barron, Burnett   Chippewa, Polk, Rusk
**** Clark, Dunn, Eau Claire, Pierce, St Croix

Source: USDA, 2020a

APPENDIX B

Inbound Rail Service to MRBT

APPENDIX C



Source: USDA 2020

Appendix D

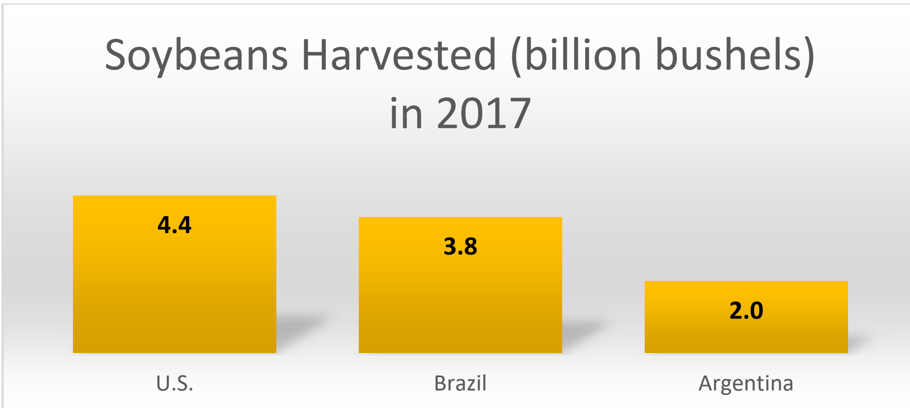
Minnesota and Wisconsin Grain Purchasers

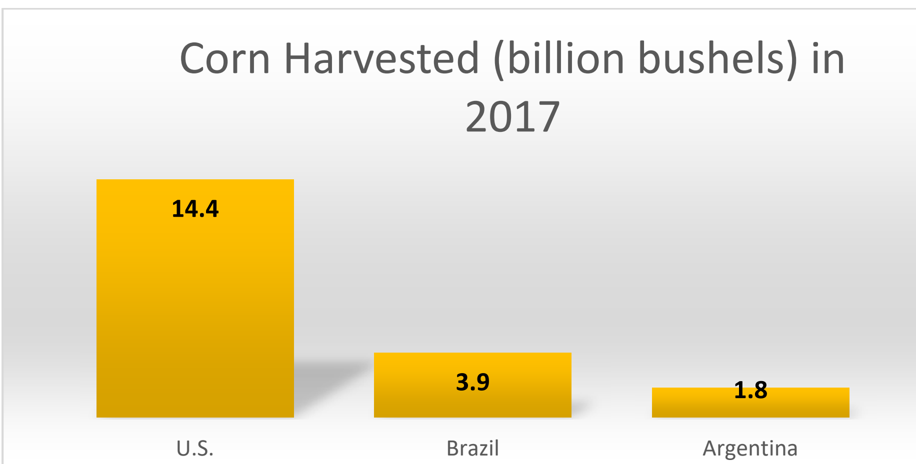
Competitor - location	Million bu.
Elevator shipping Unit Trains to Mexico - CFS Randolph MN	17
River Terminal Barge and Rail Cargill West Savage MN	25
River Terminal Barge Cargill East Savage MN	25
River Terminal Barge and Rail CHS Savage MN	25
River Terminal Barge CGB Savage MN	25
River Terminal Barge ADM Saint Paul MN	25
River Terminal Barge Red Wing Grain Red Wing MN	20
River Terminal Barge ADM Winona MN	25
River Terminal Barge CHS Winona MN	25
Soybean Processor ADM Mankato MN	30
Soybean Processor CHS Mankato MN	30
Ethanol Plant (corn) Big River Boyceville WI	20
Ethanol Plant (corn) Guardian Janesville MN	34
Ethanol Plant (corn) Corn Plus Claremont MN	34
Total	**360**

Source: MRBT 2020

APPENDIX E

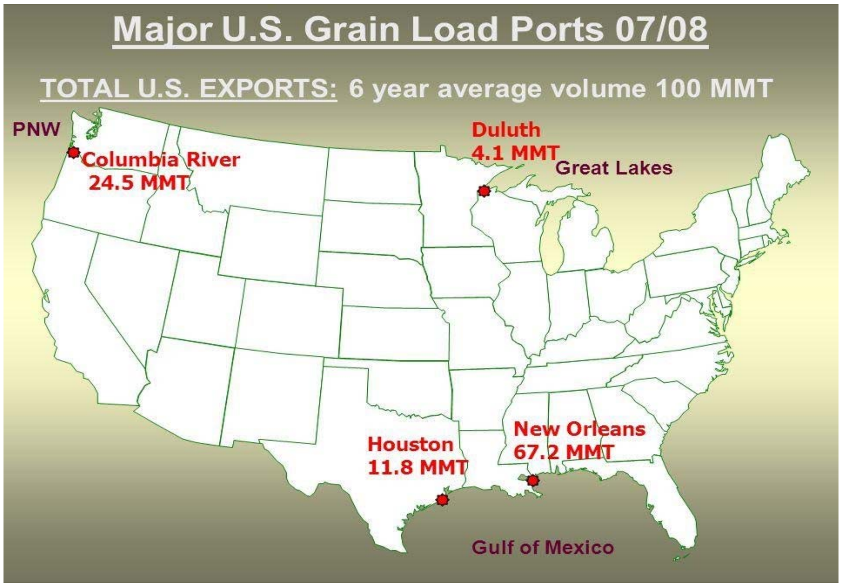
Global Soybean and Corn Production Areas





Source: Cordonnier (2017)

APPENDIX F


Major U.S. Grain Load Ports 07/08
TOTAL U.S. EXPORTS: 6 year average volume 100 MMT
PNW
Columbia River
24.5 MMT
Duluth
4.1 MMT
Great Lakes
Houston
11.8 MMT
New Orleans
67.2 MMT
Gulf of Mexico

APPENDIX G


Export Catchment Areas
Pacific
Northwest
Southern
Rail
Gulf

APPENDIX H

Top 5 Countries Importing Corn, Soybeans, and White from the U.S (Million MT)

Corn Importers from U.S.

