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FINAL REPORT

THE IMPACT OF JUMBO COVERED HOPPER CARS ON KANSAS SHORTLINE RAILROADS

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16 Abstract

Class I railroads have been replacing 263,000-pound (loaded weight) covered hopper cars capable of handling 100 tons of grain with 286,000-pound covered hopper cars that can handle 111 tons. While these heavier cars provide a decrease in railroad cost per ton-mile for the Class I (Union Pacific and Burlington Northern Santa Fe) Railroads; they will cause a significant increase in operating and maintenance costs for the shortline railroads in the state of Kansas. Currently the shortline railroads make up 44% of the Kansas rail system. Five of the major shortline railroads that were consulted in this study found that at least 70% of their mainline tracks would need to be upgraded in order to efficiently and safely handle the 286,000 pound cars. Eight-six percent of their bridges would also need to be upgraded. The total cost to upgrade the tracks and bridges is estimated at $308.7 million, a sum the shortlines are unlikely to be able to obtain in the private capital market. An analysis was done that indicated that none of the shortlines can earn an adequate rate of return on upgrading track and bridge investment at their current traffic densities and other characteristics, thus abandoning the lines is a possibility.

Kansas has an economic interest in preserving shortline rail service since shortlines annually save the state at least $58 million per year in avoided road damage cost, and also save the state's wheat shippers $20.7 million in wheat transportation handling costs. The Federal government, Class I railroads, the state of Kansas, and wheat shippers all have an interest in keeping shortline rail service in Kansas viable.

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Final Report

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A Report on Research Sponsored By

THE KANSAS DEPARTMENT OF TRANSPORTATION
TOPEKA, KANSAS

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PREFACE

The Kansas Department of Transportation's (KDOT) Kansas Transportation Research and New-Developments (K-TRAN) Research Program funded this research project. It is an ongoing, cooperative and comprehensive research program addressing transportation needs of the state of Kansas utilizing academic and research resources from KDOT, Kansas State University and the University of Kansas. Transportation professionals in KDOT and the universities jointly develop the projects included in the research program.

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DISCLAIMER

ABSTRACT

Railroad abandonment has increased in Kansas in recent decades. In the 1970-79 period, 415 miles of rail line were abandoned, in the 1980-89 interval an additional 815 miles, and in the 1990-2000 period, 1,246 miles. Abandonment was 335 miles in 2001 and 22 miles in 2002. What has changed since 1990 is that a larger portion of abandonment is accounted for by shortline railroads. In the 1990-2000 period nearly half of the 1,246 miles were abandoned by shortlines, and in 2001, 86% of the 335 miles were attributable to shortlines. Many factors have contributed to this trend but the shift to larger, heavier covered hopper cars has the potential to accelerate Kansas shortline railroad abandonment in the future.

Class I railroads have been replacing 263,000-pound (loaded weight) covered hopper cars capable of handling 100 tons of grain with 286,000-pound cars that can handle 111 tons. The percentage of the combined Union Pacific (UP)-Burlington Northern Santa Fe (BNSF) covered hopper car fleet accounted for by 286,000-pound cars rose from about 25% (1999) to 37% (2003). By the year 2010, UP expects that 286,000-pound cars will account for 60% of their grain car fleet, while BNSF expects these cars to amount to half of their grain car fleet.

The motivation for the switch in car size is decreased railroad cost per ton-mile. Using larger rail cars results in a reduction in Class I railroad car and locomotive ownership costs, labor costs, fuel costs, car and locomotive maintenance costs, as well as an increase in rail system capacity. One study estimated that Class I railroad operating costs of 286,000-pound cars are nearly 9% less than that of 263,000-pound cars.

Since the quality of track on Kansas shortlines is generally less than that of Class I railroads, it is likely that increased usage of the 286,000-pound rail car will have a greater impact

on shortlines. Since shortline railroads account for 44% of the Kansas rail system, the impact of the 286,000-pound car on these railroads has great implications for the future of rail freight transport in Kansas. If shortline track and bridges are not upgraded to safely and efficiently handle the 286,000-pound car, the percentage of the grain car fleet that can move on shortlines will decline, and shippers located on shortlines will have no alternative but to truck their grain to terminal markets.

If universal adoption of the 286,000-pound covered hopper car leads to abandonment of Kansas shortline railroads, it could have several negative consequences for rural Kansas communities including the following:

- Lower grain prices received by farmers
- Higher transportation costs and lower profits for rail shippers
- Reduction of market options for shippers
- Lost economic development opportunities for rural communities
- Loss of local tax base needed to fund basic government services
- Potential increases in highway traffic accidents due to increased truck traffic
- Increased road damage costs on county roads and state highways
- Increased energy use and emissions

State transportation policymakers need to know to what extent the rail industry shift to 286,000-pound cars will lead to abandonment of Kansas shortlines and where abandonment is likely to occur. This information will enable KDOT and the Kansas legislature to develop a state rural transportation plan to deal with the potential impacts. Among other things, this information could assist KDOT in deciding to what degree to help shortlines upgrade their tracks to handle the larger grain cars.

Given the potential impact of increasing use of 286,000-pound cars on shortline railroad abandonment and the resulting negative effects on rural Kansas communities, the objectives of the research are as follows:

Objective 1 – Document the shift from the 263,000-pound (C6-100 ton) rail car to the 286,000-pound car (C6X-111 ton) by Class I railroads.

Objective 2 – For each Kansas shortline railroad, measure the number of route miles, sidings and yards, and bridges that will require upgrading and rehabilitation to handle the 286,000-pound rail car.

Objective 3 – Estimate which branchlines are likely to be upgraded and which will likely be abandoned based on rate of return on investment analysis.

Objective 4 – Measure the track upgrading cost per mile of mainline track, yards and sidings, and the cost of bridge rehabilitation.

Objective 5 – Measure the road damage costs to county roads and state highways if upgrading to handle 286,000-pound cars does not occur and shortlines (or parts of shortlines) are abandoned.

Objective 1 was accomplished with surveys and interviews of representatives of Union Pacific, Burlington Northern Santa Fe, and Kansas City Southern railroads. Objective 2 was achieved through surveys and interviews of CEOs and other personnel of Kansas shortline railroads. Objective 3 was solved using an internal rate of return on investment analysis developed by John Bitzan and Denver Tolliver at North Dakota State University. The analysis is based on the following equation.

$$C = \sum_{i=o}^{N} \frac{R_i}{(1+r)^i}$$

where:

C – Rail line upgrading cost

R_i – Incremental profits in year i from a line upgrade

r – Internal rate of return on line upgrade investment

N – Number of years over which the upgrade is expected to yield benefits

Incremental profits from the upgrade of a rail line can be estimated with data from a shortline costing model developed by Robert J. Martens of North Dakota State University.

Objective 4 was achieved by obtaining detailed upgrading costs per mile as measured by Casavant and Tolliver (2001), as well as bridge rehabilitation costs. In addition, representatives of each of the major Kansas shortline railroads provided estimates of upgrading costs per mile and the cost to rehabilitate their bridges to handle 286,000-pound rail cars.

Objective 5 was accomplished by utilizing Kansas road damage costs resulting from hypothetical abandonment of four major Kansas shortline railroads. This data is found in the KTRAN report by Babcock et. al titled *Economic Impacts of Railroad Abandonment on Rural Kansas Communities (2003)*.

The major conclusions (results) of the study include the following:

1. Impacts of 286,000-Pound Rail Cars on Kansas Shortline Track

CEOs and other personnel of five Kansas shortline railroads provided information concerning the expected impact of increasing use of heavy axle load (HAL) cars on their railroad. They indicated that about 56% of their collective mainline track has rail that is less than or equal to 90 pounds per yard. Previous studies have concluded that 90 pounds per yard rail cannot withstand the stress of 286,000-pound rail cars. In addition, they indicated that for rail weight of 90 pounds per yard or less, about 75% of the track miles have 64% or fewer good crossties, and 82% of the track miles have eight inches or less ballast under the rails. One of the Class I railroads in the study indicated that 9 to 12 inches of ballast is needed to adequately handle the 286,000-pound car. Thus it is unlikely that the approximately one-half of the total shortline miles that are ≤ 90 pounds per yard rail will be able to handle 286,000-pound cars at full weight and efficient operating speeds.

Representatives of the five Kansas shortlines were asked how many mainline route miles on their shortline would need to be upgraded (heavier weight rail, more ballast, and/or more good crossties) to handle 286,000-pound cars. Their collective responses are summarized as follows:

- 1,583 mainline route miles need heavier weight rail
- 1,530 mainline route miles need more ballast
- 1,513 mainline route miles need more good crossties (ties that would hold gauge and surface)

Thus according to representatives of the shortlines about 70% of the total mainline route miles of the five major Kansas shortlines will need to be upgraded to efficiently and safely handle 286,000-pound cars. The shortline representatives also indicated that a minimum of 218 miles of yard track and 75 miles of siding track would have to be upgraded as well.

2. Impact of HAL Rail Cars on Kansas Shortline Bridges

There are a total of 1,581 bridges located on the systems of the five major Kansas shortline railroads. The shortline representatives said that 1,352 (or 86%) would have to be upgraded to handle HAL cars. The representative of one shortline said that all the wooden bridges on his railroad would have to be reinforced. Another said all the bridges on his railroad would have to be upgraded. The representative of another railroad said that 80% of the bridges on his railroad would have to be reinforced and the other 20% would have to be replaced.

3. Kansas Shortline Railroad Track and Bridge Upgrading Costs

Personnel of the five major Kansas shortlines provided estimates of the cost per mile to upgrade mainline track to handle HAL cars. For each railroad, the cost per mile estimates were multiplied by the estimated number of miles of mainline track requiring upgrading to handle 286,000-pound cars. The total track upgrading costs for the five major railroads as a group is $291.5 million.

Representatives of the Kansas shortlines also provided estimates of bridge rehabilitation costs to equip their systems with the ability to handle 286,000-pound cars. As a group, these costs totaled $17.2 million. Thus the total upgrading costs for mainline track and bridges for the five railroads is $308.7 million.

4. Impact of 286,000-Pound Rail Cars on Kansas Shortline Expense and Revenue

Personnel of four of the five railroads had the opinion that operating and maintenance expenses would increase at their railroads as a result of handling HAL cars. The representative of the other railroad said that operating costs would fall but maintenance costs would rise. The respondents that indicated these costs would increase estimated that the increase would be 6 to 15%.

Representatives of three of the railroads had the opinion that operating revenue would not increase, one representative said operating revenue would rise, and the representative of the fifth railroad was uncertain. Thus majority opinion among the representatives of the five major Kansas shortlines was that increased use of HAL cars would increase their operating and maintenance costs and not increase their operating revenue.

5. Internal Rates of Return to Upgrading

Internal rates of return to upgrading the railroad to handle 286,000-pound rail cars were calculated for the five major Kansas shortlines. The internal rates of return are hypothetical rates of return assuming a railroad with the same characteristics (average length of haul, miles of mainline track to be upgraded, carloads per mile, and total miles of mainline track) as each of the five Kansas shortlines.

The simulated internal rates of return to upgrading increase as traffic density and time horizon increase. However, the most significant result of the internal rate of return analysis is that the hypothetical rate of return to upgrading is negative (or slightly positive in a few cases) for all the Kansas shortlines when their actual average traffic density and other characteristics are assumed. This result occurs for all time horizons examined in the study (8 to 25 years).

6. Additional Profits Required to Earn an 11% Rate of Return on a Line Upgrade

An alternative analysis to evaluate the decision of a railroad to upgrade the line to handle HAL cars was to compute the additional annual profits the railroad would have to receive in order to obtain an 11% rate of return on the investment. The "actual" annual profits were subtracted from the "11% rate of return" profits to obtain the additional annual profits that have to be earned by each shortline to receive the target rate of return of 11%. For each shortline the term "actual annual profits" refers to the annual profits a hypothetical railroad with a particular shortline's characteristics would receive after upgrading the railroad to handle 286,000-pound cars. These are <u>not</u> the actual annual profits of the five major Kansas shortlines since the upgrade investments are hypothetical at this point in time.

The total additional annual profits to earn an 11% return of the five major Kansas shortlines are $43.4 million with the eight year time horizon, while the corresponding figure for the 25 year time horizon is only $21.2 million, less than half that of the eight year period.

7. Impacts of the Upgrading Decision on Kansas Highway Damage Costs

The 2003 study by Babcock et. al titled *Economic Impacts of Railroad Abandonment on Rural Kansas Communities* concluded that if only the rail miles in Kansas of four of the five (excluding the South Kansas and Oklahoma Railroad) major Kansas shortlines were abandoned, the annual road damage costs would be $57.8 million. If the five Kansas shortlines conclude that the rate of return to upgrading does not justify the investment, and subsequently abandon the railroads, Kansas' annual road damage costs will rise by over $58 million.

The analysis indicates that none of the shortlines can earn an adequate rate of return on upgrading track and bridge investment at their current traffic densities and other characteristics. The cost to upgrade track and bridges of the five Kansas shortlines was estimated to be $308.7 million, a sum the shortlines are likely to be unable to obtain in the private capital market.

However, Kansas has an economic interest in the preservation of shortline rail service since shortlines annually save the state at least $58 million per year in avoided road damage cost, and also save the state's wheat shippers $20.7 million in wheat transportation and handling costs (Babcock et. al, 2003, p. 86). Federal government goals of cleaner air and energy conservation are fostered by rail service.

Class I railroads have an economic interest in the preservation of shortline railroads. One of the questions on the Class I railroad questionnaire was as follows: To what extent does the long term viability of Kansas shortline railroads and their ability to handle 286,000-pound rail cars affect your railroad?

One of the respondents indicated that they rely on Kansas shortlines for part of their grain carloadings, with the degree of importance depending on the individual line segment. The representative noted that shortline ability to handle 286,000-pound cars would increase grain carloadings on the respondent's railroad. Another Class I railroad representative said that shortline connections enables the railroad to extend its service to shippers located on shortlines. Thus the Class I's shortline connections are integral parts of both the physical and marketing networks of the Class I railroad.

Given that shortline owners, the state and Federal governments, wheat shippers, and Class I railroads have an economic interest in preserving shortlines, what policies are available to secure this outcome?

Kansas currently has two shortline railroad assistance plans which are the Federal Local Rail Freight Assistance to States (LRFA) and the State Rail Service Improvement Fund (SRSIF). In 1989, the Kansas legislature granted KDOT the authority to loan Federal Railroad Administration (FRA) funds to shortline railroads through the LRFA program, which provides low interest revolving loans below the prime interest rate to shortlines. The SRSIF was established in 1999 to provide Kansas shortlines with low interest, 10 year revolving loans and grants to be used primarily for track rehabilitation. For SRSIF projects the shortline must pay 30% of the cost of the project and the state provides a combination of grants (30%) and loans (40%) for the remaining 70%. The interest rate on the loan portion is currently less than 3%.

In order for Kansas shortline railroads to be able to safely and effectively handle HAL cars and provide better service, the funds in the SRSIF program need to be greatly increased. Also the SRSIF program should be extended beyond the current funding timeline. These actions are necessary to enable the state to assist shortlines in financing the $308.7 million track and bridge upgrading cost to handle HAL cars.

The rate of return analysis indicated that the five Kansas shortlines could earn an adequate rate of return to upgrading investment if traffic density is 100 to 150 cars per mile and the time horizon is 15 years or more. One of the keys to higher traffic density is an adequate supply of covered hopper cars. Thus it is recommended that Port Authorities consider the purchase of covered hopper cars, new or used, and lease them to shortline railroads for use in

Kansas. Given periodic car shortages and railroad congestion, the Class I railroads can not always supply shortline railroads with rail cars in a timely manner. Having an adequate car supply to move Kansas wheat to market is a necessary ingredient for increased shortline traffic and enhanced ability to make the investments required to handle HAL cars.

The Federal government needs to change the Railroad Rehabilitation and Improvements Financing (RRIF) program which has not been used at all in Kansas. The program provides for up to one billion dollars in direct loans and loan guarantees for track and bridge projects benefiting shortline railroads. The program has been underutilized due to the credit risk premium component. This is a cash payment made prior to appropriation of funds by the loan applicant or alternatively a non-Federal infrastructure partner on behalf of the loan applicant.

