

# **Motor Carrier Industry Profile: Linkages Between Financial and Safety Performance Among Carriers in Major Industry Segments**

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October 23, 2002**

**Prepared for  
Federal Motor Carrier Safety Administration, Analysis Division  
U.S. Department of Transportation  
Washington, D.C.  
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# **Motor Carrier Industry Profile: Linkages Between Financial and Safety Performance Among Carriers in Major Industry Segments**

## **Executive Summary**

The central focus of this report is to investigate the relationship between a carrier's safety performance and its financial performance, controlling for major descriptive features of carriers (i.e., size, revenues, ton-miles, average load, average haul, etc.) The important question is whether financial performance of a firm has an impact on carrier safety performance. Do carriers with financial problems have a safety performance record that differs significantly from that of carriers without these same problems?

In order to address these issues, researchers from the Supply Chain Management Center within the Robert H. Smith School of Business matched the DOT numbers of carriers in the SafeStat database with those in the Annual Report database from the American Trucking Associations. There are approximately 700 carriers with a matched data set covering both complete safety data as well as complete financial data. This study reports on the linkage between safety and financial performance for carriers with both SafeStat and Annual Report data. While the data set represents only a small fraction of the total number of carriers in the universe, it includes, nonetheless, most of the industry's largest carriers.

Among all carriers in the linked database, 656 had CRs in the 18-month period prior to the construction of the database (September 2000). Of these carriers, 553 received a satisfactory review, while 103 received either an unsatisfactory (7) or a conditional (96) rating. According to the results, carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating

revenues, total ton-miles, and average load. However, the observed differences in means between the groups are not statistically significant due to the large standard deviations in these measures for both carrier groups.

Turning to the crucial financial variables, study results find some statistically significant linkages. Indeed, among the carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.04. This difference is statistically significant. On a second financial measure, return on assets, the carriers with recent satisfactory results averaged a five percent return on assets, while the carriers with non-satisfactory results had a negative two percent return on assets. This difference is also statistically significant. These results do provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

The results examining the relationship between the operating ratio for all the carriers in the database (those with and without recent CRs) and their safety performance (measured by individual driver, vehicle, crash, safety management variables) showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance did not materialize among all the carriers combined. The correlation scores were quite low, in general. There is, as a result, little connection between individual safety performance measures (covering driver, vehicle, and crashes) and carrier operating ratio for all carriers combined.

The results examining the relationship between return on assets of all carriers combined and their safety performance on individual variables showed that all the correlation

coefficients had all the expected signs indicating that carriers with higher returns on assets had stronger safety performance. However, with several exceptions, the coefficients were not generally statistically significant. The exceptions involved the relationship between returns on assets and crash rates as well as returns on assets and a carrier's enforcement history record. The correlation coefficient between returns on assets and crash rate indicates that higher crash rates are associated with lower returns on assets. The correlation coefficient between returns on assets and enforcement severity indicates that carriers with more enforcement actions have lower returns on assets.

A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are several statistically significant results. Carriers with better driver safety performance have larger average loads and shorter average lengths of haul than do carriers with worse driver safety performance. Furthermore, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and measures of vehicle and driver safety performance. As a result, carriers using a higher percentage of their operating expenses to pay wages have better driver and vehicle safety performance scores than do carriers with a lower percentage of their operating expenses devoted to driver wages.

## **1. Introduction**

The Supply Chain Management Center of the Robert H. Smith School of Business has been involved in a multi-year assessment of the safety performance of the major segments of the motor carrier industry. A major component of this investigation has included a comprehensive review of data collected in SafeStat by the Volpe National Transportation Systems Center. The SafeStat data provide a multi-dimensional profile of the safety performance of carriers of all sizes in all major industry segments. Carrier safety performance in the following areas is included in the database: roadside inspections, carrier reviews (CRs), enforcement actions, crashes, driver moving violations, and hazardous materials incidents. All of a carrier's actions in these areas are recorded in the carrier's SafeStat data. Summary measures dealing with carrier performance include the following areas: Driver Safety Evaluation Area (DRSEA), Vehicle Safety Evaluation Area (VSEA), Safety Management Safety Evaluation Area (SMSEA), and Accident Safety Evaluation Area (ACSEA). Detailed measures to support each of these major areas are recorded in the database as well.

The central focus of this report is to investigate the relationship between a carrier's safety performance and its financial performance, controlling for major descriptive features of carriers (i.e., size, revenues, ton-miles, average load, average haul, etc.) The central question is whether financial performance of a firm has an impact on carrier safety performance. Do carriers with financial problems have a safety performance record that differs significantly from that of carriers without these same problems? Since major regulatory reforms in the industry in 1980, this has been an important question. While the subject has been of interest to investigators, systematic research into the issue has been

hampered by the lack of available data. This current investigation is made possible as a result of the SafeStat data matched to financial performance data for some of the larger carriers in the industry. Researchers matched the DOT numbers of carriers in the SafeStat database with those in the Annual Report database from the American Trucking Associations. There are approximately 700 carriers with a matched data set covering both complete safety data as well as complete financial data. This study reports on the linkage between safety and financial performance for carriers with both SafeStat and Annual Report data. While the data set represents only a small fraction of the total number of carriers in the universe, it includes, nonetheless, most of the industry's largest carriers.

Results of the analysis will be helpful for safety auditors of the Federal Motor Carrier Safety Administration whose efforts are directed at reducing crashes and improving highway safety. To the extent that safety performance is linked to financial performance, auditors can use dips in financial performance as a cause for concern and need for greater diligence in safety auditing. The results of this investigation should be helpful in providing the needed insights to guide policy actions.

The remainder of this report will present study results of the linkage between safety and financial performance while controlling for a number of descriptive variables. The initial section will focus on all carriers included in the database. Subsequent sections will concentrate on the larger industry segments. The discussion will compare on both descriptive and financial variables carriers recently assessed as satisfactory during the CR process with those rated as non-satisfactory. Subsequently, the emphasis will be on a series of safety performance measures and their correlation with financial performance and descriptive characteristics.



## **2. Methodology**

Each section is divided into two parts. Initially, the focus is a comparison between carriers with an overall satisfactory carrier review (CR) and carriers receiving an unsatisfactory or conditional review. These two groups of carriers are compared on both a series of descriptive variables as well as on a series of financial performance variables. Researchers employed standard ANOVA (analysis of variance) to determine the statistical significance of observed differences in means between the two groups of carriers. The following discussion compares means between carriers with satisfactory CRs and those with non-satisfactory results and reports the statistical significance of the observed differences.

The second part presents the correlation analysis between both financial and descriptive variables and a series of detailed safety performance variables to determine relationships between the variable sets. Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio (operating expenses/operating revenues). The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). During the CR, investigators examine specific carrier performance attributes. These include: the carrier's recordable crash/accident rate, its driver safety review measure (DRM), its safety management review measure (SMRM), and its enforcement severity measure (ESM). The DRM and the SMRM are based on acute and critical violations found during a CR in the respective areas of driver regulations and safety management regulations. Higher values for both the DRM and the SMRM indicate a greater instance of violations and hence poorer safety performance. The ESM is based on closed

enforcement cases stemming from a CR. Again, higher values of the measure are associated with poorer safety performance.

### **3. All Carriers, All Segments**

The initial section provides an analysis of all carriers in the database, regardless of the industry segment represented. Since all carriers must have detailed financial data for inclusion, the carriers examined in this analysis are large, for-hire carriers.

#### **3.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers**

- **Descriptive Variables.** Among all carriers in the linked database, 656 had CRs in the 18-month period prior to the construction of the database (September 2000). Of these carriers, 553 received a satisfactory review, while 103 received either an unsatisfactory (7) or a conditional (96) rating. Table 1 presents results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to the results, carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between the groups are not statistically significant due to the large standard deviations in these measures for both carrier groups.

Carriers with satisfactory CRs have on average 255 power units in their fleets compared with an average fleet size of 106 for carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews average \$44.6 million in annual revenues compared to only \$17.0 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 301.4 million ton-miles with average loads of 16.98 tons. Among the carriers with non-satisfactory reviews, these numbers are 188.9

million ton-miles and 7.89 tons. However, carriers with non-satisfactory reviews do have average lengths of haul that exceed the average for carriers with satisfactory reviews (763 versus 570 miles, respectively).