	Mexico	Japan	S Korea	Columbia	Peru
2018/19	15.40	12.63	3.70	4.69	1.99
2019/20	14.17	9.78	2.69	4.88	0.55

Soybean Importers from U.S.

	China	Mexico	Indonesia	Japan	Egypt
2018/19	13.36	5.01	2.43	2.43	2.70
2019/20	16.26	4.72	2.22	2.27	3.83

Wheat Importers from U.S.

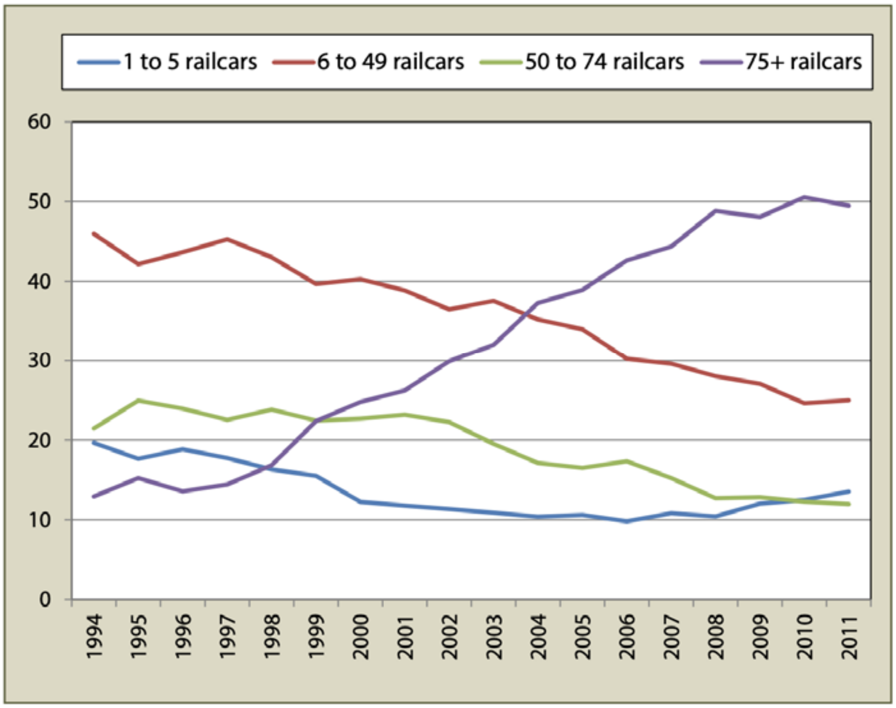
	Mexico	Philippines	Japan	S. Korea	Indonesia
2018/19	3.21	2.89	2.65	1.237	1.20

Source: USDA, n.d.

APPENDIX I

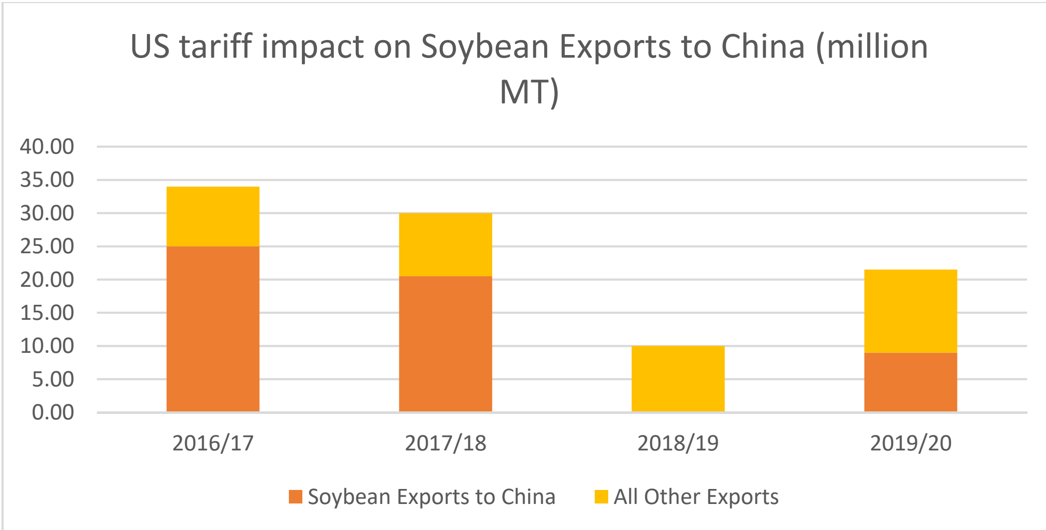
Growth of Unit Trains in the U.S.

Figure 1. Percentage of Grain and Oilseeds by Movement Size



Source: USDA analysis of Surface Transportation Board Confidential Waybill Samples

APPENDIX J


US tariff impact on Soybean Exports to China (million MT)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2016/17
2017/18
2018/19
2019/20
Soybean Exports to China
All Other Exports