The Federal government needs to relax the provisions of RRIF to allow shortlines access to available capital needed to upgrade their track and bridges to handle HAL cars. The maximum repayment period should be extended to 30 years and the interest rate should be reduced to 3%. The credit risk premium should be deleted or made more user friendly.

Bills have been introduced in Congress to provide tax credits for track improvements. This policy should be enacted to reduce the cost of upgrading shortline track to handle 286,000-pound rail cars.

To upgrade the Kansas shortline railroad infrastructure to handle HAL cars will require financial commitments and coordination of all the major stakeholders in continued shortline rail service including shortlines, Class I railroads, wheat shippers located on shortlines, the Federal government, and the state of Kansas.

ACKNOWLEDGEMENTS

The research could not have been completed without the assistance and cooperation of many people. John Rosacker of the Kansas Department of Transportation (KDOT) was helpful in obtaining funding for the research project, and John Maddox of the Rail Affairs Unit of KDOT managed the project in a professional manner. Kristi Smith typed the final report. Special thanks go to personnel in the Agricultural Products unit of the Union Pacific and Burlington Northern Santa Fe railroads, and to the CEOs and other personnel of the Kansas shortline railroads. Without their cooperation and assistance, this study would not have been possible.

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Introduction

1.1 The Research Problem

Railroad abandonment in Kansas has increased in recent decades. In the 1970-79 period, 415 miles of rail line were abandoned, in the 1980-89 interval an additional 815 miles, and in the 1990-2000 period, 1246 miles. In 2001 alone, 335 miles were abandoned. The trend in abandonment declined substantially in 2002 to only 22 miles. What has changed since 1990 is that a larger proportion of abandonment is accounted for by shortline railroads. In the 1990-2000 period nearly half of the 1,246 miles were abandoned by shortlines. In 2001, 86% of the 335 miles were accounted for by shortlines. Many factors have contributed to this trend but the shift to larger, heavier covered hopper cars has the potential to accelerate Kansas shortline railroad abandonment in the future.

Class I railroads have been replacing 263,000-pound (loaded weight) covered hopper cars capable of handling 100 tons of grain with 286,000-pound cars that can handle 111 tons. Table 1 consists of the number of 263,000-pound and 286,000-pound covered hopper cars in the Union Pacific and Burlington Northern Santa Fe railroads fleets as of mid-year for the 1999-2003 period. The combined total hopper car fleet of the two railroads fell from 72,607 cars in 1999 to 60,614 cars in 2003, a 16.5% decline. The percentage of the combined fleet accounted for by 263,000-pound cars fell from 75.3% (1999) to 63.0% (2003) while the corresponding figures for 286,000-pound cars were 24.7% (1999) and 37.0% (2003). By the year 2010, Union Pacific expects that 286,000-pound cars will account for 60% of their grain car fleet, while Burlington Northern Santa Fe expects these cars to amount to half of their grain car fleet.

<u>TABLE 1: Combined Union Pacific, Burlington Northern Santa Fe Grain Hopper Car Fleet</u>

1999-2003*

Year	263,000-Pound Cars	Percent of Combined Fleet	286,000-Pound Cars	Percent of Combined Fleet	Total Combined Fleet
1999	54,700	75.3%	17,907	24.7%	72,607
2000	50,051	71.2	20,294	28.8	70,345
2001	45,065	66.9	22,294	33.1	67,359
2002	38,079	63.1	22,259	36.9	60,338
2003	38,177	63.0	22,437	37.0	60,614
%) 1999-2003	-30.2%		25.3%		-16.5%

* Measured as of mid-year

Data supplied by representatives of the Union Pacific and Burlington Northern Santa Fe railroads.

The motivation for the switch in car size is the decrease in railroad cost per ton-mile. Using larger railcars results in a reduction in Class I railroad car and locomotive ownership costs, labor costs, fuel costs, and car and locomotive maintenance costs, as well as an increase in rail system capacity. Shippers that are able to utilize the heavy axle load (HAL) cars benefit from lower rates per carload. According to a study by Kenneth Casavant and Denver Tolliver titled *Impacts of Heavy Axle Loads on Light Density Lines in the State of Washington* (2001, App. A, p. 20), Class I railroad operating costs of 286,000-pound cars are nearly 9% less than that of 263,000-pound cars.

Table 2 contains data comparing wheat rates per ton for 268,000-pound and 286,000-pound rail cars. The comparison is for wheat shipped from Wichita, Hutchinson, Salina, and Kansas City, Kansas to the Texas Gulf including Houston, Galveston, and Beaumont, Texas. The rates in Table 2 are based on November 2003 BNSF rates for cars shipped in 52 to 109 car unit trains and for cars shipped in 110 to 120 car unit trains. In all cases the rates for the 286,000-pound car are 1.9 to 2.0% less than the rates for the 268,000-pound car. Thus, 286,000-

pound cars are profitable for Class I railroads because the decline in cost per ton is greater than the decrease in revenue per ton.

The 286,000-pound railcar has the potential to worsen four problem areas of light density rail lines owned and operated by shortline railroads. These are light rail (rail weighing 90 pounds per yard or less), thin ballast sections (less than one foot of ballast under ties), deferred tie maintenance, and old bridges. According to a study by Zeta-Tech Associates titled *An Estimation of the Investment in Track and Structures Needed to Handle 286,000-Pound Rail Cars* (2000), 90 pound per yard rail *may* perform satisfactorily under 286,000-pound carloads provided the line has good tie maintenance, good ballast, and the train is operated at slow speed (between 10 and 25 mph). However, deferred maintenance and/or higher speed train operations will increase rail deflection to unacceptable levels. Deflection is the up and down movement of the track under repeated wheel loads and is the primary source of track deterioration. The Zeta-Tech study concluded that 90 pound rail is marginal for operating speeds of 25 miles per hour or less, even at the lightest traffic densities. Casavant and Tolliver (2001) concluded that unless a track has excellent ballast support (400 tons per mile) and tie maintenance (500 new ties per mile), 90 pound per yard rail sections should be upgraded to 112 to 115-pound rail so that trains can be operated at cost effective speeds of at least 25 mph.

Table 2: Comparison of Wheat Rates Per Ton for 268,000-Pound and 286,000-Pound Rail Cars*

Rates for Cars Shipped in 52 to 109 Car Trains

Origin	Rate for 268,000-Pound Car	Rate for 286,000-Pound Car	Percent Difference
Wichita	$19.70	$19.31	-2.0%
Hutchinson	20.35	19.95	-2.0
Salina	21.00	20.59	-2.0
Kansas City, KS	19.00	18.62	-2.0

Rates for Cars Shipped in 110 to 120 Car Trains

Origin	Rate for 268,000-Pound Car	Rate for 286,000-Pound Car	Percent Difference
Wichita	$18.20	$17.84	-2.0%
Hutchinson	18.85	18.48	-2.0
Salina	19.50	19.12	-1.9
Kansas City, KS	17.50	17.16	-1.9

* Destination is the Texas Gulf including Houston, Galveston, and Beaumont, Texas

Source: Rates are calculated from data in BNSF Rate Book 4022 (Item # 46,540 and 46,800) at http://www.bnsf.com, November 2003. Calculations assume 100 tons per 268,000-pound car and 111 tons per 286,000-pound car.

Since the quality of track on Kansas shortlines is generally less than that of Class I railroads, it is likely that the increasing use of the HAL rail car will have a greater impact on shortlines. Since shortline railroads account for 44% of Kansas rail miles, the impact of the HAL car on these railroads has great implications for the future of rail freight transport in Kansas. If light density rail lines are not upgraded to handle the 286,000-pound car, the percentage of the grain car fleet that can move on shortlines will decline, and shortline shippers will have no alternative but to truck their grain to terminal markets.

If universal adoption of the 286,000-pound covered hopper car leads to abandonment of Kansas shortline railroads, it could have several negative consequences for rural Kansas communities including the following:

- Lower grain prices received by farmers
- Higher transportation costs and lower profits for rail shippers
- Reduction of market options for shippers
- Lost economic development opportunities for rural communities
- Loss of local tax base needed to fund basic government services
- Potential increases in highway traffic accidents due to increased truck traffic
- Increased road damage costs on county roads and state highways
- Increased energy use and emissions

State transportation policy makers need to know to what extent the rail industry shift to HAL cars will lead to abandonment of Kansas shortline railroads and where abandonment is likely to occur. This information will enable KDOT and the legislature to develop a state rural transportation plan to deal with the potential impacts. Among other things, this information could assist KDOT in deciding to what degree to help shortlines upgrade their tracks to handle the larger grain cars.

1.2 Research Objectives

Given the potential impact of increasing use of HAL railcars on shortline abandonment and the resulting negative effects on rural Kansas communities, the objectives of the research are as follows:

Objective 1 – Document the shift from the 263,000-pound (C6-100 ton) rail car to the 286,000-pound car (C6X-111 ton) by Class I railroads.

Objective 2 – For each Kansas shortline railroad, measure the number of route miles, sidings and yards, and bridges that will require upgrading and rehabilitation to handle HAL railcars.

Objective 3 – Estimate which branchlines are likely to be upgraded and which will likely be abandoned based on rate of return on investment analysis.

Objective 4 – Measure the track upgrading cost per mile of mainline track, yards and sidings, and the cost of bridge rehabilitation.

Objective 5 – Measure the road damage cost to county roads and state highways if upgrading to handle HAL cars does not occur and shortlines (or parts of shortlines) are abandoned.

1.3 Methodology

Objective 1 was accomplished with surveys and interviews of representatives of Union Pacific (UP), Burlington Northern Santa Fe (BNSF), and Kansas City Southern (KCS) railroads. They were asked to provide the current number of 263,000-pound and 286,000-pound cars in their grain car fleets and the time frame over which they expect to have only 286,000-pound cars in their fleets. The Class I rail personnel were also asked to document the advantages and disadvantages of HAL cars from the Class I railroad perspective.

Objective 2 was accomplished through surveys and interviews of CEOs of Kansas shortline railroads. They were asked to provide miles of track on their railroads by rail weight, ballast below the cross ties, percent of good ties, and type of rail (jointed or continuous welded). They were asked how many bridges on their railroad would need to be rehabilitated to handle 286,000-pound cars. Other questions included whether 286,000-pound cars are currently used on their railroad, how many 286,000-pound carloads are hauled each year, how many route miles would have to be upgraded to effectively handle HAL cars, condition of sidings and yards, would 286,000-pound cars cause the railroad to reduce train speed, and what would it cost to upgrade their railroad to handle HAL cars.

Objective 3 was accomplished using an internal rate of return on investment analysis developed by John Bitzan and Denver Tolliver and published in *The Impact of an Industry Switch to Large Rail Grain Hopper Cars on Local Infrastructure—A Case Study of North*

Dakota (2003). The analysis is based on the following equation.

Equation 1.1: $$C = \sum_{i=0}^{N} \frac{R_i}{(1+r)^i}$$

Where: C – Rail line upgrading cost

R_i – Incremental profits in year i resulting from a line upgrade

r – Internal rate of return on line upgrade investment

N – Number of years over which the upgrade is expected to yield benefits

Incremental profits from the upgrade of a rail line can be estimated with data from a shortline costing model developed by Robert J. Martens of North Dakota State University. Incremental revenue of upgrading the line to handle HAL cars is obtained by solving equation 1.2.

Equation 1.2: Incremental Revenue = Average Revenue Per Carload x Average Rail Line Length x Carloads Per Mile

Annual profits are the incremental revenues minus the costs per mile as measured by the Martens model.

Rail line upgrading cost is measured by the following equation.

Equation 1.3: Line Upgrading Cost = Upgrading Cost Per Mile x Length of the Rail Line in Miles

Thus the model was used to compute internal rates of return for upgrading Kansas shortlines to handle HAL cars.

Objective 4 was achieved by obtaining detailed upgrading costs per mile as measured by Casavant and Tolliver (2001), as well as bridge rehabilitation costs. In addition, representatives of each of the major Kansas shortline railroads provided estimates of upgrading costs per mile and the cost to rehabilitate their bridges to handle 286,000-pound rail cars.

Objective 5 was accomplished by utilizing Kansas road damage costs resulting from hypothetical abandonment of four major Kansas shortline railroads. This data is found in the K-TRAN report written by Babcock et. al. titled Economic Impacts of Railroad Abandonment on Rural Kansas Communities (2003).

Chapter 2

Literature Review

The use of heavy axle load cars has become a concern to many shortline railroads, shippers, and state DOTs in recent years. A review of major studies on this topic reveals that early interest was on economic efficiency gains. Later, studies began to focus on effects that heavy axle load cars have on rail transportation systems. Branch lines often consist of light density track with less than desirable support conditions, and much short line and regional railroad track is unable to efficiently and safely handle 286,000-pound railcars. As a consequence, large portions of rail networks will require upgrading or face prospects of abandonment. By one account, 23% of the nation's short line and regional railroad track will need to be replaced (ZETA-TECH, 2000). States have identified the use of heavy axle load cars as an important issue and have directed several Department of Transportation (DOT) studies.

Studies on the use of heavy axle load cars often have key aspects in common. It is necessary to determine track conditions and characteristics in a study area. Surveys are the most common means of obtaining information on track condition; although, one study relied entirely on physical inspection of track. An important question involves the accuracy of survey data.

Track analysis is common to many studies. Track analysis involves the use of engineering models to determine how the stresses of axle loadings affect different types of track. Track analysis has been used to determine minimum standards for heavy axle load cars, and it has provided the basis for development of logic tables which are matrices used to evaluate the performance of track components. Each track component's performance under heavy axle loads may be evaluated with track analysis, and the minimum investment required to bring track up to standard is determined with logic tables. In general, standards that have been developed by the various studies have all been consistent.

Studies have estimated the costs required to upgrade track. Railroads and railroad material vendors have provided much of the information on costs of materials and labor. A range of different costs reflecting differing assumptions have been generated by a number of studies. For example, some studies have estimated minimum upgrade costs while one study estimated the cost of complete replacement of all track components. Several other assumptions may differ between studies.

This literature review will present a short history of major studies on the use of heavy axle load cars. Next, important aspects of these studies will be examined.

2.1 History of Major Studies

A limited number of studies have been prepared on the use of 286,000-pound or heavier railcars. The emphasis of studies has ranged from examining route-specific benefits for a single Class I railroad to estimation of impacts on the nation's shortline and regional railroads. Analysis methods have included application of engineering analysis to track components, modeling the decision to upgrade as an investment decision, and physical inspection of track. A short history of studies follows.

Newman, R. R., A.M. Zarembski, and R.R. Resor. "Burlington Northern's Assessment of the Economics of High Capacity / Heavy Axle Load Cars." *American Railway Engineering Association Bulletin.* No. 726 Vol. 91 (May 1990).

The First International Heavy Haul Railways Conference was held in 1978. Shortly after the conference, Australian railroads adopted a heavier 36.3 tons system-wide standard for axle loads. Economic efficiency gains were realized, and axle loads were increased further. Cost reductions of 1 to 4% experienced by Australian railroads provided impetus for other railroads to begin study of the economic implications of heavier axle loads.

In the Spring of 1987, Burlington Northern (BN) management commissioned a study on increasing the loads in existing bulk commodity coal equipment and increasing train size. The study was to be specific to BN's Northern Coal Route. While the BN study was proprietary, results of the study were presented in a paper at the 1990 American Railway Engineering Association Technical Conference in Chicago, Illinois. The paper presented at the technical conference was subsequently published as "Burlington Northern's Assessment of the Economics of High Capacity / Heavy Axle Load Cars" by Newman, Zarembski, and Resor in the *American Railway Engineering Association Bulletin* No. 726, Vol. 91 (1990).

The BN bulk commodity coal route study found that significant economic benefits could be gained by increasing train size and loads in existing coal equipment. The total cost curve for the coal route decreased to a minimum for a 120-car train with 112.5 tons of coal per car. The study projected annual cost savings of 5.2% over the costs of the then-current train configuration.