Interestingly, the carriers with satisfactory reviews have an average driver wage of \$34,870. This compares with an average wage of \$31,506 for carriers with non-satisfactory reviews, although the difference is not statistically significant. However, carriers with satisfactory reviews devote 16 percent of their operating expenses to wages. The comparable percentages are 16 percent for the carriers without positive reviews.

- Financial Variables. Turning to the crucial financial variables, study results find some statistically significant linkages. Indeed, among the carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.04. This difference is statistically significant at the 0.04 level of significance (F score = 2.89). On a second financial measure, return on assets, the carriers with recent satisfactory results, averaged a five percent return on assets, while the carriers with non-satisfactory results had a negative two percent return on assets. This difference is also statistically significant at the 0.08 level of significance (F score = 2.30). These results do provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

### 3.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 2 presents the results of the correlation analysis for all carriers combined. The key financial variables to correlate with safety performance are operating ratio and return on

assets. The key descriptive measures are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio for all the carriers combined and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance did not materialize among all the carriers combined. The correlation scores were quite low, in general, and only modestly positive for the ACSEA (0.032). There is, as a result, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for all carriers combined.

The results in Table 2, suggest no statistically significant connections between DRM, SMRM, and ESM and the operating ratio. In fact, the correlation values are extremely low for DRM and SMRM and only a little larger (0.035) and positive for ESM. The correlation coefficient for the recordable crash rate is also very low and statistically insignificant. There appears to be little support for the hypothesis that among all carriers combined safety performance is correlated with financial performance in a positive manner.

- Return on Assets. The results examining the relationship between return on assets of all carriers combined and their safety performance showed only two statistically significant results at the 0.10 level or greater. While the correlation coefficients had all the expected signs indicating that all carriers combined with higher returns on assets had stronger safety performance, the coefficients were not generally statistically significant.

The summary safety performance measures dealing with vehicle, driver, and crashes were all negatively correlated with returns on assets. This suggests that higher values of the

safety evaluation scores and poorer performance were associated with lower returns on assets. The correlation coefficient between the ACSEA and returns on assets equaled  $-.064$  and reached a significance level of  $.097$ . Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with returns on assets are all negative, but none was statistically significant at the  $.10$  level.

- Carrier Size. It is hypothesized that the size of all carriers combined is positively correlated with safety performance. However, only one of the correlation coefficients linking size variables with safety performance is statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle and driver, these measures are negatively correlated with total operating revenues with the DRSEA having a statistically significant (at the  $.003$  level) coefficient. This suggests, of course, that higher firm revenues, among all carriers combined, are associated with lower driver and vehicle safety evaluation scores and better safety performance. The linkage between VHSEA and total ton-miles is likewise negative, but not statistically significant. The accident summary measure is positively correlated with revenues and ton-miles, suggesting that higher accident safety evaluation scores are associated with higher revenues and ton-miles. Again, however, the results are not statistically significant.

On the detailed measures from the CR, the expectation is that the measures would have negative correlation with the size variables to suggest that lower values of the CR measures and better safety performance is associated with larger size. Indeed, the driver review measures and the safety management review measure are both negatively correlated

with revenues and ton-miles, respectively, although the coefficients are not statistically significant.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. As shown in the correlation results, there are several statistically significant correlation coefficients at the .05 level or better. In particular, there is a significant negative correlation between DRSEA and average load (0.08), which suggests that lower DRSEA scores are associated with larger average loads. Furthermore, the relationship between DRSEA score and average haul is both statistically significant (at the .001 level) and positive. Carriers with higher DRSEA scores and worse driver performance have longer haul lengths. Furthermore, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and VHSEA and DRSEA among all carriers combined. Thus, those carriers using more of their operating expenses to pay wages can expect lower VHSEA and DRSEA scores.

#### **4. General Freight—Truckload**

The initial component of this section compares general freight TL carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

##### 4.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the general freight truckload carriers, 298 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 64 had non-satisfactory reviews. Of the 64 with non-satisfactory reviews, 60

were conditional reviews and 4 were unsatisfactory. Table 3 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, general freight TL carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between the groups are not statistically significant due to the large standard deviations in these measures among both carrier groups.

General freight TL carriers with satisfactory CRs have on average 241 power units compared with an average fleet size of 121 for general freight TL carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$37.2 million in annual revenues compared to only \$19.5 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 319.7 million ton-miles with an average load of 14.2 tons. Among the carriers with non-satisfactory reviews, these averages are 71.6 million and 9.1 tons, respectively. However, carriers with non-satisfactory reviews do have average lengths of haul that exceed the average for carriers with satisfactory reviews (946.5 versus 728.3 miles, respectively).

Driver wages between the two general freight TL carrier groups are not significantly different. The general freight TL carriers with satisfactory reviews have average driver wages equal to \$30,982, while the comparable figure among carriers without satisfactory reviews is \$30,772. In addition, carriers with positive CRs devote 31 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 29 percent.

- Financial Variables. Focusing on the important financial variables, study results find some statistically significant linkages. Indeed, among the general freight TL carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.07. This difference is statistically significant at the .07 level (F score = 2.39). On a second financial measure, return on assets, the general freight TL carriers with a recent satisfactory result, averaged a 6 percent return on assets, while the carriers with a non-satisfactory result had a negative 6 percent return on assets. This difference, however, is not statistically significant. These results do provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

#### 4.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 4 presents the results of the correlation analysis for the general freight TL carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the general freight TL carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the general freight TL carriers.



Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). The correlation scores are quite low and only positive for the ACSEA (0.05). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the general freight TL carriers.

As results in Table 4 denote, all three measures, DRM, SMRM, and ESM are positively correlated with operating ratio. This suggests that higher values of these measures and poorer safety performance are, indeed, correlated with higher operating ratios and poorer financial performance. Yet, the correlation coefficients are low with the highest being 0.064 between DRM and operating ratios and none are statistically significant. The recordable crash rates for TL carriers, based on data gathered during a CR, are positively correlated (.152) with operating ratio. This coefficient is not statistically significant at the 10 percent significance level.

- Return on Assets. The results examining the relationship between return on assets of the general freight TL carriers and their safety performance showed only one statistically significant result at the .10 level or greater. While the correlation coefficients had all the expected signs indicating that general freight TL carriers with higher returns on assets had stronger safety performance, the coefficients were not generally statistically significant. The summary safety performance measures dealing with vehicle, driver, and accidents were all negatively correlated with return on assets. This suggests that higher values of the safety

evaluation scores and poorer performance were associated with lower returns on assets. The correlation coefficient between the ACSEA and return on assets equaled  $-.09$  and reached a significance level of  $0.08$ .

Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but not statistically significant. The coefficient between the general freight TL carrier's recordable crash rate and return on assets is  $-.123$ , significant at the  $.20$  level and well below the level of statistical significance.

- Carrier Size. It is hypothesized that the size of general freight TL carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle and driver, these measures are negatively correlated with revenue and ton-miles. This suggests that increases in total firm revenues and ton-miles are associated with lower vehicle and driver safety evaluation scores and better safety performance. The results are not, however, statistically significant. In contrast, the accident summary measure is positively correlated with revenues and ton-miles denoting that higher accident safety evaluation scores are associated with higher revenues and ton-miles. Again, however, the results are not statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the safety management review measure and the enforcement safety measure are both negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater

safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the general freight TL carriers, especially with respect to driver issues. As shown in the correlation results, there are several statistically significant correlation coefficients at the .10 level or better. In particular, there is a statistically significant correlation coefficient of .156 between average haul and DRSEA. This suggests that as average length of haul increases so to does the DRSEA score.

Furthermore, among the general freight TL carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the VHSEA and the DRSEA. Thus, for these variables, it is likely that companies using more of their operating expenses to pay wages can expect lower driver, vehicle and accident safety evaluation scores. In the case of the DRSEA and the VHSEA correlation coefficients, they are statistically significant at the .001 level. A final result of interest is the negative correlation coefficient (significant at the .107 level) between the driver review measure and the percent of operating expenses spent on driver wages. Carriers devoting a higher percentage of their operating expenses to driver wages can expect to have lower driver review scores during a CR.

## 5. Tank Truck Carriers

The initial component of this section compares tank truck carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

### 5.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the tank truck carriers, 162 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 21 had non-satisfactory reviews. Of the 21 with non-satisfactory reviews, all were conditional reviews and 0 were unsatisfactory. Table 5 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, tank truck carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between the groups are not statistically significant due to the large standard deviations in these measures among both carrier groups.

Tank truck carriers with satisfactory CRs have on average 399 power units compared with an average fleet size of 218 for tank truck carriers with conditional CRs. The carriers with satisfactory reviews averaged \$74.2 million in annual revenues compared to only \$15.8 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 479.9 million ton-miles with an average load of 27.3 tons. Among the carriers with non-satisfactory reviews, these averages are 88.6 million and 11.3 tons,

respectively. Carriers with satisfactory reviews have average lengths of haul that exceed the average for carriers with un-satisfactory reviews (538.3 versus 228.4 miles, respectively).

Driver wages between the two tank truck carrier groups are not significantly different. The tank truck carriers with satisfactory reviews have average driver wages equal to \$34,144 while the comparable figure among carriers without satisfactory reviews is \$32,820. In addition, carriers with positive CRs devote 36 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 34 percent.

- Financial Variables. Focusing on the important financial variables, study results find some statistically significant linkages. Indeed, among the tank truck carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.25. This difference is statistically significant at the 0.01 level (F score = 4.40).

On a second financial measure, return on assets, the tank truck carriers with a recent satisfactory result averaged a 5 percent return on assets, while the carriers with a non-satisfactory result had a negative 18 percent return on assets. This difference, however, is not statistically significant. These results do provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

## 5.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 6 presents the results of the correlation analysis for the tank truck carriers. The key financial variables to correlate with safety performance are operating ratio and return on

assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the tank truck carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the tank truck carriers.

Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). The correlation scores are quite low and only positive for the ACSEA (0.08). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the tank truck carriers.

As results in Table 6 denote, all three measures, DRM, SMRM, and ESM are positively correlated with operating ratio. This suggests that higher values of these measures and poorer safety performance are, indeed, correlated with higher operating ratios and poorer financial performance. Yet, the correlation coefficients are low with the highest being 0.073 between SMRM and operating ratios and none are statistically significant. The recordable crash rates for tank truck carriers, based on data gathered during a CR, are negatively correlated (-0.176) with operating ratio. This coefficient is not statistically significant.

- Return on Assets. The results examining the relationship between return on assets of the tank truck carriers and their safety performance showed only one statistically significant result at the .10 level or greater. While all but one of the correlation coefficients had the expected signs indicating that tank truck carriers with higher returns on assets had stronger safety performance, the coefficients were not generally statistically significant. The summary safety performance measures dealing with vehicle, driver, and accidents were all negatively correlated with return on assets. This suggests that higher values of the safety evaluation scores and poorer performance were associated with lower returns on assets.

Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but not statistically significant. The coefficient between the tank truck carrier's recordable crash rate and return on assets is 0.27, significant at the 0.073 level indicating some statistical significance. However, this direction of correlation is counter to the hypothesized direction. It indicates that higher returns on assets are associated with higher rates of recordable crashes.

Carrier Size. It is hypothesized that the size of tank truck carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance.

Examining the overall safety performance measures in SafeStat for vehicle, driver and accident, these measures are negatively correlated with revenue and ton-miles (except for vehicle with revenue and ton-miles). This suggests that increases in total firm revenues and ton-miles are associated with lower driver and accident safety evaluation scores and better safety performance. The results are not, however, statistically significant. On the

detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the safety management review measure and the enforcement severity measure are both negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. As shown in the correlation results, there are two statistically significant correlation coefficients at the .10 level or better. In particular, there is a statistically significant correlation coefficient of  $-0.134$  between average load and DRSEA. This suggests that as the average load increases, the DRSEA score decreases. Furthermore, among the tank truck carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA. Thus, for these variables, it is likely that companies using more of their operating expenses to pay wages can expect lower driver and vehicle safety evaluation scores. In the case of the DRSEA correlation coefficient, it is statistically significant at the .001 level.

## **6. Building Materials**

The initial component of this section compares building material carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.



## 6.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the building materials carriers, 115 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 28 had non-satisfactory reviews. Of the 28 with non-satisfactory reviews, 27 were conditional reviews and 1 was unsatisfactory. Table 7 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, building materials carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between the groups are not statistically significant due to the large standard deviations in these measures among both carrier groups.

Building materials carriers with satisfactory CRs have on average 418 power units compared with an average fleet size of 93 for building materials carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$80.1 million in annual revenues compared to only \$11.9 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 515.7 million ton-miles with an average load of 15.7 tons. Among the carriers with non-satisfactory reviews, these averages are 59.3 million and 10.9 tons, respectively. However, carriers with non-satisfactory reviews do have average lengths of haul that exceed the average for carriers with satisfactory reviews (1,026.7 versus 709.4 miles, respectively).

Driver wages between the two building materials carrier groups are significantly different. The building materials carriers with satisfactory reviews have average driver wages equal to \$32,891, while the comparable figure among carriers without satisfactory

reviews is \$32,985. However, carriers with positive CRs devote 32 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 33 percent.

- Financial Variables. Focusing on the important financial variables, study results find no statistically significant linkages. Indeed, among the building materials carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.98, while the comparable figure among the carriers with a non-satisfactory rating is 0.99. This difference is not statistically significant. On a second financial measure, return on assets, the building materials carriers with a recent satisfactory result, averaged a 5 percent return on assets, while the carriers with a non-satisfactory result had a 3 percent return on assets. This difference is also not statistically significant. These results do not provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

## 6.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 8 presents the results of the correlation analysis for the building materials carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the building materials carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results

(higher operating ratios) would have poorer safety performance results did not materialize among the building materials carriers. Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). The correlation scores are low and only positive for the VHSEA (0.05). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the building materials carriers.

As results in Table 8 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small, and only SMRM is positive (0.036). This suggests that higher values of this measure and poorer safety performance are correlated with higher operating ratios and poorer financial performance. However, the correlation coefficients are low and none are statistically significant. The recordable crash rates for building materials carriers, based on data gathered during a CR, are not correlated (0.0) with operating ratio.

Return on Assets The results examining the relationship between return on assets of the building materials carriers and their safety performance showed only one statistically significant result at the 0.05 level or greater. While the correlation coefficients had the expected signs indicating that building materials carriers with higher returns on assets had stronger safety performance, the coefficients were not generally statistically significant.

The summary safety performance measures dealing with vehicle and accidents were negatively correlated with return on assets. This suggests that higher values of the safety

evaluation scores and poorer performance were associated with lower returns on assets. The correlation coefficients are all relatively low and statistically insignificant. Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but not statistically significant. The coefficient between the building materials carrier's recordable crash rate and return on assets is -0.334, significant at the 0.05 level. This coefficient indicates that lower crash rates are associated with higher returns on assets.

- Carrier Size. It is hypothesized that the size of building materials carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle, driver and accident, these measures are negatively correlated with revenue and ton-miles. This suggests that increases in total firm revenues and ton-miles are associated with lower vehicle, driver, and accident safety evaluation scores and better safety performance. The results are not, however, statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the safety management review measure and the enforcement safety measure are both negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the building materials carriers, especially with respect to driver issues. As shown in the correlation results, there are few results that are statistically significant. The positive correlation between average length of haul and vehicle, driver, and safety evaluation scores, suggests that as average length of haul increases so too do the safety evaluation scores, reflecting poorer safety performance.

Furthermore, among the building materials carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA. Thus, for this variable, it is likely that companies using more of their operating expenses to pay wages can expect lower driver and vehicle safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.301), they are statistically significant at the .001 level. A final result of interest is the positive correlation coefficient (significant at the 0.054 level) between the enforcement severity measure and the percent of operating expenses spent on driver wages. Carriers devoting a higher percentage of their operating expenses to driver wages can expect to have higher enforcement severity measure scores during a CR—an indication of poorer safety performance .