Martens, Bobby Joel. "An Economic Analysis of Heavy Axle Loads: The Effects on Shortline Railroads and the Tradeoffs Associated with Heavy Cars." Thesis submitted for Master of Science in Agricultural Economics, North Dakota State University, 1999.

Martens examined the effects of 286,000-pound railcars on shortline and regional railroads. Rather than estimating the economic efficiency benefits of increased axle loads, the Martens study looked at effects on the rail transportation system. Martens surveyed railroads to determine the portion of the rail system which could not handle 286,000-pound railcars. Martens also analyzed the impacts of the resulting line abandonments. The upgrading of light density lines holds potential to preserve the viability of lines which otherwise cannot handle heavy axle load cars. Martens determined the amount of track which required upgrading and the associated costs. Another important part of the study defined the tradeoffs between reduced operating speeds and use of larger railcars.

Martens' study was different from the Burlington Northern study in that it examined how the shortline rail system would be affected by the use of heavy axle load railcars. Taken together, the Burlington Northern study and the Martens study illustrate the dichotomy associated with use of heavier axle loads. While the BN study found economic efficiency gains associated with the use of heavy axle load cars on the BN Northern Coal route, the Martens study determined that 38% of the shortline rail system was incapable of handling 286,000-pound railcars even at the slowest operating speeds. Martens also determined that the average track cost to upgrade lines which would otherwise be abandoned due to heavier railcars would be $118,662 per mile.

Resor, Randolph R., Allan M. Zarembski, and Pradeep K.Patel. *An Estimation of the Investment in Track and Structures Needed to Handle 129,844 kg (286,000 lb) Rail Cars on Short Line Railroads.* Prepared for the American Short Line and Regional Railroad Association by ZETA-TECH Associates, Inc. 2000.

ZETA-TECH Associates, Inc. published a study in 2000 on the effects of 286,000-pound railcars on the nation's shortline and regional railroad system. The objectives of the study were to estimate the amount of shortline and regional railroad trackage which met minimum standards for use of heavy axle load railcars and to estimate the investment in components required to bring the entire shortline and regional railroad system up to standard.

Results of the ZETA-TECH study included minimum standards for use of 286,000-pound railcars. The standards were developed with regard to safe, long-term operation using proprietary ZETA-TECH engineering models. The engineering models reflect forces of axle loads on track and interaction between track components. Using minimum standards, logic tables were developed for evaluating track components. Evaluation of track, using logic tables designed with engineering analysis, provided a sound foundation to this study. BN previously used engineering analysis to estimate route-specific economic benefits of heavy axle loads. This study used engineering models to evaluate the nation's shortline and regional rail system.

The study found that the nation's 50,000 mile shortline and regional railroad system would need 10,000 miles of new rail and 20 million ties to bring the entire system up to standard. The total cost to upgrade the system was estimated at $6.86 billion. The authors pointed out that an upgrading program spread out over 10 years would require 1000 miles of rail and 2 million ties per year which would be within the productive capacity of U.S. producers.

Bitzan, John D. and Denver D. Tolliver. "The Impacts of an Industry Switch to Large Rail Grain Hopper Cars on Local Infrastructure: A Case Study of North Dakota." *Journal of the Transportation Research Forum*. Vol. 57 No. 2. Spring 2003: 135-154.

The Spring 2003 volume of *Journal of the Transportation Research Forum* contains "The Impacts of an Industry Switch to Large Rail Grain Hopper Cars on Local Infrastructure: A Case Study of North Dakota" by Bitzan and Tolliver. The authors of this study provided insights into specific areas where abandonment was likely to occur. Abandonment was treated as the result of inability to handle 286,000-pound railcars and insufficient returns from investment in track upgrades.

This study modeled a railroad's decision to upgrade as an investment decision. A firm will invest in a project as long as the internal rate of return to the project exceeds the return available from alternatives. The investment decision approach to upgrading was unique to this study. It inserted the railroad decision-making process into analysis of the use of heavy axle load cars.

A railroad may realize incremental traffic from an upgrade. Factors which affect incremental traffic were examined in the study. Incremental profits and cost increases were estimated, and these estimates were used as inputs to the investment decision analysis.

The study reported important findings. The authors concluded that railroads were unlikely to upgrade shortline track with traffic of less than 200 cars per mile. However, the study also discussed alternatives to abandonment of these lines. Longer-term financing mechanisms may allow shortlines to upgrade track with traffic as light as 150 cars per mile. Increased revenue splits with Class I railroads, and partial subsidies in the amount of avoided highway damage could also provide greater incentives to upgrade.

Bitzan, John D. and Denver D. Tolliver. *Heavier Loading Rail Cars*. Upper Great Plains Transportation Institute, MPC Report No. 01-127.4, North Dakota State University, October 2001.

The report *Heavier Loading Rail Cars* by Bitzan and Tolliver contains a discussion of the economics of heavy covered hopper railcars. For this study, the authors performed simulations of heavy axle load cars to determine which track was unable to handle heavier railcars. Engineering equations were used to simulate track performance for light-rail and for heavier rail. The authors found any rail of less than 90 pounds per yard to be inadequate for heavy axle load traffic. The authors recommended using heavier rail when upgrading. The report also contains a railroad upgrade decision model designed as an investment decision. The methods and findings are identical to those found in Bitzan and Tolliver's *Journal of Transportation Research Forum* article discussed above.

2.2 State Department of Transportation Studies

State transportation departments have identified the use of heavy axle load cars on light density lines as an important strategic issue. The states have an interest in maintaining the viability of their rail transportation systems, and the use of heavy axle load railcars may contribute to the abandonment of large portions of shortline rail systems. State transportation studies have been commissioned to provide analysis of this issue.

Upper Great Plains Transportation Institute. *North Dakota State Rail Plan*. Prepared for North Dakota Department of Transportation, October 1998.

The 1998 *North Dakota State Rail Plan* is a comprehensive document containing information on all aspects of the state's rail system. The plan identified the use of 286,000-pound railcars on branch lines as an important issue facing the state. Input to the state rail plan was obtained from a rail advisory committee consisting of a cross-section of representatives from railroads, shippers, and public organizations. The use of 286,000-pound railcars on branch lines was the major topic of discussion for the rail advisory committee. Shippers and regional railroads in the state were concerned about the viability of lines with light-weight rail and thin ballast. Following the input of the rail advisory committee, the *North Dakota State Rail Plan* listed the use of heavy axle load cars as one of eight important strategic issues facing the state.

Casavant, Ken and Denver Tolliver. *Impacts of Heavy Axle Loads on Light Density Lines in the State of Washington*. Prepared for the Washington State Department of Transportation, February 2001.

Casavant and Tolliver prepared a study for the Washington State Department of Transportation in 2001. The study was designed to provide information on the potential impact of 286,000-pound railcars on light-density track and shortline railroads in Washington. The study assessed the likelihood of heavier railcars being used, and it examined the condition of track in the state. The study included technical analysis using railroad track models, and it was determined that 480 miles of track would need to be upgraded to handle the heavier axle loads at a cost of between $250,000 and $300,000 per mile. This study, entirely devoted to the use of heavy axle load railcars, reflected the State of Washington's recognition of the importance of this issue.

Office of Rail Transportation, Iowa Department of Transportation. *2001 Heavy Axle Load Upgrade Report*. March 2002.

The State of Iowa recognized the need to assess the potential magnitude of rail line abandonment due to heavy axle loads. The *2001 Heavy Axle Load Upgrade Report* was designed to be more comprehensive than other Iowa Department of Transportation studies on heavy railcars. An important achievement of the study was the physical inspection of 97% of the track in the study area. Rail information such as weight and general condition was recorded during the inspection, and data was collected on ties and ballast. Logic tables were used to evaluate track components, and necessary upgrading costs were calculated using material and labor costs obtained from railroads. The study found the state's immediate short-term needs related to the use of 286,000-pound railcars to be $297 million. The long-term needs were estimated at $390 million.

2.3 Summary of Major Studies

The history presented here illustrates how studies of the use of heavy axle load cars have evolved over time. The first efforts by Burlington Northern (1990) were directed at determining route-specific economic efficiency gains. It was found that heavier axle loads could mean cost savings of more than 5% on a specific route. Later, studies such as those by Martens (1999) and ZETA-TECH (2000) began to examine how greater use of 286,000-pound cars would affect the regional railroad and shortline systems. ZETA-TECH applied engineering models and logic tables to this problem. These studies determined that large portions of rail networks would need upgrading to remain viable. The decision to upgrade was modeled as an investment decision by Bitzan and Tolliver. This approach recognized the importance of the railroad decision-making process.

It is important to note that efforts to determine economic efficiency gains from the use of heavy axle load railcars continued beyond the first BN study. "BN: Big-Car Economics" in the April 1990 issue of *Railway Age* described further research into heavy axle loads for new coal equipment and existing grain equipment. Results of this further research were presented at the

October 1990 joint AREA/American Society of Mechanical Engineers conference in Jacksonville, Florida. Research showed that benefits should be evaluated for specific routes, but that operating cost savings could be as much as 5%.

The Transportation Technology Center, Inc. (TTC) is another organization which has conducted research on the use of heavy axle load railcars. The TTC facility used for testing is known as the Facility for Accelerated Service Testing (FAST). Tests at FAST have been sponsored by the Association of American Railroads (AAR) and the Federal Railroad Administration (FRA). Testing at FAST has shown greater economic benefits for the 286,000-pound railcar than for the 315,000-pound car. Some of the testing results are presented in "Heavy Axle Loads: the Dollars and Sense Case," *Railway Age*, March 1998 by Semih Kalay and Tom Guins.

State transportation studies have been directed toward the issue of heavier railcars as the states recognize the significance of the problems facing railroads and shippers. *The North Dakota State Rail Plan* of 1998 identified the increased use of heavy axle load cars as a major strategic transportation issue facing the state. Casavant and Tolliver (2001) prepared a study entirely devoted to the impacts of heavy axle loads for the State of Washington, and the Iowa Department of Transportation (2002) commissioned a study in which 97% of the track in a study area was physically surveyed to assess condition.

The following sections of this review discuss three important components of studies on the use of heavy axle load cars; measuring track condition, use of technical track analysis, and estimation of upgrade costs. A number of studies include each of these components.

2.4 Track Condition

A key aspect of studies on the use of heavy axle load cars is determination of track conditions.

Most studies have used survey techniques to gather information on track. In some instances, railroads were simply asked to provide information on their systems. The Iowa Department of Transportation (2002) study used physical inspection to determine track conditions. Several studies and their methods are discussed here.

To gather information on track condition, Martens (1999) developed a 16 question survey which was sent to 88 short line railroads. The railroads were identified in the 1996 American Short Line Railroad Association Annual Data Profile. The survey asked for information on the amount of track which was likely to be closed or upgraded due to use of heavy axle load cars. It also requested effects on train operating speeds and how shippers would be affected. The response rate to the survey was 44%.

ZETA-TECH (2000) developed a survey of track conditions and characteristics for the shortline and regional railroad industry. A questionnaire was sent to all American Shortline and Regional Railroad Association members, and 46 railroads responded. Other information used in the study was obtained directly from RailAmerica which operates 27 U.S. railroads. RailAmerica obtained information from a 'due-diligence' survey prepared on its railroads.

Condition of track in Washington was gathered by Casavant and Tolliver (2001) from a survey of major shippers and shortlines. The survey consisted of a mail questionnaire and telephone survey. Information was obtained through questions about awareness of the use of 286,000-pound railcars, current and expected future use, effects on operating speeds, and others. In addition, the BNSF railroad was asked to provide information on Class I track conditions in Washington.

One study departs from the methods of others in determining track conditions. The Iowa Department of Transportation (2002) study relied on physical inspection of track. Inspections of

97% of the track in the study area were conducted at five mile increments. Rail information such as weight, section, type of joint, control-cooled status, and general condition was recorded at each inspection. The number of good ties per rail length was recorded as was the depth and condition of ballast. Information on bridges was obtained from railroads. Extensive physical inspection of track represents an important advancement for studies of this type.

While most studies have used survey data to estimate track conditions, one important point should be considered. Reliance on survey data may not provide the most accurate track condition data. *The North Dakota State Rail Plan* (1998) contains a summary of comments on the plan from public hearings. Comments point to discrepancies between survey data obtained for the study and knowledge of personnel working in the industry. Discrepancies involve time frames of completed upgrades, improvement of track components, traffic densities and other issues. The accuracy of some survey data should be checked given such potential discrepancies.

2.5 Technical Track Analysis

Once condition and characteristics of track in a study area are known, technical track analysis may be used to determine which track is unable to handle heavy axle load cars. Several studies have used railroad track models to set minimum standards for 286,000-pound railcars. Technical analysis may also be used to determine costs required to bring track up to minimum standards. Logic tables have been developed for evaluation of track components and have been useful in determining which track components need to be upgraded. Technical analysis often involves the use of equations developed by A.N. Talbot. The Talbot equations will be briefly discussed here as will a few of the studies which have used technical track analysis.

In 1918, A.N. Talbot and associates presented work on track analysis to the American Railway Engineering Association Special Committee on Stresses in Railroad Track (Hay, 1982).

Talbot modeled track stresses with continuous, elastically supported beam procedures which are known as Talbot equations. Wheel loadings cause track deflection or bending under stress. The function of track is to distribute wheel loads from rail to other components. Talbot equations model deflection and the distribution of loading through ties and ballast as a function of rail stiffness; the spacing, size, and stiffness of ties; and the stiffness of ballast and subgrade. Talbot equations are simple enough that calculations may be performed on a pocket calculator (Hay, 1982), and they provide the basis for railroad engineering track models.

The ZETA-TECH (2000) study used proprietary engineering models to determine minimum track standards required for 286,000-pound railcars. The interaction between components is important in track analysis, so minimum standards reflect combinations of components. The study also estimated track component replacements which would be necessary to bring track up to minimum standards.

Track analysis in the study was carried out with logic tables. ZETA-TECH developed logic tables in which each track component is rated on performance under heavy axle loads. Logic tables are matrices which give component suitability ratings based on multiple characteristics. For example, the rail matrices give ratings based on the weight of rail, operating speed, and traffic density. The rail tie matrices use the number of good ties per rail length, operating speed, and traffic density to provide ratings.

There are three track component ratings used in the logic tables. 'OK' indicates that a component is adequate under heavy axle loads. A 'Marginal' rating is provided when track component adequacy depends on the condition of other components, and a 'Replace' rating indicates the need to improve or replace a component. Track upgrades in the study are assumed to bring track up to an 'OK' status.

The logic tables developed by ZETA-TECH proved valuable to the study, and have been used by other studies. The Iowa Department of Transportation (2002) study utilized the tables with slight modifications based on input from several chief railroad engineers. Use of the ZETA-TECH methods by other studies gives an indication of strong engineering foundations, practicality, and convenience of use.

The Casavant and Tolliver (2001) study employed Talbot equations to model track performance. Specifically, the Talbot track deflection equation was used to simulate track performance for two categories of rail; 70 pound per yard, and 90 pound per yard. Rail deflection is a function of rail and other component characteristics. Tie spacing, ballast depth, and rail modulus were simulated in the study by modification of the Talbot track equation.

Each of the studies employing technical track analysis methods contain general findings. The ZETA-TECH (2000) study found rail of less than 90 pounds per yard to be inadequate for heavy axle load cars even with good support conditions. The study also found that a minimum of 10 good ties per 39 foot rail length and at least two inches of clean, good quality ballast were necessary to meet minimum standards. ZETA-TECH, and Casavant and Tolliver (2001) conclude that 90 pound rail may perform marginally at slow operating speeds with good tie and ballast support. Casavant and Tolliver recommend heavier rail of 112 to 115 pounds when upgrading. Overall, track analysis findings of the different studies are generally consistent.

2.6 Upgrade Costs

Studies on the use of heavy axle load cars often utilize track analysis to determine which track in a study area is unable to handle heavy cars. The next step for these studies is to estimate the costs associated with upgrading track. Studies show a range of different upgrading costs based on differing assumptions. Some studies assume that new rail is used for rehabilitation while others assume the rail is used. One study estimated short-term and long-term costs. Some studies have included bridge rehabilitation costs in estimates while others have excluded bridge costs. A summary of studies' costs and assumptions follows.

Martens (1999) surveyed shortline and regional railroad operators for information on the amount of upgrade investment required to keep all route miles in the study area in operation with heavy axle load cars. The mean investment per railroad from returned surveys was $5.1 million, and the average track investment required to keep all route miles in operation was $118,662 per otherwise closed mile of track. Surveys also indicated that an average investment of $51,776 in bridge costs per otherwise closed mile of track would be required. Martens left questions regarding the use of new or used components for upgrades to the railroads in the survey.

The ZETA-TECH (2000) study determined the quantities of components required to bring track up to minimum standards and then calculated upgrading costs using unit costs of track components. The study obtained costs used by three Class I railroads for budgeting upgrading activities and used the lowest cost to produce shortline upgrading cost estimates. Materials, transportation, storage, and overhead were all reflected in the cost estimates. Upgrades were assumed to be completed with new 115 pound rail and good quality ballast. ZETA-TECH obtained bridge condition and cost information from railroads in the study area. Complete replacement of all track components was calculated to cost $516,066 per mile. The average cost for track rehabilitation in the study area was found to be $102,017 per mile, and it was determined that 22% of bridges would need to be replaced. The total nationwide shortline and regional railroad industry cost for upgrading to handle 286,000-pound railcars was estimated to be $6.86 billion.

The Casavant and Tolliver (2001) study estimated minimum upgrade costs. Upgrades were assumed to be performed with used 115 pound rail, and the minimum cost was calculated at $265, 000 per mile. This estimate did not include bridge costs. Costs of materials and labor were obtained through discussions with vendors and shortline railroads. The study also investigated using cheaper, curve worn rail and subtracting the salvage value of old rail from the cost of the curve worn rail. A cost of $205,000 per mile resulted. Using the estimated per-mile costs for upgrading over 400 miles of track in Washington, the authors produced an upgrading cost range of $117 to $141 million.

Short-term and long-term upgrade requirements were estimated for the Iowa Department of Transportation (2002) study. The minimum short-term cost reflected immediate needs utilizing 'Marginal' rail and upgrading ties and ballast to an 'OK' status according to track analysis logic tables. The minimum upgrade cost was estimated at $117,000 per mile or a total of $297 million for the state. The study also determined a long-term cost of $154,000 per mile or $390 million for the state assuming rail was upgraded to an acceptable level along with ties and ballast. Iowa DOT obtained cost information on track upgrading from railroads in the state, and the DOT had access to information on state projects. The cost of new rail was used for estimates. Bridge information was obtained from railroads and included in upgrade costs. The Iowa DOT study arrived at a grim conclusion about the rate of upgrading investment in the state. At the current rates, it would take 33 years to complete the upgrades necessary for system-wide use of heavy axle load cars.

The range of upgrading costs found in studies of the heavy axle load cars reflects differences in assumptions. Studies assume that upgrades are carried out with either new or used rail. Bridge costs are included in some studies and excluded from others. The Iowa DOT (2002) study calculated both the minimum short-term costs and long-term costs of upgrading. The cost of complete replacement of track components is sometimes reported as is the cost required to bring track up to minimum standards. The Iowa DOT (2002) study reported the minimum short-term cost for upgrading including bridge costs to be $117,000 per mile, while the ZETA-TECH (2000) study estimated the cost for complete replacement of components using new rail to be $516,000 per mile. These figures illustrate the range of cost estimates found in studies, and they reflect how differing assumptions affect the investment estimates.

2.7 Technical Track Upgrading Literature

Two excellent resources for technical information on track rehabilitation are listed below.

Hay, William W. *Railroad Engineering*. Second Edition. John Wiley & Sons. New York. 1982.

Railroad Engineering was first published in 1954, and the updated and revised second edition was published in 1982. This text is comprehensive and practical on all aspects of track design, construction, evaluation, and maintenance. The book is divided into two parts. The first part is on the principles of location and operation, and the second part is on the principles of maintenance and construction. Each part contains numerous chapters. The basic principles of track design and maintenance have changed very little over the years, so this text contains much information relevant to the topic of railroad track upgrades including descriptions of the Talbot equations which are used for track analysis.

Ahlf, Robert E. *The Behavior of Railroad Track, and the Economical Practices of its Maintenance and Rehabilitation.* Institute for Railroad Engineering. October 1988.

The Behavior of Railroad Track, and the Economical Practices of its Maintenance and Rehabilitation is a guide used by the Institute for Railroad Engineering for its railway consulting and training work. The author reveals much practical railroad experience in this guide. Ahlf is a railway civil engineer who spent 17 years with a Class I railroad. The guide contains a great amount of technical information on the fundamentals and behavior of track. Emphasis is placed on the interrelated nature of track components. The guide explains the analysis, design, maintenance, management, and evaluation of track structures.

The guide contains a section on the topic of upgrading smaller railroads. The section on upgrading was published in *Railway Track and Structures* as “Rehabbing the Short Line,” in April 1988. The article explains track differences between Class I and shortline railroads. It also has information on developing a rehabilitation program and working with contractors. Recommendations include information on how to write contracts, and the role of the project engineer. The focus of the section on rehabilitation of shortlines is less technical and more administrative than the rest of the guide.

2.8 Summary

The focus of much attention has been on how the use of heavy axle load railcars will affect shortline and regional railroads. The states have recognized the importance of this issue as much of their shortline and regional railroad systems are unable to accommodate heavy railcars. Many of the studies on heavy axle load cars have relied on common methods. The Talbot equations provide a convenient basis for technical track analysis, and the conclusions of studies regarding minimum track standards have been consistent. Studies agree that 90 pound rail performs marginally at best in its ability to handle heavy axle load railcars. It should only be considered for use with good tie and ballast support at slow operating speeds. Any rail of less than 90 pounds per yard is unacceptable, and upgrades should be performed with heavier 112 or 115 pound rail. Railroads have been instrumental to studies by providing information on track condition and upgrading costs, but physical inspection of track has also been used. Each of the studies which estimate upgrade costs have produced different figures. The range of $117,000 to

$516,000 per mile presented in this review illustrates the difference between a minimum short term cost and the cost of complete replacement of track components. The different cost figures and related assumptions represent the unique objectives of different studies and provide a range of important information. A review of the literature on heavy axle load railcars on light density lines reveals that a limited number of studies have been completed; most using similar or common analysis methods. It is also evident that track analysis methods have strong engineering foundations, and many of the findings and conclusions of studies are consistent.

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Upper Great Plains Transportation Institute. *North Dakota State Rail Plan*. Prepared for North Dakota Department of Transportation, October 1998.

Chapter 3

The Shift to HAL Rail Cars and the Impacts of Kansas Shortline Railroads

3.1 Description of Kansas Shortline Railroads

The five Kansas shortline railroads in this study are the Cimarron Valley Railroad (CV), the Kansas and Oklahoma Railroad (K&O), the Kyle Railroad, the Nebraska, Kansas, and Colorado Railnet (NKC), and the South Kansas and Oklahoma Railroad (SKOL). Some characteristics of these railroads are displayed in Table 3.

The Cimarron Valley Railroad was purchased from Santa Fe Railroad and began operations in 1996. The CV has 254 route miles with 186 of those located in southwest Kansas. The CV has 18 full-time employees in Kansas.

The Kansas and Oklahoma Railroad was created in 2001 as a result of the purchase of the former Central Kansas Railway. The K&O serves central Kansas from Wichita, Kansas and west to the Colorado border. It also serves south central Kansas and has a line in north central Kansas as well. The K&O has all 832 of its route miles in Kansas and has 40 full-time employees.

The Kyle Railroad is the oldest shortline of the five Kansas railroads in this study. Created in 1982, the Kyle Railroad serves northern Kansas with 482 miles of its 557 mile system. The Kyle has 110 full-time employees.

The Nebraska, Kansas, and Colorado Railnet was created in 1996 and serves five counties in northwest Kansas with 122 of its 434 mile system. The NKC also has 17 miles of trackage rights on the Kyle Railroad. The NKC has 17 full-time employees.

The South Kansas and Oklahoma Railroad was created in 1990 and has 272 miles of its 404 mile system in southeast Kansas. The SKOL has 76 full-time employees.

TABLE 3: Kansas Shortline Railroads

Railroad	Starting Date	Kansas Route Miles	Total Route Miles	Full-Time Employment
Cimarron Valley Railroad	1996	186	254	18
Kansas and Oklahoma Railroad	2001	832	832	40
Kyle Railroad	1982	482	557	110
Nebraska, Kansas, and Colorado Railnet	1996	122	434	17
South Kansas and Oklahoma Railroad	1990	272	404	76
Total	--	1,894	2,481	261

All the data in the table was obtained from questionnaires completed in the summer of 2003 by representatives of the railroads.

Table 4 contains the connections of the five shortlines with each other and with Class I railroads. The CV has connections to Burlington Northern Santa Fe (BNSF) at Boise City, Oklahoma and Springfield, Colorado. The Kansas and Oklahoma Railroad has connections to the BNSF at Abilene, Hutchinson, Newton, and Wichita, Kansas. The K&O also connects to Union Pacific (UP) at Hutchinson, McPherson, Salina, and Wichita, Kansas; and to Kyle Railroad at Osborne, Kansas. The Kyle connects to BNSF at Courtland and Concordia, Kansas and to UP at Colby and Salina, Kansas as well as Limon, Colorado. Kyle connects to NKC at Norton and Oronoque, Kansas and to K&O at Osborne, KS. The NKC connects to BNSF at Orleans and Holdredge, Nebraska as well as Sterling, Colorado. It connects to the Kyle Railroad at Norton, Kansas. The SKOL has connections with BNSF at Columbus and Winfield, Kansas and at Tulsa, Oklahoma. It connects to UP at Coffeyville, Winfield, and Neodesha, Kansas as well as Tulsa, Oklahoma. The SKOL connects to Kansas City Southern at Pittsburg, Kansas.

3.2 Kansas Shortline Railroad Traffic

Table 5 contains the combined 2003 traffic of four of the five Kansas shortline railroads. Together these railroads moved 145,503 carloads with Field Crops (wheat, corn, sorghum, soybeans, etc.) accounting for 38% of the total carloads. Other major commodity markets of the Kansas shortlines were Hazardous Materials (17.7% of the total carloads), Coal (10.7%), Stone, Clay, Glass, and Concrete Products (8.8%), and Chemical Products (9.4%).

3.3 Track, Ballast, Crosstie, and Bridge Conditions of Kansas Shortline Railroads

Table 6 contains track miles of major Kansas shortlines by rail weight and rail type as of the summer of 2003. Of the 2,252 route miles, 75.9% are jointed rail and 24.1% are continuous welded rail. Of the 1,708.7 route miles of jointed track, 1,185.1 miles, or 69.4% is rail weighing 90 pounds per yard or less. Whereas, only 71.9 of the 543.3 miles of continuous welded track is in this category. The Zeta-Tech (2000) and Casavant and Tolliver (2001) studies concluded that 90 pounds per yard rail can not withstand the stress of 286,000-pound rail cars and should be replaced with heavier weight rail. If this is the case, 1,257 of the 2,252 total track miles (i.e., 55.8%) should be replaced with heavier weight rail.

TABLE 4: Kansas Shortline Railroad Connections

Connection to:	Location(s)
Cimarron Valley Railroad	
Burlington Northern Santa Fe	Boise City, OK and Springfield, CO
Kansas and Oklahoma Railroad	
Burlington Northern Santa Fe	Abilene, Hutchinson, Newton, and Wichita, KS
Union Pacific	Hutchinson, McPherson, Salina, and Wichita, KS
Kyle Railroad	Osborne, KS
Kyle Railroad	
Burlinton Northern Santa Fe	Courtland and Concordia, KS
Union Pacific	Colby and Salina, KS and Limon, CO
Nebraska, Kansas, and Colorado Railnet	Norton and Oronoque, KS
Kansas and Oklahoma Railroad	Osborne, KS
Nebraska, Kansas and Colorado Railnet	
Burlington Northern Santa Fe	Orleans and Holdredge, NE and Sterling, CO
Kyle Railroad	Norton, KS
South Kansas and Oklahoma Railroad	
Burlington Northern Santa Fe	Columbus and Winfield, KS and Tulsa, OK
Union Pacific	Coffeyville, Winfield, Neodesha, KS and Tulsa, OK
Kansas City Southern	Pittsburgh, KS

All the data in the table was obtained from questionnaires completed in the summer of 2003 by representatives of the railroads.

TABLE 5: 2003 Kansas Shortline Railroad Traffic*

Carloads by Commodity

Commodity	Carloads	Percent of Total
Field Crops (011)	54,093	38.0%
Metallic Ore (10)	54	--
Coal (11)	15,301	10.7
Non-Metallic Minerals (14)	4,389	3.1
Food and Kindred Products (20)	5,453	3.8
Lumber and Wood Products (24)	1,523	1.1
Pulp and Paper Products (26)	5	--
Chemical Products (28)	13,422	9.4
Petroleum and Coal Products (29)	4,238	3.0
Rubber and Plastic Products (30)	78	--
Stone, Clay, Glass, Concrete (32)	12,566	8.8
Primary Metal Products (33)	2,045	1.4
Fabricated Metal Products (34)	228	0.2
Transportation Equipment (37)	1,212	0.9
Scrap (40)	2,447	1.7
Hazardous Materials (48,49)	25,232	17.7
Miscellaneous	217	0.2
Total	145,503	100.0

* Carloads are the combined 2003 carloads of the K&O, Kyle, NKC, and SKOL railroads. Detailed carloads by commodity were not available for the CV. Numbers in parentheses following commodity names are Standard Transportation Commodity Code (STCC) numbers.

TABLE 6: Miles of Track by Rail Weight and Rail Type

Five Major Kansas Shortlines Total

Rail Weight (Pounds Per Yard)	Rail Type Jointed	Continuous Welded	Total Miles
Less than 70	0	0	0
70-89	370.0	0	370.0
90	815.1	71.9	887.0
91-111	352.3	5.4	357.7
112	80.3	192	272.3
115	23.0	119	142.0
116-131	0	0	0
Greater than 131	68	155.0	223.0
Total Miles	1,708.7	543.3	2,252.0

Data supplied by representatives of five Kansas shortline railroads.

Further perspective on this issue was provided by representatives of the BNSF and UP railroads. On the questionnaire completed by both railroads, the following question was asked.

> What is the optimum weight of rail (pounds per yard) required to handle 286,000-pound rail cars?

The BNSF representatives said 115 pounds per yard or greater is needed. The UP respondents said 112 pounds per yard rail is the minimum rail weight on the railroad, and that 130 pounds per yard rail is used on mainlines. Class I railroads have greater carloads per mile and operate at higher speed than shortlines, but the rail weights to handle HAL cars suggested by the Class I railroad representatives are substantially higher than 90 pounds per yard.

Table 7 displays miles of Kansas shortline track by rail weight and percent of good crossties. Examination of the data indicate that 35% of the 2,252 track miles have less than 45% good crossties. Another 36% of the total track miles have only 45% to 64% good crossties. For rail weight of 90 pounds per yard or less, 75.3% of the track miles have 64% or fewer good crossties. This contributes to the conclusion that track weighing 90 pounds per yard or less can not handle 286,000-pound rail cars since about 75% of the track miles in this category have 64% or fewer good crossties.

TABLE 7: Miles of Track by Rail Weight and Percent of Good Crossties

Five Kansas Shortline Total

Rail Weight (Pounds Per Yard)	Percent of Good Crossties				
	Less than 45%	45% to 64%	65% to 85%	Greater than 85%	Total Miles
Less than 70	0	0	0	0	0
70-89	80.0	285.0	5	0	370.0
90	346.0	235.0	306.0	0	887.0
91-111	257.7	75.0	25.0	0	357.7
112	31.3	91.0	150.0	0	272.3
115	0	42.0	100.0	0	142.0
116-131	0	0	0	0	0
Greater than 131	74.0	90.0	49.0	10.0	223.0
Total	789.0	818.0	635.0	10.0	2,252.0

Data supplied by representatives of the five Kansas shortline railroads.