## **7. Refrigerated Carriers**

The initial component of this section compares refrigerated carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

## 7.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the refrigerated carriers, 98 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 32 had non-satisfactory reviews. Of the 32 with non-satisfactory reviews, 30 were conditional reviews and 2 were unsatisfactory. Table 9 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, refrigerated carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between the groups are not statistically significant due to the large standard deviations in these measures among both carrier groups.

Refrigerated carriers with satisfactory CRs have on average 281 power units compared with an average fleet size of 161 for refrigerated carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$46.3 million in annual revenues compared to only \$13.0 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 330.6 million ton-miles with an average load of 16.9 tons. Among the carriers with non-satisfactory reviews, these averages are 89.9 million and 8.6 tons, respectively. However, carriers with non-satisfactory reviews do have average lengths of haul that exceed the average for carriers with satisfactory reviews (826.9 versus 801.3 miles, respectively).

Driver wages between the two refrigerated carrier groups are significantly different. The refrigerated carriers with satisfactory reviews have average driver wages equal to \$30,866, while the comparable figure among carriers without satisfactory reviews is \$31,964.

However, carriers with positive CRs devote 30 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 27 percent.

- Financial Variables. Focusing on the important financial variables, study results did not find statistically significant linkages for refrigerated carriers. Indeed, among the refrigerated carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.17. This difference is not statistically significant. On a second financial measure, return on assets, the refrigerated carriers with a recent satisfactory result averaged a 7 percent return on assets, while the carriers with a non-satisfactory result had a negative 15 percent return on assets. This difference is also not statistically significant.

## 7.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 10 presents the results of the correlation analysis for the refrigerated carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the refrigerated carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the refrigerated carriers. Initially, the summary safety performance measures for SafeStat in the

areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). However, the correlation scores are low and only positive for the ACSEA (0.105). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the refrigerated carriers.

As results in Table 10 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small, yet positive, suggesting that higher values of this measure and poorer safety performance are correlated with higher operating ratios and poorer financial performance. However, the correlation coefficients are relatively low and none are statistically significant. The recordable crash rates for refrigerated carriers, based on data gathered during a CR, are positively correlated; however, this coefficient is also not statistically significant.

- Return on Assets. The results examining the relationship between return on assets of the refrigerated carriers and their safety performance showed no statistically significant results at the 0.05 level or greater. While the correlation coefficients had the expected signs indicating that refrigerated carriers with higher returns on assets had stronger safety performance, the coefficients were not generally statistically significant. The summary safety performance measures dealing with vehicle, and accidents were negatively correlated with return on assets. This suggests that higher values of the safety evaluation scores and poorer performance were associated with lower returns on assets. The correlation coefficients are all relatively low and statistically insignificant. Concerning the detailed CR



measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but not statistically significant.

- Carrier Size. It is hypothesized that the size of refrigerated carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle, driver and accident, these measures are negatively correlated with revenue and ton-miles (except for ACSEA and total ton-miles). This suggests that increases in total firm revenues and ton-miles are associated with lower vehicle, driver, and accident safety evaluation scores and better safety performance. The results are not, however, statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the review measures are either close to zero or negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the refrigerated carriers, especially with respect to driver issues. As shown in the correlation results, there are a few results that are statistically significant. There is a significant negative correlation (-0.256 with 0.02

significance level) between average length of haul and vehicle safety evaluation scores, suggesting that as average length of haul increases, scores decrease reflecting improved safety performance.

Furthermore, among the refrigerated carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the VHSEA and DRSEA. Thus for these variables, it is likely that companies using more of their operating expenses to pay wages can expect lower driver and vehicle safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.223), it is statistically significant at the .009 level.

## **8. Bulk Carriers**

The initial component of this section compares bulk carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

### **8.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers**

- **Descriptive Variables.** Among the bulk carriers, 110 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 20 had non-satisfactory reviews. Of the 20 with non-satisfactory reviews, 20 were conditional reviews and 0 were unsatisfactory. Table 11 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, bulk carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between operating ratios in satisfactory and unsatisfactory carriers is the only

statistically significant means comparison. The means comparisons between descriptive variables are statistically insignificant due to the large standard deviations in these measures.

Bulk carriers with satisfactory CRs have on average 241 power units compared with an average fleet size of 217 for bulk carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$37.5 million in annual revenues compared to only \$14.1 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 258.9 million ton-miles with an average load of 15.4 tons. Among the carriers with non-satisfactory reviews, these averages are 87.8 million and 8.1 tons, respectively. Carriers with satisfactory reviews also have average lengths of haul that exceed the average for carriers with non-satisfactory reviews (471.8 versus 284.4 miles, respectively).

Driver wages between the two bulk carrier groups are significantly different. The bulk carriers with satisfactory reviews have average driver wages equal to \$32,636, while the comparable figure among carriers without satisfactory reviews is \$30,706. However, carriers with positive CRs devote 33 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 35 percent.

- Financial Variables. Focusing on the important financial variables, study results find some statistically significant linkages. Indeed, among the bulk carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.96, while the comparable figure among the carriers with a non-satisfactory rating is 1.27. This difference is statistically significant to the 0.03 level. On a second financial measure, return on assets, the bulk carriers receiving a recent satisfactory score averaged a 6 percent return on assets, while the carriers with a non-satisfactory result had a negative 21 percent return on assets.

This difference is not statistically significant. These results do provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

## 8.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 12 presents the results of the correlation analysis for the bulk carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the bulk carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the bulk carriers. Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). However, the correlation scores are low and only positive for the ACSEA (0.108). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the bulk carriers.

As results in Table 12 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small, and positive for only SMRM, suggesting that higher values of this measure and poorer safety performance are slightly correlated with higher operating ratios and poorer financial performance. However, the correlation coefficients are relatively low and none are statistically significant. The recordable crash rates for bulk carriers, based on data gathered during a CR, are positively correlated; however, this coefficient is also small and not statistically significant.

- Return on Assets. The results examining the relationship between return on assets of the bulk carriers and their safety performance showed no statistically significant results. While the correlation coefficients had the expected signs indicating that bulk carriers with higher returns on assets had stronger safety performance, the coefficients were small and not statistically significant.

The summary safety performance measures dealing with vehicle, and accidents were negatively correlated with return on assets. This suggests that higher values of the safety evaluation scores and poorer performance were associated with lower returns on assets. The correlation coefficients are all relatively low and statistically insignificant. Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but not statistically significant.

- Carrier Size. It is hypothesized that the size of bulk carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle, driver and accident, these measures are

negatively correlated with revenue and ton-miles (except for small positive correlations between DRSEA/ACSEA and total ton-miles). This suggests that increases in total firm revenues and ton-miles are associated with lower vehicle, driver, and accident safety evaluation scores and better safety performance. The results are not, however, statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the review measures are either close to zero or negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the bulk carriers, especially with respect to driver issues. As shown in the correlation results, there are a few results that are statistically significant. There is a significant positive correlation (0.245 with 0.031 significance level) between average length of haul and driver safety evaluation scores, suggesting that as average length of haul increases, scores increase reflecting poorer safety performance.

Furthermore, among the bulk carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA. Thus for these variables, it is likely that companies using more of their operating expenses to pay

wages can expect lower driver safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.238), it is statistically significant at the 0.006 level.

## **9. Combined Farm Products**

The initial component of this section compares combined farm products carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

### 9.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the combined farm products carriers, 164 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 48 had non-satisfactory reviews. Of the 48 with non-satisfactory reviews, 45 were conditional reviews and 3 were unsatisfactory. Table 13 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, combined farm products carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between gross revenue in satisfactory and unsatisfactory carriers is the only statistically significant comparison. The means comparisons between other descriptive variables are statistically insignificant due to the large standard deviations in these measures.

Combined farm product carriers with satisfactory CRs have on average 202 power units compared with an average fleet size of 134 for combined farm products carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$31.9 million in annual revenues compared to only \$11.8 million among the carriers with

non-satisfactory reviews. The carriers with satisfactory reviews average 219.9 million ton-miles with an average load of 14.9 tons. Among the carriers with non-satisfactory reviews, these averages are 90.8 million and 10.7 tons, respectively. However, carriers with non-satisfactory reviews have average lengths of haul that exceed the average for carriers with satisfactory reviews (814 versus 732 miles, respectively).

Driver wages between the two combined farm products carrier groups are significantly different. The combined farm products carriers with satisfactory reviews have average driver wages equal to \$32,510, while the comparable figure among carriers without satisfactory reviews is \$29,850. However, carriers with positive CRs devote 30 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 27 percent.

- Financial Variables. Focusing on the important financial variables, the study results find some distinctive yet statistically insignificant linkages. Indeed, among the combined farm products carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.11. This difference is statistically insignificant. On a second financial measure, return on assets, the combined farm products carriers receiving a recent satisfactory score averaged a 5 percent return on assets, while the carriers with a non-satisfactory result had a negative 8 percent return on assets. This difference is also not statistically significant.



## 9.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 14 presents the results of the correlation analysis for the combined farm products carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the combined farm products carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the combined farm products carriers. Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). However, the correlation scores are low and only positive for the ACSEA (0.09). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the combined farm products carriers.

As results in Table 14 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small, and negative for only ESM, suggesting that higher values of this measure and poorer safety performance are slightly correlated with higher operating ratios and poorer financial performance. However, the

correlation coefficients are relatively low and none are statistically significant. The recordable crash rates for combined farm products carriers, based on data gathered during a CR, are positively correlated; however, this coefficient is also small and not statistically significant.

- Return on Assets. The results examining the relationship between return on assets of the combined farm products carriers and their safety performance showed few statistically significant results. While the correlation coefficients had the expected signs indicating that combined farm products carriers with higher returns on assets had stronger safety performance, the coefficients were small and not statistically significant. Only the ACSEA was negatively correlated with ROA (-0.13) at the 0.056 significance level.

The summary safety performance measures dealing with vehicle, driver and accidents were negatively correlated with return on assets. This suggests that higher values of the safety evaluation scores and poorer performance were associated with lower returns on assets. Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but small and not statistically significant.

- Carrier Size. It is hypothesized that the size of combined farm products carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle, driver and accident, these measures are negatively correlated with revenue and ton-miles (except for small positive correlations between ACSEA and total ton-miles). This suggests that

increases in total firm revenues and ton-miles are associated with lower vehicle, driver, and accident safety evaluation scores and better safety performance. The results are not, however, statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the review measures are either close to zero or negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the combined farm products carriers, especially with respect to driver issues. As shown in the correlation results, there are few results that are statistically significant. However, there is a significant negative correlation (-0.133 at 0.057 significance level) between average load (tons) and driver safety evaluation scores, suggesting that as average loads increase, scores decrease and safety performance improves. Furthermore, among the combined farm products carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA. Thus for these variables, it is likely that companies using more of their operating expenses to pay wages can expect lower driver safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.186), it is statistically significant at the 0.006 level.

## 10. Produce

The initial component of this section compares produce carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

### 10.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the produce carriers, 90 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 33 had non-satisfactory reviews. Of the 33 with non-satisfactory reviews, 30 were conditional reviews and 3 were unsatisfactory. Table 15 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, produce carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between groups are statistically insignificant due to the large standard deviations in these measures.

Produce carriers with satisfactory CRs have on average 262 power units compared with an average fleet size of 163 for produce carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$44.8 million in annual revenues compared to only \$13.4 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 261.9 million ton-miles with an average load of 16.7 tons. Among the carriers with non-satisfactory reviews, these averages are 90.7 million and 9.2 tons, respectively. However, carriers with non-satisfactory reviews have average

lengths of haul that exceed the average for carriers with satisfactory reviews (968.3 versus 785.1 miles, respectively).

Driver wages between the two produce carrier groups are significantly different. The produce carriers with satisfactory reviews have average driver wages equal to \$30,711, while the comparable figure among carriers without satisfactory reviews is \$30,702. However, carriers with positive CRs devote 29 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 25 percent.

- Financial Variables. Focusing on the important financial variables, the study results find some distinctive yet statistically insignificant linkages. Indeed, among the produce carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 1.15. This difference is statistically insignificant. On a second financial measure, return on assets, the produce carriers receiving a recent satisfactory score averaged a 7 percent return on assets, while the carriers with a non-satisfactory result had a negative 14 percent return on assets. This difference is also not statistically significant. These results do indicate a linkage between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets), but the results were not statistically valid.

## 10.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 16 presents the results of the correlation analysis for the produce carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues,

total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the produce carriers and their safety performance showed no statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the produce carriers. Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). However, the correlation scores are low and only positive for the ACSEA (0.105). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the produce carriers.

As results in Table 16 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small and positive, suggesting that higher values of this measure and poorer safety performance are correlated with higher operating ratios and poorer financial performance. However, the correlation coefficients are relatively small and none are statistically significant. The recordable crash rates for produce carriers, based on data gathered during a CR, are positively correlated (0.24); however, this coefficient is also small and not statistically significant.

- Return on Assets. The results examining the relationship between return on assets of the produce carriers and their safety performance showed few statistically significant results.

While the correlation coefficients had the expected signs indicating that produce carriers with higher returns on assets had stronger safety performance, the coefficients were small and not statistically significant. Only the ACSEA was negatively correlated with ROA (-0.15) at the 0.094 significance level.

The summary safety performance measures dealing with vehicle, driver and accidents were negatively correlated with return on assets. This suggests that higher values of the safety evaluation scores and poorer performance were associated with lower returns on assets. Concerning the detailed CR measures, the correlation coefficients linking DRM, SMRM, and ESM with return on assets are all negative, but small and not statistically significant.

- Carrier Size. It is hypothesized that the size of produce carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for vehicle, driver and accident, these measures are negatively correlated with revenue and ton-miles (except for small positive correlations between ACSEA and total ton-miles). This suggests that increases in total firm revenues and ton-miles are associated with lower vehicle, driver, and accident safety evaluation scores and better safety performance. The results are not, however, statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the review

measures are either close to zero or negatively correlated with revenues and ton-miles, respectively. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the produce carriers, especially with respect to driver issues. As shown in the correlation results, there are few results that are statistically significant. However, among the produce carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA and VHSEA. Thus for these variables, it is likely that companies using more of their operating expenses to pay wages can expect lower driver and vehicle safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.203), it is statistically significant at the 0.022 level. Similarly, there is a negative correlation (-0.267) at 0.002 significance level for the VHSEA.

## **11. Large Machinery**

The initial component of this section compares large machinery carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

### **11.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers**

- Descriptive Variables. Among the large machinery carriers, 79 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 16 had non-satisfactory reviews. Of the 16 with non-satisfactory reviews, 14 were conditional



reviews and 2 were unsatisfactory. Table 17 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, large machinery carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between groups are statistically insignificant due to the large standard deviations in these measures.

Large machinery carriers with satisfactory CRs have on average 368 power units compared with an average fleet size of 105 for large machinery carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$65.3 million in annual revenues compared to only \$13.9 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 433.3 million ton-miles with an average load of 17.6 tons. Among the carriers with non-satisfactory reviews, these averages are 50.9 million and 10.4 tons, respectively. Carriers with satisfactory reviews have average lengths of haul that exceed the average for carriers with non-satisfactory reviews (730.2 versus 489.7 miles, respectively).

Driver wages between the two large machinery carrier groups are significantly different. The large machinery carriers with satisfactory reviews have average driver wages equal to \$32,816, while the comparable figure among carriers without satisfactory reviews is \$29,934. However, carriers with positive CRs devote 33 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 35 percent.

- Financial Variables. Focusing on the important financial variables, the study results find some distinctive yet statistically insignificant linkages. Indeed, among the large machinery carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.97, while the comparable figure among the carriers with a non-satisfactory rating is 0.99. This difference is statistically insignificant. On a second financial measure, return on assets, the large machinery carriers receiving a recent satisfactory score averaged a 4 percent return on assets, while the carriers with a non-satisfactory result had a 0 percent return on assets. This difference is also not statistically significant. These results indicate linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets), but the results were not statistically valid.