Table 8 contains miles of Kansas shortline track by rail weight and ballast depth. Of the 2,252 track miles of the five Kansas shortlines, a total of 1,296 miles (57.5% of total miles) has eight inches or less of ballast under the rails. A total of 28.8% of the track miles have fewer than six inches of ballast. Of the track miles that have 90 pounds per yard or less rail weight, 81.7% have eight inches or less of ballast; 43.8% have fewer than 6 inches of ballast under the rail.

TABLE 8: Miles of Track by Rail Weight and Ballast Depth

Five Major Kansas Shortline Total

Rail Weight (Pounds Per Yard)	Ballast Depth				
	Less than 6"	**6 to 8"**	**9 to 12"**	**13 to 17"**	**Total**
Less than 70	0	0	0	0	0
70-89	160.0	210.0	0	0	370.0
90	390.0	267.0	230.0	0	887.0
91-111	40.0	30.0	287.7	0	357.7
112	45.0	36.0	191.3	0	272.3
115	0	23.0	0	0	23.0
116-131	0	0	4.0	0	4.0
Greater than 131	13.0	82.0	124.0	119.0	338.0
Total	648.0	648.0	837.0	119.0	2,252.0

Data supplied by representatives of the five Kansas shortline railroads.

Another question on the questionnaire completed by both UP and BNSF respondents was "how many more inches of track ballast are needed to adequately handle 286,000-pound cars relative to 263,000-pound cars?" Representatives of BNSF suggested four to six additional inches of ballast are needed. UP representatives said no additional ballast is needed to handle the 286,000-pound car, but 9 to 12 inches of ballast is the UP standard for the 263,000-pound car. Although Class I rail ballast standards may be higher than shortlines due to higher traffic density and operating speeds, it appears that most of the shortline track miles of 90 pounds per yard or less do not have enough ballast (eight inches or less) to adequately handle 286,000-pound cars.

Overall, the 90 pounds per yard or less track does not have a high percentage of good crossties, and the great majority of these track miles have eight inches or less of ballast under the rail. Thus, it is very unlikely that the approximately one-half of the total shortline miles that are ≤ 90 pounds per yard track will be able to handle 286,000-pound rail cars at full weight and efficient operating speeds.

Further information on the ability of Kansas shortlines to handle 286,000-pound rail cars was obtained from the questionnaires completed by shortline representatives. The respondents were asked how many mainline route miles on their shortline need to be upgraded (heavier weight rail, more ballast, or more crossties) to handle 286,000-pound cars. Their collective responses are summarized as follows:

- 1,583 mainline route miles need heavier weight rail
- 1,530 mainline route miles need more ballast
- 1,513 mainline route miles need more crossties

Thus by the estimate of shortline representatives about 70% of the total mainline route miles of the five Kansas shortlines need heavier weight rail, and more ballast and crossties to handle 286,000-pound rail cars. The shortline representatives also indicated that a minimum of 218 miles of yard track and 75 miles of siding track would have to be upgraded as well.

The representatives of the Kansas shortlines were asked how many bridges on their shortline would have to be upgraded to handle 286,000-pound cars. There are a total of 1,581 bridges located on the systems of the five Kansas shortline railroads. The respondents said that 1,352 (or 86%) would have to be upgraded to handle the HAL cars. The representative of one shortline said all the wooden bridges on the system would have to be reinforced. Another said all the bridges on the railroad would have to be upgraded. The representative of another railroad said 80% of the bridges on the railroad would have to be reinforced and the other 20% would have to be replaced.

3.4 Kansas Shortline Railroad Upgrading Costs

Personnel of the five Kansas shortlines provided estimates of the cost per mile to upgrade mainline track to handle 286,000-pound covered hopper cars. The cost per mile estimates, including all materials and labor costs, are as follows:

Cimarron Valley Railroad	$265,109
Kansas and Oklahoma Railroad	$210,000
Kyle Railroad	$138,000
Nebraska, Kansas, and Colorado Railnet	$106,307
South, Kansas, and Oklahoma Railroad	$209,000

For each railroad, the cost per mile estimates were multiplied by the number of miles of mainline track requiring upgrading to handle HAL cars (estimated by representatives of the railroads). The resulting upgrading costs by railroad are as follows:

Cimarron Valley Railroad	$25.5 million
Kansas and Oklahoma Railroad	$126.6 million
Kyle Railroad	$29.1 million
Nebraska, Kansas, and Colorado Railnet	$25.9 million
South, Kansas, and Oklahoma Railroad	$84.4 million
Total	$291.5 million

The CV, Kyle, and NKC railroads' total upgrading costs are clustered between $25.5 million and $29.1 million. The K&O accounts for 43.4% of the total upgrading costs because it has the largest number of mainline route miles of the five shortlines. The SKOL accounts for 29% of the total upgrading costs since representatives of the SKOL estimated that the entire railroad would have to be upgraded to handle HAL cars.

It is interesting to note the similarity of the estimated upgrading costs for about 1600 miles of the Kansas shortline track to the estimate published in Iowa Department of Transportation (2002). According to the study, the minimum upgrade cost for the state of Iowa was $297 million.

Representatives of the Kansas shortlines also provided estimates of bridge rehabilitation costs to equip their systems with the ability to handle 286,000-pound cars. These costs are summarized as follows:

Cimarron Valley Railroad	$1.0 million
Kansas and Oklahoma Railroad	$8.1 million
Kyle Railroad	$6.0 million
Nebraska, Kansas, and Colorado Railnet	$1.0 million
South, Kansas, and Oklahoma Railroad	$1.1 million
Total	$17.2 million

The CV, NKC, and SKOL bridge upgrading costs are each only about $1 million, while K&O and Kyle railroads account for most of the total bridge rehabilitation costs. Thus the total upgrading costs for mainline track and bridges for the five railroads is $308.7 million.

The upgrading costs per mile of mainline track provided by the representatives of the five Kansas shortlines are similar to estimates in Casavant and Tolliver (2001). The authors estimated the cost per mile of track (net of salvage value) for 115 pounds per yard rail to be $205,000 per mile. Their estimate of the cost per mile of track for 132 pounds per yard, curve-worn rail was $209,015 per mile. The Iowa Department of Transportation has estimated a per mile upgrading cost of $262,385. Both BNSF and UP representatives estimated the per mile upgrading cost at $250,000 per mile.

3.5 Impact of 286,000-Pound Rail Cars on Kansas Shortline Expense and Revenue

In addition to the investment costs required to upgrade Kansas shortline railroad track and bridges, the increasing use of 286,000-pound rail cars will affect operating expense, maintenance expense, and operating revenue. The representatives of the five Kansas shortlines were asked if the increased use of 286,000-pound cars would increase their operating and maintenance expense. Personnel of four of the five railroads said that these expenses would increase, while the representative of the other railroad said operating costs would decrease but maintenance costs would rise. The survey respondents that said these costs would increase estimated that the increase would be between 6 and 15%.

The representatives of the shortlines were asked if increased use of 286,000-pound hopper cars would increase the operating revenue of their railroad. Representatives of three of the railroads said operating revenue would not increase, one representative said operating revenue would rise, and the representative of the fifth railroad was uncertain. In the latter case, the railroad respondent said that his railroad is paid a fee for delivering cars to Class I railroads. With adoption of HAL cars the shortline would deliver fewer cars. If Class I railroads were willing to compensate the shortline by paying more for delivering HAL cars, then operating revenue would be the same (or possibly more) as before. If Class I railroads were not willing to pay the shortline more for delivering each HAL car, operating revenue would decline.

3.6 Summary

About half the mainline track of the five Kansas shortlines is 90 pounds per yard or less. This track does not have a high percentage of good crossties, and most of it has eight inches or less of ballast under the rail. To be able to handle HAL cars on their systems, representatives of the railroads estimated 1,583 mainline route miles would need higher weight rail, 1,530 miles would need more ballast, and 1,513 miles would require more crossties. The personnel of the railroads estimated that 86% of the bridges on their systems would have to be upgraded to handle 286,000-pound rail cars. The total cost to upgrade the mainline track of the five shortlines was estimated to be $291.5 million, with an additional $17.2 million required to upgrade bridges. Majority opinion among the representatives of the shortlines was that increased use of 286,000-pound rail cars would increase their operating and maintenance costs and not increase their operating revenue.

Chapter 4

Analysis of Rates of Return on Investment in Line Upgrades by Kansas Shortline Railroads

As noted previously in this report, the old railroad industry standard of 263,000-pound cars capable of hauling 100 tons of grain is being replaced with 286,000-pound cars capable of hauling 111 tons. According to estimates provided by executives of five Kansas shortline railroads, about 70% of their collective rail mileage will have to be upgraded to handle 286,000-pound rail cars under normal operating conditions.

Although it may be possible for Kansas shortlines to operate at lower speeds or to not load the 286,000-pound cars to full capacity, these actions do not appear to be long term solutions for adjusting to an eventual industry switch to the larger cars. Lower rates per bushel received by shippers for loading the larger rail cars will likely make fully loaded 286,000-pound cars operating at normal speed the predominant mode of operation in the future. Thus, Kansas shortlines face a choice of abandonment or upgrading their lines to handle 286,000-pound hopper cars. The process employed by railroads to make this decision is described below.

4.1 Theoretical Model of Shortline Upgrading Decision

The following discussion is based on Bitzan and Tolliver (2003). The shortline's decision for upgrading the railroad to accommodate heavy axle load (HAL) cars is the same as that of any other business considering an investment in new plant or equipment. It is well known that a firm will make these investments if the internal rate of return from the investment is greater than rate of return on alternative investments, so long as the firm is able to obtain the required capital for the investment. For a Kansas shortline this means that it will invest in upgrading the rail line if the rate of return to upgrading exceeds the rate of return the shortline could receive from investing in other rail lines or property, as long as the railroad was able to obtain the capital to make the investment. The internal rate of return for a shortline investment in upgrading can be calculated by solving for ρ (the internal rate of return) in equation (4.1).

Equation 4.1: $$C_u = \sum_{i=0}^{N} \frac{R_i}{(1+\rho)^i}$$

Where: C_u - Upgrading cost

N - Number of years over which the upgrade is expected to generate benefits

R_i - Incremental profits in year i resulting from the upgrade

ρ - Internal rate of return

The investment criterion of investing in line upgrading as long as the internal rate of return is greater than the rate of return on alternative investments is equal to the net present value criterion, which says to invest in a project if the net present value of the investment exceeds its costs. The net present value criterion is equation (4.2).

Equation 4.2: $$NPV = \sum_{i=0}^{N} \frac{R_i}{(1+r)^i}$$

Where: NPV - Net Present Value

N - Number of years over which the upgrade is expected to yield benefits

R_i - Incremental profits in year i resulting from the upgrade

r - The rate of return on the best alternative investment

If ρ (the internal rate of return on the upgrade) exceeds r (rate of return on the best alternative investment), then the NPV must be greater than the cost of upgrading the line. Thus, the two criteria are equivalent. To calculate the rates of return, equation (4.1) will be used since it provides a useful framework for ranking investment alternatives.

4.2 Factors Influencing the Internal Rate of Return and Upgrading Decision

The five factors influencing the decision of Kansas shortlines to upgrade their lines to handle 286,000-pound cars are as follows:

- Number of years over which the rail line upgrade is expected to yield benefits
- Incremental traffic expected as a result of the upgrade
- Incremental revenues and costs attributable to the incremental traffic from the upgrade
- Service improvements resulting from the upgrade that raise revenues
- The upgrading cost

4.2.1 Useful Life of the Upgrade

Although railroad assets (rail line, bridges, and track components) have long physical lives, railroads consider a relatively short time frame when evaluating the potential benefits of a rail investment (Bitzan and Tolliver 2003). This is due to uncertainty of future traffic levels and the difficulty of transferring railroad assets within a railroad system. Future traffic is uncertain since the railroad's ability to maintain current traffic depends on the competitiveness of the businesses located on the rail line and the decisions by these businesses to remain at their current locations. Also, if a railroad loses traffic the physical facilities used to upgrade the line can't be productively used on another part of the railroad's system or by another railroad. The inability to move or liquidate railroad assets increases the risks to banks in providing loans with long repayment periods.

The appropriate time horizon to consider the benefits of upgrading the rail line depends on the risk perceptions of the railroad making the upgrading decision and the banks that are financing the upgrades. According to Bitzan and Tolliver (2003, p. 138), the longest period considered for the benefits of an upgrade by North Dakota shortlines is seven years. In a national survey of bankers specializing in loans to shortline railroads, the bankers state that the maximum term they would grant on a railroad loan is five to eight years (Bitzan, Tolliver, and Benson, 2002). Thus, in modeling Kansas shortline railroad upgrading decisions, an eight year time horizon is used. However, Kansas shortlines may have access to government loans with longer repayment periods. Thus, 15, 20, and 25 year loans are considered as well.

4.2.2 Incremental Traffic

Incremental traffic as a result of an upgrade investment is the traffic gained compared to a scenario where the railroad line is abandoned. One important factor affecting incremental traffic from an upgrade is the proximity of the shortline to rail competitors. Shippers are likely to move their grain by the closest railroad alternative. If a railroad decides not to upgrade a rail line and instead abandons it, the railroad may lose traffic to a nearby rail competitor. If the closest rail line to the line where the upgrading decision is being made is owned by the railroad making the decision, then traffic is likely to be maintained by the railroad if it abandons the line instead of upgrading it. In this case the incremental traffic from the upgrade is zero. Thus, shortlines are more likely to upgrade the line when rail competitors are close by than in cases where they own the nearest alternative line.

In Kansas, shortline railroads act as feeder lines to the Class I railroads. Although neither the shortlines nor their Class I partners regard each other as competitors, the proximity of a Class I partner to the line being evaluated for upgrading will influence the shortline's investment decision. If the shortline decides not to upgrade and abandons the line, all the traffic that moved on the line will divert to the Class I partner. Thus, a shortline facing the decision to upgrade will be equally influenced by the proximity of its line to that of its Class I partner and its competitors.

Another factor affecting incremental traffic from an upgrade decision is the action taken by rival railroads in upgrading their lines. For example, suppose two railroads (A and B) have lines in close proximity and both need to be upgraded. If railroad B upgrades its line, then the incremental traffic for railroad A from an upgrade is only its current traffic on its own line. However, if railroad B abandons its line, the incremental traffic for railroad A is the traffic on its line plus some part of railroad B's traffic.

In modeling the upgrading decision, it is assumed that shortlines estimate the internal rate of return of upgrading based on the assumption that rival railroads will upgrade their lines. This is because railroads are risk averse, and upgrading involves a large immobile investment. Thus, it is unlikely that a Kansas shortline would make the investment assuming it would gain traffic from a rival that abandoned its line.

A third factor affecting the amount of incremental traffic resulting from an upgrade is the ability of trucks to serve destination markets directly. Even if the branchline's closest rail alternative is another line on the same shortline railroad, the traffic could still be lost to trucks if the railroad decides to abandon the line rather than upgrade it. If trucks are competitive with rail in transporting to final or intermediate destinations, shippers losing rail service may transport directly to markets by truck. Although there are varying estimates of the distance for which trucks are competitive with rail, it is clear that many Kansas grain shippers are relatively close to markets at Salina, Hutchinson, Wichita, or Class I railroad shuttle train stations. Thus, even if the closest rail alternative to the line in question is on the same shortline railroad, all the traffic on that line should be considered incremental traffic to an upgrade since it may be lost to truck if the line is abandoned instead.

A fourth factor impacting the amount of incremental traffic resulting from an upgrade is the location of shuttle train stations that ship trains of 100 or more rail cars. Since these facilities have lower transport rates, they can offer higher grain prices to farmers and thus take grain away from elevators in close proximity to the shuttle train station. Thus, the incremental traffic from an upgrade will be smaller for a rail line in close proximity to shuttle train stations, but without their own shuttle train facilities.