#### 11.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 18 presents the results of the correlation analysis for the large machinery carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the large machinery carriers and their safety performance showed little statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the large machinery carriers. Initially, the summary safety performance measures for

SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). However, the correlation scores are low and only positive for the VHSEA (0.144). There is, therefore, little connection between overall safety performance measures (covering driver, vehicle, and accidents) and carrier operating ratio for the large machinery carriers.

As results in Table 18 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small and negative, suggesting that higher values of this measure and poorer safety performance are correlated with lower operating ratios and stronger financial performance. However, the correlation coefficients are relatively small and none are statistically significant. The recordable crash rates for large machinery carriers, based on data gathered during a CR, are negatively correlated (-0.357) with operating ratio and are statistically significant (0.042 level of significance). This would indicate that higher crash rates are associated with lower operating ratios—counter to expectations.

- Return on Assets. The results examining the relationship between return on assets of the large machinery carriers and their safety performance showed few statistically significant results. The correlation coefficients did not have the expected signs, therefore suggesting that large machinery carriers with higher returns on assets had worse safety performance. However, the coefficients were very small and not statistically significant.

The summary safety performance measures dealing with vehicle, driver and accidents were negatively and positively correlated with return on assets. The ESM measure is

negatively correlated with ROA (-0.119). These results are mixed; however, one would expect that higher values of the safety performance scores and poorer performance would be associated with lower returns on assets. Concerning the detailed CR measures, the correlation coefficients were small and not statistically significant.

- Carrier Size. It is hypothesized that the size of large machinery carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for driver and accident, these measures are negatively correlated with revenue and ton-miles. This suggests that increases in total firm revenues and ton-miles are associated with lower driver and accident safety evaluation scores and better safety performance. However, the results are not statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the review measures (DRM, SMRM) are negatively correlated with revenues and ton-miles. The positive correlation results for ESM suggest that larger size leads to worse safety performance. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the large machinery carriers, especially

with respect to driver issues. As shown in the correlation results, there are few results that are statistically significant. However, there is a significant positive correlation (0.204 at 0.046 significance level) between average load (tons) and vehicle safety evaluation scores. This suggests that as average loads increase, scores increase and safety performance worsens.

Among the large machinery carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA and VHSEA. Thus for these variables, it is likely that companies using more of their operating expenses to pay wages can expect lower driver and vehicle safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.36), it is statistically significant at the 0.001 level. Similarly, there is a negative correlation (-0.23) at 0.022 significance level for the VHSEA.

## **12. General Freight - LTL**

The initial component of this section compares general freight LTL carriers with an overall satisfactory carrier review (CR) and those in that segment receiving an unsatisfactory or conditional review.

### 12.1 Means Comparison: Satisfactory vs. Non-Satisfactory Carriers

- Descriptive Variables. Among the general freight LTL carriers, 74 had satisfactory CRs in the 18 month period prior to the construction of the database (September 2000), while 13 had non-satisfactory reviews. Of the 13 with non-satisfactory reviews, 11 were conditional reviews and 2 were unsatisfactory. Table 19 provides results of the ANOVA comparing the carriers with satisfactory CRs and those with non-satisfactory results on a number of descriptive control variables. According to these results, general freight LTL

carriers with satisfactory CRs are larger than those carriers with non-satisfactory CRs on the following size dimensions: power units, operating revenues, total ton-miles, and average load. However, the observed differences in means between groups are statistically insignificant due to the large standard deviations in these measures.

Large machinery carriers with satisfactory CRs have on average 520 power units compared with an average fleet size of 88 for general freight LTL carriers with either conditional or unsatisfactory CRs. The carriers with satisfactory reviews averaged \$122.8 million in annual revenues compared to only \$16.0 million among the carriers with non-satisfactory reviews. The carriers with satisfactory reviews average 333.9 million ton-miles with an average load of 32.1 tons. Among the carriers with non-satisfactory reviews, these averages are 19.6 million and 5.6 tons, respectively. However, carriers with non-satisfactory reviews have average lengths of haul that exceed the average for carriers with satisfactory reviews (515.8 versus 337.8 miles, respectively).

Driver wages between the two general freight LTL carrier groups are significantly different. The general freight LTL carriers with satisfactory reviews have average driver wages equal to \$40,247, while the comparable figure among carriers without satisfactory reviews is \$30,144—a difference statistically significant at the .05 level of confidence. Indeed, the LTL carriers with positive CRs devote 49 percent of their operating expenses to driver wages, while the comparable figure among carriers with non-satisfactory reviews is 43 percent. The observed differences in means between groups with respect to the percent of operating expenses dedicated to driver wages is statistically significant to 0.05 level.

- Financial Variables. Focusing on the important financial variables, the study results find some distinctive yet statistically insignificant linkages. Indeed, among the general

freight LTL carriers with a satisfactory rating, the average operating ratio (operating expenses/operating revenues) is 0.98, while the comparable figure among the carriers with a non-satisfactory rating is also 0.98. This difference is statistically insignificant. On a second financial measure, return on assets, the general freight LTL carriers receiving a recent satisfactory score averaged a 3 percent return on assets, while the carriers with a non-satisfactory result had a 5 percent return on assets. This difference is also not statistically significant. These results do not provide evidence of important linkages between poor safety performance (non-satisfactory review) and poor financial performance (high operating ratio and negative return on assets).

## 12.2 Correlation Analysis: Linkages Between Financial/Descriptive Measures and Safety Performance

Table 20 presents the results of the correlation analysis for the general freight LTL carriers. The key financial variables to correlate with safety performance are operating ratio and return on assets. The key descriptive measures of interest are the following: total operating revenues, total ton-miles, average load, average length of haul, and wages as a percent of operating expenses.

- Operating Ratio. The results examining the relationship between the operating ratio of the general freight LTL carriers and their safety performance showed little statistically significant results. The hypothesized finding that carriers with poorer financial results (higher operating ratios) would have poorer safety performance results did not materialize among the general freight LTL carriers. Initially, the summary safety performance measures for SafeStat in the areas of driver (DRSEA), vehicle (VHSEA), and accident (ACSEA) were correlated with carrier operating ratio. The expected sign would be positive to indicate that

higher safety evaluation scores (and worse safety performance) are positively correlated with higher operating ratios (and poorer financial performance). Only VHSEA is strongly correlated with operating ratio (0.287), and is statistically significant to the 0.006 level. However, the other safety evaluation scores are low and negative for the ACSEA (-0.14). Therefore, there is only a connection between overall safety performance measures (covering vehicle) and carrier operating ratio for the general freight LTL carriers.

As results in Table 20 denote, all three measures, DRM, SMRM, and ESM are not closely correlated with operating ratio. Correlations are small and negative, suggesting that higher values of this measure and poorer safety performance are correlated with lower operating ratios and stronger financial performance. However, the correlation coefficients are relatively small and none are statistically significant. The recordable crash rates for general freight LTL carriers, based on data gathered during a CR, are negatively correlated (-0.369) and are statistically insignificant.

- Return on Assets. The results examining the relationship between return on assets of the general freight LTL carriers and their safety performance showed few statistically significant results. The correlation coefficients did have the expected signs, therefore suggesting that general freight LTL carriers with higher returns on assets had better safety performance. Specifically, the VHSEA evaluation score was negatively correlated (-0.232) to firm's ROA at the 0.029 level of significance. The summary safety performance measures dealing with vehicle, driver and accidents were negatively correlated with return on assets. These results suggest that higher values of the safety performance scores and poorer performance are associated with lower returns on assets. Concerning the detailed CR measures, the correlation coefficients were statistically insignificant.



- Carrier Size. It is hypothesized that the size of general freight LTL carriers is positively correlated with safety performance. However, none of the correlation coefficients linking size variables with safety performance are statistically significant, although many have signs suggesting a linkage between larger size and improved safety performance. Examining the overall safety performance measures in SafeStat for driver and accident, these measures are negatively correlated with revenue and ton-miles. This suggests that increases in total firm revenues and ton-miles are associated with lower driver and accident safety evaluation scores and better safety performance. However, the results are not statistically significant.