The fifth variable affecting the amount of incremental traffic from an upgrading investment is service level changes resulting from the upgrade such as higher speeds and more frequent service. However, for the Kansas shortline's calculation of internal rate of return on investment in upgrading, the service level change isn't expected to have much impact on incremental traffic. This is because competitor railroads are assumed to upgrade their lines as well, resulting in no service advantage for the shortline that upgrades its line.

4.2.3 Incremental Revenues and Costs

The incremental revenues due to the upgrades are the revenues on incremental traffic for the entire length of haul that the traffic moves on the railroad's system. The incremental costs generated by the upgrade, in addition to the investment cost of the upgrade, are the routine maintenance costs of the line and the transportation cost of the incremental traffic for the entire movement on the shortline's system. However, the operating cost per bushel shipped will be lower due to the ability to ship grain in 286,000-pound rail cars after the upgrade. Using HAL cars results in a reduction in car and locomotive ownership costs, labor costs, fuel costs, and car and locomotive maintenance costs (Kalay and Guins 1998).

Martens (1999) developed a shortline railroad costing model that can be used to measure the cost reductions resulting from the use of 286,000-pound cars. The model is a spreadsheet based model that employs inputs obtained from interviews with shortline railroad operators. The Martens model accounts for savings in fuel costs, car and locomotive ownership costs, car and locomotive maintenance costs, and labor costs resulting from the shift to larger rail cars. In a later section of this chapter, his model is employed to simulate operating costs of shortlines before and after the upgrading investment. For a detailed description of the model see Bitzan and Tolliver (2001, pp. 63-65).

4.2.4 Service Improvements That Generate Incremental Revenue

It is unlikely that major service changes (speed and frequency of service) would result from upgrading the shortline to handle 286,000-pound cars. Instead, the upgrade will allow continued service at current service levels. Thus, incremental revenues from service improvements are not considered in internal rate of return calculations for Kansas shortlines.

4.3 Kansas Shortline Internal Rates of Return

4.3.1 Data Inputs

The required data inputs to calculate internal rates of return for upgrades to handle larger cars for Kansas shortlines are in Table 9. The mainline miles of road in Table 9 include Kansas mileage and mileage in bordering states for the Kyle, Cimarron Valley, Nebraska, Kansas and Colorado Railnet, and the South Kansas and Oklahoma Railroad. The length of haul data in Table 9 was obtained from *Profiles of U.S. Railroads* published by the Association of American Railroads. There was a great deal of annual variation in the length of haul data. In most cases the most recent available year's estimate or an average of more recent years' data was used. Total carloads are the 2001-2003 averages for the K&O, Kyle, and SKOL railroads. Total carloads for the NKC is the 2002-2003 average. These averages are based on data provided by shortline personnel. Total carloads for the CV railroad was suggested by KDOT. Carloads per mile were obtained by dividing total carloads by mainline miles of road. Upgrade miles data was obtained from the questionnaires completed by Kansas shortline personnel. These are the miles the railroad personnel said need to be upgraded to handle 286,000-pound cars. Tons per car of

111 is the maximum carrying capacity of a 286,000-pound car. The upgrade cost per mile of $207,770 was obtained by averaging the estimates reported in Table 10. The total upgrading cost is obtained for each Kansas shortline by multiplying $207,770 per mile by the number of miles to be upgraded. Other data inputs from the Martens model are in Table 11.

TABLE 9: Internal Rate of Return Analysis Data Inputs for Kansas Shortlines

			Railroad		
Data Input	**SKOL**	**K&O**	**Kyle**	**NKC**	**CV**
Mainline Miles	404	832	557	434	254
Length of Haul	85	128	98	85	59
Carloads Per Mile	98	60	37	58	32
Total Carloads*	39,391	49,519	20,311	24,980	8,000
Upgrade Miles	404	603	211	244	96
Upgrade Cost Per Mile	$207,770	$207,770	$207,770	$207,770	$207,770
Tons Per Car	111	111	111	111	111

Data in the table is based on personal interviews and questionnaires completed by personnel of the five Kansas shortline railroads.

* Total carloads are the 2001-2003 averages for the SKOL, K&O, and Kyle railroads. Total carloads for the NKC is the 2002-2003 average. Total carloads for the CV was suggested by KDOT.

TABLE 10: Shortline Upgrade Cost Per Mile Estimates—Mainline Track

Source of Estimate	Cost Per Mile
Iowa Department of Transportation*	$262,385
Casavant and Tolliver (115 pound rail)*	265,111
Casavant and Tolliver (115 pound rail, net of salvage value)*	205,000
Casavant and Tolliver (132 pound curve-worn rail)*	209,015
Kansas and Oklahoma Railroad (115 pound rail)	210,000
Kyle Railroad (115 pound rail)	138,000
Nebraska, Kansas, and Colorado Railnet (115 pound rail)	106,307
South Kansas and Oklahoma Railroad (115 pound rail)	209,000
Cimarron Valley Railroad	265,109
Mean	$207,770

* See Casavant and Tolliver (2001)

TABLE 11: Data Inputs of the Martens Model*

Variable	Assumed Value
Average Cars Per Train	26.0
Average Speed (mph)	25.0
Switch Time Per Car (minutes)	9.3
Train Crew Size	2.0
Wages Per Hour (dollars)	$16.00
Payroll Tax (percent)	25%
Fringe Benefits (percent)	20%
Locomotive Replacement Costs (dollars)	$200,000
Locomotive Useful Life (years)	15
Locomotive Salvage Value (dollars)	$50,000
Locomotives Per Train	1
Gallons Per Freight Mile (gallons)	4.77
Cost Per Gallon of Fuel (dollars)	$0.98
Locomotive Cost Per Locomotive Day (dollars)	$120.00
286,000-Pound Car Replacement Cost (dollars)	$63,000
Useful Life of 286,000-Pound Car (years)	35
Salvage Value of 286,000-Pound Car (dollars)	$4,000
Average Car Days Per Car Per Shipment (days)	4.5
Cost Per Car Mile (dollars)	$0.043
Other Transportation Costs Per Train Mile (dollars)	$2.88
Non-Capitalized Maintenance of Way Cost Per Mile (dollars)	$3,000

* Based on discussions with industry personnel

4.3.2 Internal Rate of Return Calculation Procedure

As discussed previously in this chapter, the internal rate of return for an upgrading investment to handle larger rail cars depends on the incremental annual profits from upgrading the rail line and the upgrading cost.

Incremental annual revenues are obtained by multiplying revenue per carload by the number of cars per mile and by the railroad's mainline miles. The average revenue per car is from American Shortline and Regional Railroad Association (2000) and is $3.03 per ton for 263,000-pound rail cars. It is assumed that the average revenue per ton would remain the same after the shift to larger cars, resulting in a revenue per car of $336 for the larger cars (111 tons per car). The number of cars per mile varies. Incremental revenues (and costs) are calculated for the actual cars per mile of each Kansas shortline as well as assumed traffic densities of 50, 75, 100, 150, and 200 cars per mile.

Incremental annual costs are estimated using a modified version of the Martens (1999) spreadsheet shortline cost model. The model is an economic engineering model that estimates the equipment and transportation costs to carry a given amount of grain in 286,000-pound rail cars.

The incremental profits per year resulting from the upgrade investment are the estimated incremental revenues minus the incremental equipment, transportation, and maintenance of way costs of Kansas shortline operation. The incremental maintenance of way costs include only those related to routine maintenance such as vegetation control, snow removal, and signal maintenance. Investment types of maintenance of way (tie, rail, and ballast replacement) are not considered since they are included in the upgrading investment.

4.3.3 Internal Rates of Return to Upgrading

In Tables 12 through 16 the internal rates of return to upgrading the railroad to handle 286,000-pound rail cars are calculated for the five major Kansas shortlines. For each shortline the internal rate of return is calculated for actual cars per mile and for assumed traffic densities of 50, 75, 100, 150, and 200 cars per mile. For each traffic density (i.e., 50 cars per mile, etc.), the internal rate of return is calculated for four time horizons of 8, 15, 20, and 25 years. For a given shortline, all the rate of return to upgrading calculations are based on the characteristics of that railroad. The four variables that are critical to the rate of return calculations and vary by shortline are average length of haul, carloads per mile, miles of mainline track to be upgraded, and total miles of mainline track. The upgrade cost per mile of $207,770 and tons per car of 111 for the 286,000-pound car are the same for all rate of return calculations. The key data inputs for the rate of return analysis are in Table 9.

The internal rates of return to upgrading in order to handle 286,000-pound rail cars for the five major Kansas shortline railroads are displayed in Tables 12 through 16. For each shortline, the internal rate of return is calculated for the average actual traffic density (cars per mile) for various time periods over which the upgrade is expected to yield benefits (i.e., 8 to 25 years). This is referred to hereafter as time horizon. In addition, internal rates of return are calculated for other traffic densities (50 to 200 cars per mile) for the same time horizons. The internal rates of return for the alternative traffic densities are hypothetical rates of return assuming a railroad with the same characteristics (i.e., average length of haul, miles of mainline track upgraded, total miles of mainline track, etc.) as each of the five Kansas shortlines. These data reveal what the internal rate of return would be for the Kansas shortline if it was able to increase its traffic up to a maximum of 200 carloads per mile.

TABLE 12: Cimarron Valley Railroad Estimated Internal Rate of Return to Upgrading, by Traffic Density and Time Horizon (Percent)

	Time Horizon			
Traffic Density	**8 Years**	**15 Years**	**20 Years**	**25 Years**
Actual Traffic	-28.3%	-9.7%	-4.9%	-2.3%
50 Cars Per Mile	-13.4	1.0	4.2	5.7
75 Cars Per Mile	0.7	11.5	13.4	14.1
100 Cars Per Mile	13.1	21.1	22.2	22.5
150 Cars Per Mile	38.0	42.1	42.4	42.4
200 Cars Per Mile	68.0	69.8	69.8	69.8

TABLE 13: Kansas and Oklahoma Railroad Estimated Internal Rate of Return to Upgrading, by Traffic Density and Time Horizon (Percent)

	Time Horizon			
Traffic Density	**8 Years**	**15 Years**	**20 Years**	**25 Years**
Actual Traffic	-27.7%	-9.3%	-4.6%	-2.0%
50 Cars Per Mile	-31.9	-12.3	-7.1	-4.2
75 Cars Per Mile	-22.1	-5.3	-1.3	0.9
100 Cars Per Mile	-15.1	-0.2	3.1	4.7
150 Cars Per Mile	-3.7	8.2	10.4	11.3
200 Cars Per Mile	6.1	15.6	17.0	17.6

TABLE 14: Kyle Railroad Estimated Internal Rate of Return to Upgrading, by Traffic Density and Time Horizon (Percent)

	Time Horizon			
Traffic Density	**8 Years**	**15 Years**	**20 Years**	**25 Years**
Actual Traffic	-28.0%	-9.5%	-4.8%	-2.2%
50 Cars Per Mile	-18.1	-2.4	1.3	3.1
75 Cars Per Mile	-4.9	7.3	9.6	10.6
100 Cars Per Mile	6.0	15.5	17.0	17.5
150 Cars Per Mile	26.6	32.3	32.8	32.9
200 Cars Per Mile	49.1	52.2	52.3	52.3

TABLE 15: Nebraska, Kansas, and Colorado Railnet Estimated Internal Rate of Return to Upgrading, by Traffic Density and Time Horizon (Percent)

	Time Horizon			
Traffic Density	**8 Years**	**15 Years**	**20 Years**	**25 Years**
Actual Traffic	-19.6%	-3.4%	0.4%	2.3%
50 Cars Per Mile	-23.3	-6.1	-1.9	0.3
75 Cars Per Mile	-12.3	1.9	4.9	6.3
100 Cars Per Mile	-3.6	8.3	10.5	11.4
150 Cars Per Mile	11.7	20.0	21.1	21.5
200 Cars Per Mile	26.4	32.1	32.6	32.7

TABLE 16: South Kansas and Oklahoma Railroad Estimated Internal Rate of Return to Upgrading, by Traffic Density and Time Horizon (Percent)

	Time Horizon			
Traffic Density	**8 Years**	**15 Years**	**20 Years**	**25 Years**
Actual Traffic	-16.9%	-1.5%	2.0%	3.7%
50 Cars Per Mile	-31.6	-12.2	-6.9	-4.1
75 Cars Per Mile	-22.9	-5.8	-1.7	0.5
100 Cars Per Mile	-16.3	-1.1	2.3	4.0
150 Cars Per Mile	-5.9	6.5	8.9	10.0
200 Cars Per Mile	3.1	13.3	15.0	15.6

As expected, the internal rates of return to upgrading increase as traffic density and time horizon increase. For example, a hypothetical railroad with the Cimarron Valley Railroad's characteristics could obtain a rate of return greater than 10% for all traffic densities of 100 or more cars per mile and a time horizon of 8 years or more (Table 12). If 75 cars per mile is assumed, the hypothetical CV could obtain a rate of return of more than 10% for time horizons of 15 years or more. A hypothetical railroad with the Kansas and Oklahoma Railroad's characteristics receives a rate of return to upgrading of 10% or more for traffic densities of 150 and 200 cars per mile and time horizons of 15 years or more (Table 13). Similar patterns are evident for the other shortlines as well.

As noted above, Bitzan and Tolliver (2003) found that banks specializing in railroad loans generally will not lend money for more than eight years. If this is the case, a hypothetical railroad with the Cimarron Valley's characteristics would have to achieve a traffic density of 100 or more cars per mile to obtain a rate of return to upgrading greater than 10% (Table 12). For hypothetical railroads with the characteristics of the Kyle and NKC railroads a traffic density of 150 or more cars per mile is necessary to obtain a rate of return greater than 10% (Tables 14 and 15). Hypothetical railroads with the characteristics of the Kansas and Oklahoma (Table 13) and

South Kansas and Oklahoma (Table 16) railroads are unable to obtain a rate of return greater than 10% for any traffic density examined in the study (i.e., up to 200 cars per mile) assuming a loan length of eight years.

The most significant result of the internal rate of return analysis is that the rate of return to upgrading is negative (or slightly positive in a few cases) for all the hypothetical Kansas shortlines when their actual average traffic density and other characteristics are assumed. This result occurs for all time horizons examined in the study.

4.3.4 Comparison of Annual Profits Required to Earn an 11% Rate of Return (on a Line Upgrade) to "Actual" Annual Profit

An alternative analysis to evaluate the decision of a railroad regarding upgrading the line to handle 286,000-pound rail cars is to compute the additional annual profits the railroad would have to receive in order to obtain an 11% rate of return on the investment. These additional profits are computed by using the modified Martens model to calculate the annual profits that would be generated if the rate of return to upgrading is assumed to be 11%. The "actual" annual profits are subtracted from these "11% rate of return" profits to obtain the additional annual profits that have to be earned by each shortline to obtain the target rate of return of 11%. These calculations are performed for four time horizons ranging from 8 to 25 years.

For each shortline the term "actual annual profits" refers to the annual profits a hypothetical railroad with a particular shortline's characteristics (carloads per mile, length of the railroad, length of haul, and miles of line requiring upgrading) would receive after upgrading the railroad to handle 286,000-pound rail cars. These are not the actual annual profits of the five Kansas shortlines since the upgrade investments are hypothetical at this point in time.

The additional annual profits required to earn an 11% rate of return to upgrading the railroad to handle 286,000-pound rail cars are displayed in Tables 17 to 21. An examination of the tables indicates that in the case of each shortline the additional profits required to earn an 11% rate of return to a line upgrade declines as the time horizon increases from 8 to 25 years. This is because the annual profit required to earn the target 11% return on investment is less the longer time available to achieve the target.

TABLE 17: Annual Profits Needed to Earn an 11% Rate of Return to a Line Upgrade Compared to "Actual Annual" Profits

Hypothetical Cimarron Valley Railroad*

Time Horizon	(1) Annual Profits Required to Earn an 11% Rate of Return	(2) Actual Annual Profits	(3) Required Additional Profit (1) – (2)
8 Years	$3,491,813	$592,825	$2,898,988
15 Years	$2,498,905	$592,825	$1,906,080
20 Years	$2,256,506	$592,825	$1,663,681
25 Years	$2,133,679	$592,825	$1,540,854

* Actual annual profits refer to the annual profits a hypothetical railroad with CV characteristics (carloads per mile, length of the railroad, length of haul, and miles of line that need to be upgraded) would receive after upgrading parts of the railroad to handle 286,000-pound cars. They are not the actual annual profits of the CV railroad since the upgrade investment is hypothetical at this point in time.

TABLE 18: Annual Profits Needed to Earn an 11% Rate of Return to a Line Upgrade Compared to "Actual Annual" Profits

Hypothetical Kansas and Oklahoma Railroad*

Time Horizon	(1) Annual Profits Required to Earn an 11% Rate of Return	(2) Actual Annual Profits	(3) Required Additional Profit (1) – (2)
8 Years	$21,932,949	$3,871,546	$18,061,403
15 Years	$15,696,245	$3,871,546	$11,824,699
20 Years	$14,173,678	$3,871,546	$10,302,132
25 Years	$13,402,169	$3,871,546	$9,530,623

* Actual annual profits refer to the annual profits a hypothetical railroad with K&O characteristics (carloads per mile, length of the railroad, length of haul, and miles of line that need to be upgraded) would receive after upgrading parts of the railroad to handle 286,000-pound cars. They are not the actual annual profits of the K&O railroad since the upgrade investment is hypothetical at this point in time.

TABLE 19: Annual Profits Needed to Earn an 11% Rate of Return to a Line Upgrade Compared to "Actual Annual" Profits

Hypothetical Kyle Railroad*

Time Horizon	(1) Annual Profits Required to Earn an 11% Rate of Return	(2) Actual Annual Profits	(3) Required Additional Profit (1) – (2)
8 Years	$7,674,714	$1,323,418	$6,351,296
15 Years	$5,492,384	$1,323,418	$4,168,966
20 Years	$4,959,612	$1,323,418	$3,636,194
25 Years	$4,689,648	$1,323,418	$3,366,230

* Actual annual profits refer to the annual profits a hypothetical railroad with Kyle characteristics (carloads per mile, length of the railroad, length of haul, and miles of line that need to be upgraded) would receive after upgrading parts of the railroad to handle 286,000-pound cars. They are not the actual annual profits of the Kyle railroad since the upgrade investment is hypothetical at this point in time.

TABLE 20: Annual Profits Needed to Earn an 11% Rate of Return to a Line Upgrade Compared to "Actual Annual" Profits

Hypothetical Nebraska, Kansas, and Colorado Railnet*

Time Horizon	(1) Annual Profits Required to Earn an 11% Rate of Return	(2) Actual Annual Profits	(3) Required Additional Profit (1) – (2)
8 Years	$8,875,024	$2,621,465	$6,253,559
15 Years	$6,351,383	$2,621,465	$3,729,918
20 Years	$5,735,286	$2,621,465	$3,113,821
25 Years	$5,423,100	$2,621,465	$2,801,635

* Actual annual profits refer to the annual profits a hypothetical railroad with NKC characteristics (carloads per mile, length of the railroad, length of haul, and miles of line that need to be upgraded) would receive after upgrading parts of the railroad to handle 286,000-pound cars. They are not the actual annual profits of the NKC railroad since the upgrade investment is hypothetical at this point in time.

TABLE 21: Annual Profits Needed to Earn an 11% Rate of Return to a Line Upgrade Compared to "Actual Annual" Profits.

Hypothetical South Kansas and Oklahoma Railroad*

Time Horizon	(1) Annual Profits Required to Earn an 11% Rate of Return	(2) Actual Annual Profits	(3) Required Additional Profit (1) – (2)
8 Years	$14,694,712	$5,013,888	$9,680,824
15 Years	$10,516,224	$5,013,888	$5,502,336
20 Years	$9,496,129	$5,013,888	$4,482,241
25 Years	$8,979,231	$5,013,888	$3,965,343

* Actual annual profits refer to the annual profits a hypothetical railroad with SKOL characteristics (carloads per mile, length of the railroad, length of haul, and miles of line that need to be upgraded) would receive after upgrading parts of the railroad to handle 286,000-pound cars. They are not the actual annual profits of the SKOL railroad since the upgrade investment is hypothetical at this point in time.

The additional annual profits required to earn the target 11% rate of return to upgrading varies a great deal by shortline. The additional annual profits required to earn the target rate of return for the time horizons of 8 and 25 years are as follows:

Kansas Shortline Railroad	8 Years	25 Years
Cimarron Valley	$2.9 Million	$1.5 Million
Kansas and Oklahoma	$18.1 Million	$9.5 Million
Kyle	$6.4 Million	$3.4 Million
Nebraska, Kansas, and Colorado Railnet	$6.3 Million	$2.8 Million
South Kansas and Oklahoma	$9.7 million	$4.0 Million
Total	$43.4 million	$21.2 Million

In the case of an eight year time horizon the additional annual profits range from a low of $2.9 million (CV) to a high of $18.1 million (K&O). For a 25 year time horizon the corresponding figures are $1.5 million (CV) and $9.5 million (K&O). Thus, for the 25 year time horizon, with one exception, the additional annual profits required to earn an 11% rate of return to a line upgrade range between $1.5 million and $4.0 million. The total additional annual profits of the five Kansas shortlines are $43.4 million with the eight year time horizon, while the corresponding figure for the 25 year time horizon is only $21.2 million, less than half that of the eight year period.

4.4 Impacts of the Upgrading Decision on Kansas Highways

In the Babcock et. al. (2003) study titled "Economic Impacts of Railroad Abandonment on Rural Kansas Communities," the road damage costs were calculated on abandoning four of the five Kansas shortlines in this study. The study concluded that if only the rail miles in Kansas of the four shortlines were abandoned, the annual road damage costs would be as follows:

Kansas and Oklahoma Railroad	$30.6 million
Kyle Railroad	$15.8 million
Cimarron Valley Railroad	$8.5 million
Nebraska, Kansas, and Colorado Railnet	$2.9 million
Total	$57.8 million

If the 272 miles of the South Kansas and Oklahoma Railroad located in Kansas were also abandoned, the annual road damage cost of $57.8 million would be even higher. If the five Kansas shortlines conclude that the rate of return to upgrading does not justify the investment, and subsequently abandon the railroads, Kansas' annual road damage costs will rise by over $58 million.

4.5 Summary

Internal rates of return for rail line upgrading to handle HAL cars were calculated for five Kansas shortline railroads using a theoretical model developed by Bitzan and Tolliver (2003) and a shortline railroad costing model (Martens 1999). For each shortline the internal rate of return is calculated for actual cars per mile and for assumed traffic densities of 50, 75, 100, 150, and 200 cars per mile. For each traffic density the internal rate of return was calculated for four time horizons of 8, 15, 20, and 25 years. For a given shortline, all the rate of return to upgrading calculations are based on the characteristics of that railroad including average length of haul, carloads per mile, miles of mainline track to be upgraded, and total miles of mainline track. The internal rates of return are hypothetical rates of return assuming a railroad with the same characteristics as each of the five Kansas shortlines.

The internal rates of return to upgrading increase as traffic density and time horizon increase. According to Bitzan and Tolliver (2003) banks specializing in railroad loans generally will not lend money for more than eight years. If this is the case, a hypothetical railroad with the CV's characteristics would have to achieve a traffic density of 100 or more cars per mile to obtain a rate of return to upgrading greater than 10%. For hypothetical railroads with the characteristics of the Kyle and NKC railroads a traffic density of 150 or more cars per mile is necessary to obtain a rate of return greater than 10%. Hypothetical railroads with the characteristics of the K&O and SKOL railroads are unable to obtain a rate of return greater than 10% for any traffic density examined in the study (i.e., up to 200 cars per mile) assuming a loan length of eight years. The most significant result of the internal rate of return analysis is that the rate of return to upgrading is negative (or slightly positive in a few cases) for all the hypothetical Kansas shortlines when actual average traffic density and other characteristics are assumed. This result occurs for all time horizons examined in the study.

An alternative analysis to evaluate the decision of a railroad regarding upgrading track to handle HAL cars is to compute the additional annual profits the railroad would have to earn in order to obtain an 11% rate of return on the investment. The "actual" annual profits are subtracted from the "11% rate of return" profits to obtain the additional annual profits that have to be earned by each shortline to obtain the target rate of return of 11%. For each shortline the term "actual annual profits" refers to the annual profits a hypothetical railroad with a particular shortline's characteristics would receive after upgrading the track to handle 286,000-pound cars. These are not the actual annual profits of the five Kansas shortlines since the upgrade investments are hypothetical at this point in time.

To obtain an 11% rate of return on the upgrade investment the total additional annual profits of the five major Kansas shortlines are $43.4 million with the eight year time horizon and $21.2 million if the time horizon is 25 years.

If the five major Kansas shortlines conclude that the rate of return to upgrading does not justify the investment, and subsequently abandon the railroad, Kansas' annual road damage costs would increase by over $58 million.

Chapter 5

Conclusions and Recommendations

5.1 Conclusions

5.1.1 Impacts of HAL Rail Cars on Kansas Shortline Track

CEOs and other personnel of five major Kansas shortline railroads provided information concerning the expected impact of increased usage of HAL cars on their railroad. They indicated that about 56% of their collective mainline track is less than or equal to 90 pounds per yard rail. Previous studies have concluded that 90 pounds per yard rail cannot withstand the stress of 286,000-pound railcars. In addition, they indicated that for rail weight of 90 pounds per yard or less, about 75% of the track miles have 64% or fewer good crossties, and 82% of the track miles have eight inches or less ballast under the rails. One of the Class I railroads in the study indicated that 9 to 12 inches of ballast is needed to adequately handle the 286,000-pound car. Thus it is unlikely that the approximately one-half of the total shortline miles that are $\leq$ 90 pounds per yard rail will be able to handle 286,000-pound cars at full weight and efficient operating speeds.

Representatives of the five Kansas shortlines were asked how many mainline route miles on their shortline would need to be upgraded (heavier weight rail, more ballast, or more good crossties) to handle 286,000-pound cars. Their collective responses are summarized as follows:

- 1,583 mainline route miles need heavier weight rail
- 1,530 mainline route miles need more ballast
- 1,513 mainline route miles need more good crossties (ties that can hold gauge and surface)

Thus according to representatives of the shortlines about 70% of the total mainline route miles of the five major Kansas shortlines will need to be upgraded to handle 286,000-pound cars. The shortline representatives also indicated that a minimum of 218 miles of yard track and 75 miles of siding track would have to be upgraded as well.

5.1.2 Impact of HAL Rail Cars on Kansas Shortline Bridges

There are a total of 1,581 bridges located on the systems of the five major Kansas shortline railroads. The shortline representatives said that 1,352 (or 86%) of the bridges would have to be upgraded to handle HAL cars. The representative of one shortline said that all the wooden bridges on his railroad would have to be reinforced. Another said all the bridges on his railroad would have to be upgraded. The representative of another railroad said that 80% of the bridges on his railroad would have to be reinforced and the other 20% would have to be replaced.

5.1.3 Kansas Shortline Railroad Track and Bridge Upgrading Costs

Personnel of the five major Kansas shortlines provided estimates of the cost per mile to upgrade mainline track to handle HAL cars. For each railroad, the cost per mile estimates were multiplied by the estimated number of miles of mainline track requiring upgrading to handle 286,000-pound cars. The total track upgrading costs for the five railroads as a group is $291.5 million.

Representatives of the Kansas shortlines also provided estimates of bridge rehabilitation costs to equip their systems with the ability to handle 286,000-pound cars. As a group, these costs totaled $17.2 million. Thus the total upgrading costs for mainline track and bridges for the five railroads is $308.7 million.

5.1.4 Impact of 286,000-Pound Rail Cars on Kansas Shortline Expense and Revenue

Personnel of four of the five major railroads had the opinion that operating and maintenance expenses would increase at their railroads as a result of handling HAL cars. The representative of the other railroad said that operating costs would fall but maintenance costs would rise. The respondents that indicated these costs would increase estimated that the increase would be 6 to 15%.

Representatives of three of the railroads had the opinion that operating revenue would not increase, one representative said operating revenue would rise, and the representative of the fifth railroad was uncertain. Thus majority opinion among the representatives of the five major Kansas shortlines in the study was that increased use of HAL cars would increase their operating and maintenance costs and not increase their operating revenue.

5.1.5 Internal Rates of Return to Upgrading

Internal rates of return to upgrading the railroad to handle 286,000-pound rail cars were calculated for the five major Kansas shortlines. The internal rates of return are hypothetical rates of return assuming a railroad with the same characteristics (average length of haul, miles of mainline track to be upgraded, carloads per mile, and total miles of mainline track) as each of the five Kansas shortlines.

The simulated internal rates of return to upgrading increase as traffic density and time horizon increase. However, the most significant result of the internal rate of return analysis is that the hypothetical rate of return to upgrading is negative (or slightly positive in a few cases) for all the Kansas shortlines when their actual average traffic density and other characteristics are assumed. This result occurs for all time horizons examined in the study (8 to 25 years).

5.1.6 Additional Profits Required to Earn an 11% Rate of Return on a Line Upgrade

An alternative analysis to evaluate the decision of a railroad to upgrade the line to handle HAL cars was to compute the additional annual profits the railroad would have to receive in order to obtain an 11% rate of return on the investment. The “actual” annual profits were subtracted from the “11% rate of return” profits to obtain the additional annual profits that have to be earned by each shortline to receive the target rate of return of 11%. For each shortline the term "actual annual profits" refers to the annual profits a hypothetical railroad with a particular shortline's characteristics would receive after upgrading the railroad to handle 286,000-pound cars. These are not the actual annual profits of the five Kansas shortlines since the upgrade investments are hypothetical at this point in time.

The total additional annual profits to earn an 11% return of the five Kansas shortlines are $43.4 million with the eight year time horizon, while the corresponding figure for the 25 year time horizon is only $21.2 million, less than half that of the eight year period.

5.1.7 Impacts of the Upgrading Decision on Kansas Highway Damage Costs

The 2003 study by Babcock et. al titled *Economic Impacts of Railroad Abandonment on Rural Kansas Communities* concluded that if only the rail miles in Kansas of four of the five (excluding the South Kansas and Oklahoma Railroad) major Kansas shortlines were abandoned, the annual road damage costs would increase by $57.8 million. If the five major Kansas shortlines conclude that the rate of return to upgrading does not justify the investment, and subsequently abandon the railroads, Kansas' annual avoided road damage costs will rise by over $58 million.

5.2 Recommendations

The analysis indicates that none of the shortlines can earn an adequate rate of return on upgrading track and bridge investment at their current traffic densities and other characteristics. The cost to upgrade track and bridges of the five major Kansas shortlines was estimated to be $308.7 million, a sum the shortlines are likely to be unable to obtain in the private capital market.

However, Kansas has an economic interest in the preservation of shortline rail service since shortlines annually save the state at least $58 million per year in avoided road damage cost, and also save the state's wheat shippers $20.7 million in wheat transportation and handling costs (Babcock et. al, 2003, p. 86). Federal government goals of cleaner air and energy conservation are fostered by rail service.

Class I railroads have an economic interest in the preservation of shortline railroads. One of the questions on the Class I railroad questionnaire was as follows:

To what extent does the long term viability of Kansas shortline railroads and their ability to handle 286,000-pound rail cars affect your railroad?

One of the respondents indicated that they rely on Kansas shortlines for part of their grain carloadings, with the degree of importance depending on the individual line segment. The representative noted that shortline ability to handle 286,000-pound cars would increase grain carloadings on the respondent's railroad. Another Class I railroad representative said that shortline connections enables the railroad to extend its service to shippers located on shortlines. Thus the Class I's shortline connections are integral parts of both the physical and marketing networks of the Class I railroad.

Given that shortline owners, the state and Federal governments, wheat shippers, and Class I railroads have an economic interest in preserving shortlines, what policies are available to secure this outcome?