On the detailed measures emanating from a CR, the expectation is that the CR measures would have negative correlation coefficients to suggest that lower values of these measures and better safety performance is associated with larger size. Indeed, the review measures (DRM, SMRM, ESM) are negatively correlated with revenues and ton-miles. Once again, the finding that greater safety performance is associated with larger size is tempered by the lack of statistical significance.

- Operating Characteristics. A final component of the analysis provides an examination between various safety performance measures and several operating characteristics: average load, average haul, and driver wages as a percentage of operating expenses. There are some very interesting results for the general freight LTL carriers, especially with respect to driver issues. As shown in the correlation results, there are a few results that are statistically significant. There is a significant positive correlation (0.29 at 0.024 significance level) between average length of haul (miles) and driver safety evaluation

scores. This suggests that as average lengths of haul increase, scores increase and safety performance worsens.

Among the general freight LTL carriers, there is a statistically significant negative correlation between driver wages as a percent of operating expenses and the DRSEA. Thus for this variable, it is likely that companies using more of their operating expenses to pay wages can expect lower driver safety evaluation scores. In the case of the DRSEA correlation coefficient (-0.312), it is statistically significant at the 0.003 level.

### **13. Summary Remarks**

Among all the carriers combined, those with satisfactory CRs (conducted in the 18 month time period prior to the database construction) compared with those receiving a non-satisfactory result are larger on average (power units, operating revenues, total ton-miles, and average load). However, these mean differences are not statistically significant due to large within-group standard deviations. Interestingly, in most segments, those with satisfactory CRs devote a higher percentage of their operating expenses to driver wages than do carriers without positive reviews.

With respect to financial variables within the segments studied, carriers with satisfactory CRs have significantly lower operating ratios and higher returns on assets than do their counterparts with unsatisfactory or conditional reviews. However, the correlation analysis provides little additional support for the link between financial performance and overall summary safety performance measures from SafeStat. Some detailed CR indicators within SafeStat do provide evidence that higher levels of acute and critical violations in driver and safety management reviews are positively correlated with operating ratios and

negatively correlated with returns on assets, as anticipated. Yet, these results do not meet the test of statistical significance.

With respect to control variables, there is a statistically significant indication that carriers devoting a higher portion of their expenses to driver wages have stronger driver and vehicle safety performance than do carriers with a lower percentage of operating expenses devoted to wages.

The following sections comment on specific results for each carrier segment studied:

- All Carriers Combined. There are only two significant correlation coefficients: one indicating that a carrier's ACSEA is negatively related to ROA and a second suggesting a negative link between ESM and return on assets—i.e., lower levels of violations are associated with higher asset returns.

With respect to control variables, there is a significant negative correlation between the percent of a carrier's expenses devoted to wages and its VHSEA and DRSEA scores. There are also significant negative correlations between a carrier's gross revenues and its DRSEA score and its average load in tons. Lastly, there is a significant positive relationship between a carrier's DRSEA score and its average length of haul in miles.

- General Freight---TL. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its VHSEA and DRSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower VHSEA and DRSEA scores, denoting better safety performance.

- Tank. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's

expenses devoted to driver wages and its DRSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA scores, denoting better safety performance.

- Building Materials. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA scores, denoting better safety performance. There is also a significant negative correlation between a carrier's return on assets and its recordable accident rate, which indicates that carriers with a lower return on its assets had higher accident rates.

- Refrigerated. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA scores, denoting better safety performance. There is also a significant negative correlation between the average length of haul (miles) and VHSEA, suggesting that as the average length of haul increases, the VHSEA score decreases signifying better safety performance. Lastly, we found a significant negative correlation between a carrier's gross revenues and its recordable accident rate, indicating that as a carrier's gross revenues increased, its accident rate decreased.

- Bulk. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA, indicating that a higher portion of

expenses devoted to driver wages will be associated with lower DRSEA scores, denoting better safety performance. There is also a significant correlation between the average length of haul (miles) and DRSEA, suggesting that as the average length of haul increases, the DRSEA score increases signifying poorer safety performance.

- Combined Farm Products. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA scores, denoting better safety performance. There is also a significant correlation between the average load (tons) and DRSEA, suggesting that as the average load increases, the DRSEA score decreases and safety performance improves.

- Produce. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA and VHSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA and VHSEA scores, denoting better safety performance.

- Large Machinery. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA and VHSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA and VHSEA scores, denoting better safety performance. In addition, there is a significant positive correlation between average load (tons) and vehicle safety evaluation scores. This suggests that as average loads increases, scores increase and safety performance worsens.

- General Freight LTL. With respect to financial variables, the general freight LTL carriers with satisfactory CRs have the same operating ratios and lower returns on assets than do their counterparts with unsatisfactory or conditional reviews. With respect to the control variables, there are several interesting significant results. There is a significant negative correlation between the percent of a carrier's expenses devoted to driver wages and its DRSEA, indicating that a higher portion of expenses devoted to driver wages will be associated with lower DRSEA scores, denoting better safety performance. In addition, there is a significant positive correlation between average length of haul (miles) and driver safety evaluation scores. This suggests that as average length of hauls increase, scores increase and safety performance worsens. Also, we found a significant positive relationship between a carrier's operating ratio and its VHSEA score, indicating that as financial performance declines (and operating ratios increase), vehicle operating performance declines (and VHSEA scores increase). Lastly, we found a significant negative relationship between a carrier's return on assets and its VHSEA score, indicating that as financial performance declines (via lower return on assets), vehicle operating performance declines (via higher VHSEA scores).

## **Appendix**

**Table 1. All Carriers/All Segments - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova	1	1	1	1	1	1	1	1	1	1
<b>df</b>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
<b>Mean Square</b>	0.15	0.19	2.65E+16	2,202.66	918,393.11	5.10E+11	343,997,868.11	0.01	0.01	0.01
<b>F</b>	2.89	2.30	0.94	0.38	0.93	0.08	0.59	1.47	1.47	1.47
<b>Sig.</b>	0.04	0.08	0.42	0.77	0.43	0.97	0.62	0.22	0.22	0.22

**Means Normalized**

	<b>Financial Performance</b>				<b>Descriptive Variables</b>						<b>Wages as % of Op. Exp.</b>	
	<b>Operating Ratio</b>	<b>Return on Assets</b>	<b>PWR_UNIT</b>	<b>Gross Revenue</b>	<b>Total Ton-Miles</b>	<b>Avg. Load (tons)</b>	<b>Avg. Length of Haul (miles)</b>	<b>Avg. Driver Wage</b>	<b>Wages as % of Op. Exp.</b>			
<b>Satisfactory</b>												
Mean	0.97	0.05	254.77	44,554,424.09	16.98	569.84	301,385.20	34,869.95	0.16			
N	553.00	551.00	553.00	553.00	504.00	336.00	531.00	478.00	553.00			
Std. Deviation	0.08	0.22	815.17	184,915,374.53	84.03	934.75	2,797,265.64	26,046.99	0.10			
<b>Non-Satisfactory</b>												
Mean	1.04	(0.02)	106.26	16,981,228.28	7.89	763.29	188,899.99	31,506.23	0.16			
N	103.00	103.00	103.00	103.00	94.00	52.00	95.00	88.00	103.00			
Std. Deviation	0.54	0.48	326.89	2,51E+12	11.06	11,253.74	282,411,344.90	10,199,684.36	0.09			