Kansas currently has two shortline railroad assistance plans which are the Federal Local Rail Freight Assistance to States (LRFA) and the State Rail Service Improvement Funds (SRSIF). In 1989, the Kansas legislature granted KDOT the authority to loan Federal Railroad Administration (FRA) funds to shortline railroads through the LRFA program, which provides low interest revolving loans below the prime interest rate to shortlines. The SRSIF was established in 1999 to provide Kansas shortlines with low interest, 10 year revolving loans and grants to be used primarily for track rehabilitation. For SRSIF projects the shortline must pay 30% of the cost of the project and the state provides a combination of grants (30%) and loans (40%) for the remaining 70%. The interest rate on the loan portion is currently less than 3%.

In order for Kansas shortline railroads to be able to safely and effectively handle HAL cars and provide better service, the funds in the SRSIF program need to be greatly increased. Also the SRSIF program should be extended beyond the current finding timeline. These actions are necessary to enable the state to assist shortlines in financing the $308.7 million track and bridge upgrading cost to handle HAL cars.

The rate of return analysis indicated that the five major Kansas shortlines could earn an adequate rate of return to upgrading investment if traffic density is 100 to 150 cars per mile and the time horizon is 15 years or more. One of the keys to higher traffic density is an adequate supply of covered hopper cars. Thus it is recommended that Port Authorities consider the purchase of covered hopper cars, new or used, and lease them to shortline railroads for use in Kansas. Given periodic car shortages and railroad congestion, the Class I railroads can not always supply shortline railroads with rail cars in a timely manner. Having an adequate car supply to move Kansas wheat to market is a necessary ingredient for increased shortline traffic and enhanced ability to make the investments required to handle HAL cars.

The Federal government needs to change the Railroad Rehabilitation and Improvements Financing (RRIF) program which has not been used at all in Kansas. The program provides for up to one billion dollars in direct loans and loan guarantees for track and bridge projects benefiting shortline railroads. The program has been underutilized due to the credit risk premium aspect. This is a cash payment made prior to appropriation of funds by the loan applicant or alternatively a non-Federal infrastructure partner on behalf of the loan applicant.

The Federal government needs to change the provisions of RRIF to allow shortlines access to capital needed to upgrade their track and bridges to handle HAL cars. The maximum repayment period should be extended to 30 years and the interest rate reduced to 3%. The credit risk premium should be deleted or made more user friendly.

Bills have been introduced in Congress to provide tax credits for track improvements. This policy should be enacted to reduce the cost of upgrading shortline track to handle 286,000-pound rail cars.

To upgrade the infrastructure of Kansas shortlines to handle HAL cars will require financial commitments and coordination of all the major stakeholders in continued shortline rail service including shortlines, Class I railroads, wheat shippers located on shortlines, the Federal government, and the state of Kansas.

APPENDIX A

SURVEY OF CEOS OF KANSAS SHORTLINE RAILROADS

CEO Name ____________________________ Railroad Name ___________________________

Part A: GENERAL QUESTIONS

1. When (month and year) did your company begin operating the shortline?

2. How many people are employed full time by the shortline?

3. Does your company own or lease the shortline (if leased, what railroad or other party is the line leased from)?

4. List all the railroads that your shortline has connections with. List the junction location for each connection.

PART B: TRAFFIC

In answering the following questions regarding traffic on your shortline, please use the following traffic class definitions.

Originated - Traffic that originates on your railroad and terminates on another railroad.

Terminated - Traffic that originates on another railroad and terminates on your railroad.

Local - Traffic that originates and terminates on your railroad.

Overhead - Traffic handled by your railroad but which originates and terminates on other railroads.

Part B1: Originated Traffic

1. List all the originated traffic commodities for your shortline.

2. For the commodities listed in the previous question, please provide the number of carloads for each commodity for the following calendar years. Attach a separate sheet if there are more than four originated commodities.

Originated Carloads

Year	Commodity Name	Commodity Name	Commodity Name	Commodity Name
2002				
2001				
2000				
1999				
1998				

Part B2: Terminated Traffic

3. List all the terminated traffic commodities for your shortline.

4. For the commodities listed in the previous question, please provide the number of carloads for each commodity for the following calendar years. Attach a separate sheet if there are more than four terminated commodities.

Terminated Carloads

Year	Commodity Name	Commodity Name	Commodity Name	Commodity Name
2002				
2001				
2000				
1999				
1998				

Part B3: Local Traffic

5. List all the local traffic commodities handled by your shortline.

6. For the commodities listed in the previous question, please provide the number of carloads for each commodity for the following calendar years. Attach a separate sheet if there are more than four local commodities.

Year	Commodity Name	Commodity Name	Commodity Name	Commodity Name
	________	________	________	________
2002	________	________	________	________
2001	________	________	________	________
2000	________	________	________	________
1999	________	________	________	________
1998	________	________	________	________

Part B4: Overhead Traffic

7. List all the overhead commodities handled by your shortline.

8. For the commodities listed in the previous question, please provide the number of carloads of <u>each</u> commodity for the following <u>calendar</u> years. <u>Attach a separate sheet if there are more than four overhead commodities</u>.

<u>Overhead Carloads</u>

	Commodity Name	Commodity Name	Commodity Name	Commodity Name
<u>Year</u>	__________	__________	__________	__________
2002	__________	__________	__________	__________
2001	__________	__________	__________	__________
2000	__________	__________	__________	__________
1999	__________	__________	__________	__________
1998	__________	__________	__________	__________

PART C: TRACK, BALLAST, AND CROSSTIE CONDITION

1. The following questions request information about track, ballast, and crosstie conditions on your shortline. The following question addresses the number of miles of your shortline in various categories of <u>rail weight and rail type</u> (jointed or continuous welded rail). For example, in the first row of the following question the form asks for the number of miles on your railroad that have 70-pound rail and are jointed or continuous welded rail. The sum of the total miles row must equal the total route miles of the shortline.

<u>Miles of Shortline by Rail Weight and Rail Type</u>

Rail Weight (Pounds Per Yard)	Rail Type	
	Jointed	Continuous Welded Rail
Less Than 70		
70-89		
90		
91-111		
112		
115		
116-131		
Greater Than 131		
Total Miles		

2. The following question addresses the number of miles of your shortline in various categories of rail weight and percent of good crossties. The sum of the total miles row must equal the total route miles of the shortline.

Miles of Shortline by Rail Weight and Percent of Good Crossties

Rail Weight (Pounds Per Yard)	Percent of Good Ties			
	Greater than 85%	85% to 65%	64% to 45%	Less Than 45%
Less than 70				
70-89				
90				
91-111				
112				
115				
116-131				
Greater Than 131				
Total Miles				

3. The following question addresses miles of your shortline in various categories of rail weight and ballast depth. The sum of the total miles row must equal the total route miles of the shortline.

Miles of Shortline by Rail Weight and Ballast Depth

Rail Weight (Pounds Per Yard)	Ballast Depth (Inches)				
	Less than 6"	6 to 8"	9 to 12"	13 to 17"	More Than 18"
Less than 70					
70-89					
90					
91-111					
112					
115					
116-131					
Greater Than 131					
Total Miles					

PART D: THE 286,000 POUND (HAL) CAR AND THE SHORTLINE

1. Are 286,000-pound (HAL) cars currently used on your shortline?
   (a) Yes _____
   (b) No _____

2. If the answer to the previous question is yes, how many 286,000-pound carloads were hauled in the previous 12 months?

3. If the answer to question 1 is yes, what percent of the total carloads that moved on your railroad in the previous 12 months occurred in 286,000-pound cars?

4. If the answer to question 1 is yes, what commodities were hauled in the 286,000-pound cars that moved on your shortline in the previous 12 months? Please provide the number of carloads of each commodity that moved in 286,000-pound cars.

5. How many mainline route miles on your shortline need to be upgraded (higher weight rail, more ballast, or more crossties) to handle 286,000-pound cars?
   Miles That Need Higher Weight Rail ______________________
   Miles That Need More Ballast ______________________
   Miles That Need More Crossties ______________________

6. How many bridges are there are on your shortline?

7. How many of the bridges on your shortline would have to be upgraded to handle 286,000-pound cars?

8. Describe the maximum and the minimum upgrading of bridges that would need to occur to safely handle 286,000-pound (HAL) cars. For example, the maximum might be completely replacing a 200 foot bridge, where the minimum might be reinforcing a 30 foot wooden bridge.

9. How many yards are there on your shortline?

10. Of the yards mentioned in the previous question, how many miles of yard track would have to be upgraded to handle 286,000-pound cars?

11. How many miles of siding track are there on your railroad?

12. How many of the miles of siding track mentioned in the previous question would have to be upgraded to handle 286,000-pound cars?

13. For how many miles of your shortline is the current average train speed equal to or greater than 25 miles per hour? For how many miles of your shortline is average train speed less than 25 miles per hour?

Miles With Average Train Speed Greater Than or Equal to 25 mph ___________
Miles With Average Train Speed of Less Than 25 mph ___________

14. If 286,000-pound cars replaced 263,000-pound cars, assuming no upgrading of tracks and bridges, what would the average train speed be on your railroad?

PART E: UPGRADING COSTS

1. If the mainline track on your shortline has to be upgraded to handle 286,000-pound cars (i.e., install 115 pound per yard rail), what would be the cost per mile and total cost? The cost per mile should be the full cost including rail, ballast, ties, tie plates, rail anchors, spikes, and labor.

Upgrading Cost Per Mile _______________
Total Mainline Upgrading Cost ________________

2. If bridges on your shortline have to be upgraded to handle 286,000-pound cars, what would be the average upgrading cost per bridge and total upgrading cost?

Average Upgrading Cost Per Bridge _______________
Total Bridge Upgrading Cost ________________

3. If yard track on your shortline has to be upgraded to handle 286,000-pound cars, what would be the total cost to upgrade the yards? The cost should include the costs of all necessary components including rail, ballast, crossties, tie plates, rail anchors, spikes, and labor.

4. If siding track on your shortline has to be upgraded to handle 286,000-pound cars, what would be the total cost to upgrade the siding track? The cost should include the costs of all necessary components including rail, ballast, cross ties, tie plates, rail anchors, spikes, and labor.

5. Will increased use of 286,000-pound cars increase the operating and maintenance expense of your railroad?

(a) Yes _____
(b) No _____
(c) Maybe _____

6. If the answer to the previous question is yes, what would be the percent increase in operating and maintenance expense?

(a) 1% to 5% _____
(b) 6% to 10% _____
(c) 11% to 15% _____
(d) 16% to 20% _____
(e) Greater than 20% _____

7. Will increased use of 286,000-pound rail cars increase operating revenue of your railroad?

(a) Yes _____
(b) No _____
(c) Maybe _____

8. If the answer to the previous question is yes, what would be the percent increase in operating revenue?

(a) 1% to 5% _____
(b) 6% to 10% _____
(c) 11% to 15% _____
(d) 16% to 20% _____
(e) Greater than 20% _____

9. What would be the impact of increased use of 286,000-pound cars on your railroad's profitability?

(a) Increase _____
(b) Decrease _____
(c) No Effect _____

PART F: SUMMARY

1. What is your strategy for dealing with increased use of 286,000-pound cars to haul grain.

2. What role should the Federal government and the state of Kansas play in helping to implement a strategy to address the impact of 286,000-pound cars on the Kansas shortline railroad industry?

APPENDIX B

SURVEY FOR VICE PRESIDENTS—GRAIN, CLASS I RAILROADS

Railroad Name ______________________________

Respondent Name ___________________________

PART A: COVERED HOPPER CAR FLEET

1. Please provide the number of covered hopper cars owned by your railroad as of mid-year for the last five years.

Year	263,000-Pound Cars	286,000-Pound Cars	Other	Total
2003				
2002				
2001				
2000				
1999				

2. How many 286,000-pound covered hopper cars has your railroad purchased in the last five years?

Year	Number of 286,000-Pound Cars Purchased
2002	
2001	
2000	
1999	
1998	

3. Does your railroad lease any 286,000-pound covered hopper cars?

(a) Yes _____

(b) No _____

4. If the answer to the previous question is yes, how many 286,000-pound covered hopper cars did your railroad lease in the last five years?

Year	Number of 286,000-Pound Cars Leased
2002	______________________________
2001	______________________________
2000	______________________________
1999	______________________________
1998	______________________________

5. By the year 2010, how many 286,000-pound cars do you expect to be in service on your railroad?

(a) Number of 286,000-pound cars (2010) _____________
(b) Percent of total covered hopper cars (2010) _______ %

PART B: MOTIVATION FOR THE 286,000-POUND CARS

1. Does the 286,000-pound car have lower operating expense per ton-mile than the 263,000-pound car?

(a) Yes _____
(b) No _____

2. If the answer to the previous question is yes, which of the following costs per ton-mile are lower for the 286,000-pound car? Check all that apply.

(a) Labor _____
(b) Fuel _____
(c) Car Maintenance _____
(d) Locomotive _____
(e) Other (specify) _____

3. Does use of the 286,000-pound car result in higher annual track maintenance costs per mile than the 263,000-pound car?

(a) Yes _____
(b) No _____

4. If the answer to the previous question is yes, how much higher are annual track maintenance expenses per mile for the 286,000-pound car relative to the 263,000-pound car?

(a) Additional Annual Cost Per Mile $ _____________
(b) Percent Increase Relative to 263,000-Pound Car _______ %

5. Does the 286,000-pound car result in higher annual bridge maintenance costs on your railroad relative to the 263,000-pound car?

(a) Yes _____
(b) No _____

6. If the answer to the previous question is yes, how much higher are annual bridge maintenance expenses for the 286,000-pound car relative to the 263,000-pound car?

(a) Additional Annual Costs $ ____________
(b) Percent Increase Relative to 263,000-Pound Car _______ %

7. Does the 286,000-pound car result in higher revenue per carload than the 263,000-pound car?

(a) Yes _____
(b) No _____

8. If the answer to the previous question is yes, what is the additional revenue per carload, assuming grain is the cargo?

(a) Additional Revenue Per Car $ ____________
(b) Percent Increase in Revenue Relative to 263,000-Pound Car _______ %

9. Are 286,000-pound cars on your railroad used to ship only grain and dry fertilizer?

(a) Yes _____
(b) No _____

10. If the answer to the previous question is no, what other commodities are shipped in 286,000-pound cars?

11. Does the 286,000-pound car have any disadvantage relative to the 263,000-pound car for your railroad? If so, please explain.

12. What are the advantages of the 286,000-pound car relative to the 263,000-pound car? Please explain.

PART C: TRACK, BRIDGE, BALLAST, AND CROSSTIE UPGRADING COST

1. What is the optimum weight of rail (pounds per yard) required to handle 286,000-pound cars?

2. How many bridges on your railroad in Kansas had to be upgraded to handle 286,000-pound cars? What was the total upgrading cost for Kansas bridges?

3. How many more inches of track ballast are needed to adequately handle 286,000-pound cars relative to 263,000-pound cars?

4. If a railroad had to upgrade its tracks to 115 pound rail to handle 286,000-pound cars, what is your estimate of the per mile upgrading cost? The cost per mile should be the full cost including rail, ballast, crossties, tie plates, rail anchors, spikes, and labor.

5. At 115-pound rail weight, what is the minimum number of good crossties per mile to handle 286,000-pound rail cars?

PART D: RELATIONSHIPS TO KANSAS SHORTLINE RAILROADS

1. What Kansas shortline railroads does your railroad have connections with? List each shortline and the connection locations of each.

2. What is the per car payment to Kansas shortlines for delivering 263,000-pound cars to your railroad, assuming grain is the cargo?

3. What is the per car payment to Kansas shortlines for delivering 286,000-pound cars to your railroad, assuming grain is the cargo?

4. To what degree does the long term viability of Kansas shortline railroads and their ability to handle 286,000-pound railcars affect your railroad? Please explain.

5. Is there anything your railroad is currently doing, or would consider doing in the future, to assist Kansas shortlines in handling the financial and operating impacts of HAL cars? Please explain.

PART E: SUMMARY

1. In your opinion, to what extent are Kansas shortline railroads, that you do business with, able to handle 286,000-pound cars on their existing systems? Please explain.

2. In your opinion, what government policies would mitigate the financial impact of the 286,000-pound rail car on Kansas shortline railroads? Please explain.