**Table 2. All Carriers/All Segments - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	-0.007	-0.03	-0.01	-0.034	-0.002	-0.065	<b>-0.145</b>
	Sig. (2-tailed)	0.854	0.443	0.785	0.382	0.961	0.196	<b>0</b>
	N	678	676	678	678	618	401	<b>678</b>
<b>DRSEA</b>	Pearson Correlation	-0.002	-0.019	<b>-0.113</b>	-0.053	<b>-0.08</b>	<b>0.193</b>	<b>-0.303</b>
	Sig. (2-tailed)	0.952	0.63	<b>0.003</b>	0.166	<b>0.046</b>	<b>0</b>	<b>0</b>
	N	678	676	<b>678</b>	678	<b>618</b>	<b>401</b>	<b>678</b>
<b>ACSEA</b>	Pearson Correlation	0.032	-0.064	0.01	0.055	-0.047	-0.014	-0.001
	Sig. (2-tailed)	0.406	0.097	0.793	0.151	0.247	0.787	0.974
	N	678	676	678	678	618	401	678
<b>DRM</b>	Pearson Correlation	-0.008	-0.008	-0.017	-0.023	-0.02	0.015	-0.043
	Sig. (2-tailed)	0.845	0.827	0.654	0.552	0.613	0.766	0.266
	N	678	676	678	678	618	401	678
<b>SMRM</b>	Pearson Correlation	-0.004	-0.02	-0.025	-0.026	-0.013	-0.009	0.023
	Sig. (2-tailed)	0.909	0.602	0.516	0.5	0.755	0.854	0.557
	N	678	676	678	678	618	401	678
<b>RAR</b>	Pearson Correlation	-0.012	-0.018	-0.041	-0.05	-0.022	-0.029	-0.012
	Sig. (2-tailed)	0.748	0.641	0.285	0.194	0.584	0.565	0.753
	N	678	676	678	678	618	401	678
<b>ESM</b>	Pearson Correlation	0.035	-0.063	0.019	0.026	-0.034	0.002	-0.014
	Sig. (2-tailed)	0.369	0.101	0.629	0.495	0.398	0.973	0.72
	N	678	676	678	678	618	401	678

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

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**Table 3. General Freight - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova		1	1	1	1	1	1	1	1	1
<b>df</b>		3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
<b>Mean Square</b>		0	6.86E+15	299,715	0.02	447	161,209,026,645	1,096,301	58,692,980,78	3.00
<b>F</b>		2.39	0.31	0.52	0.12	0.72	0.06	0.83	0.54	1.19
<b>Sig.</b>		0.07	0.82	0.67	0.95	0.54	0.98	0.48	0.65	0.31

**Means Normalized**

	<b>Financial Performance</b>				<b>Descriptive Variables</b>						
	Operating Ratio	Return on Assets	PWR_UNIT	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Avg. Driver Wage	Wages as % of Op. Exp.		
<b>Satisfactory</b>											
Mean	0.97	0.06	241.39	37,195,575.36	319,684,294.48	14.22	728.29	30,981.65	0.31		
N	298.00	298.00	298.00	298.00	298.00	275.00	180.00	259.00	298.00		
Std. Deviation	0.07	0.27	842.29	164,412,912.84	1.40E+09	27.31	1,068.02	10,245.92	0.15		
<b>Non-Satisfactory</b>											
Mean	1.07	(0.06)	121.31	19,515,149.67	71,595,291.19	9.14	946.47	30,772.20	0.29		
N	64.00	64.00	64.00	64.00	64.00	59.00	33.00	53.00	64.00		
Std. Deviation	0.68	0.61	466.06	4.11E+12	2.67E+14	12.09	22,409.63	16,917,659.02	0.15		

**Table 4. General Freight - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation Sig. (2-tailed) N	-0.022 0.668 378	-0.029 0.569 378	-0.036 0.485 378	-0.047 0.367 378	0.064 0.236 348	-0.044 0.515 223	<b>-0.193</b> <b>0</b> <b>378</b>
<b>DRSEA</b>	Pearson Correlation Sig. (2-tailed) N	-0.031 0.545 378	-0.045 0.378 378	-0.084 0.102 378	-0.063 0.219 378	-0.085 0.114 348	<b>0.156</b> <b>0.02</b> <b>223</b>	<b>-0.285</b> <b>0</b> <b>378</b>
<b>ACSEA</b>	Pearson Correlation Sig. (2-tailed) N	0.048 0.348 378	-0.09 0.08 378	0.036 0.48 378	0.069 0.182 378	0.048 0.367 348	0.018 0.784 223	-0.011 0.824 378
<b>DRM</b>	Pearson Correlation Sig. (2-tailed) N	0.064 0.509 108	-0.053 0.587 108	0.05 0.608 108	0.001 0.99 108	-0.017 0.87 99	0.026 0.842 59	-0.156 0.107 108
<b>SMRM</b>	Pearson Correlation Sig. (2-tailed) N	0.017 0.86 108	-0.063 0.517 108	-0.058 0.552 108	-0.056 0.563 108	-0.007 0.942 99	-0.05 0.709 59	0.122 0.207 108
<b>RAR</b>	Pearson Correlation Sig. (2-tailed) N	0.152 0.117 108	-0.123 0.205 108	0.105 0.278 108	-0.1 0.303 108	-0.033 0.743 99	-0.182 0.168 59	0.04 0.684 108
<b>ESM</b>	Pearson Correlation Sig. (2-tailed) N	0.03 0.755 108	-0.062 0.524 108	-0.082 0.399 108	-0.119 0.221 108	-0.06 0.557 99	-0.103 0.44 59	0.024 0.803 108

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

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<b>Bold</b>

**Table 5. Tank - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova	1	1	1	1	1	1	1	1	1	1
<b>df</b>	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
<b>Mean Square</b>	1	3.73E+16	474,134	0.02	1.43E+11	747,828	1.70	44,303,245.08	2.00	0
<b>F</b>	4.40	0.49	0.35	0.16	0.08	1.70	0.43	0.66	0.66	0.66
<b>Sig.</b>	0.01	0.62	0.71	0.86	0.92	0.19	0.65	0.52	0.52	0.52

**Means Normalized**

		<b>Descriptive Variables</b>									
		<b>Financial Performance</b>					<b>Operational Performance</b>				
		Operating Ratio	Return on Assets	PWR UNIT	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Avg. Driver Wage	Wages as % of Op. Exp.	
<b>Satisfactory</b>	Mean	0.97	0.05	399.25	74,243,228.57	479,878,036.45	27.25	538.26	34,144.78	0.36	
	N	162.00	161.00	162.00	162.00	162.00	158.00	109.00	141.00	162.00	
	Std. Deviation	0.05	0.17	1,235.15	294,997,907.32	1.87E+09	145.67	700.14	10,002.49	0.15	
<b>Non-Satisfactory</b>	Mean	1.25	(0.18)	218.29	15,767,664.43	88,588,483.76	11.31	228.38	32,820.92	0.34	
	N	21.00	21.00	21.00	21.00	21.00	20.00	15.00	19.00	21.00	
	Std. Deviation	1.20	1.05	499.13	17,833,389.10	163,017,157.95	11.57	299.64	11,594.98	0.17	

**Table 6. Tank - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation Sig. (2-tailed) N	-0.053 0.474 186	-0.008 0.919 185	0.024 0.745 186	0.007 0.928 186	0.025 0.737 181	-0.1 0.267 126	-0.078 0.287 186
<b>DRSEA</b>	Pearson Correlation Sig. (2-tailed) N	-0.02 0.784 186	-0.075 0.31 185	-0.068 0.358 186	-0.003 0.966 186	-0.134 0.071 181	0.122 0.172 126	<b>-0.287</b> <b>0</b> <b>186</b>
<b>ACSEA</b>	Pearson Correlation Sig. (2-tailed) N	0.08 0.277 186	-0.093 0.208 185	-0.047 0.527 186	0.032 0.667 186	-0.1 0.182 181	-0.023 0.802 126	0.038 0.603 186
<b>DRM</b>	Pearson Correlation Sig. (2-tailed) N	0.131 0.385 46	-0.113 0.46 45	0.107 0.481 46	0.024 0.874 46	-0.128 0.407 44	0.038 0.826 36	0.084 0.579 46
<b>SMRM</b>	Pearson Correlation Sig. (2-tailed) N	0.073 0.628 46	-0.107 0.486 45	-0.083 0.586 46	-0.227 0.129 46	-0.129 0.404 44	0.19 0.267 36	-0.105 0.486 46
<b>RAR</b>	Pearson Correlation Sig. (2-tailed) N	-0.176 0.243 46	0.27 0.073 45	0.111 0.463 46	-0.13 0.389 46	0.006 0.971 44	-0.003 0.987 36	-0.023 0.881 46
<b>ESM</b>	Pearson Correlation Sig. (2-tailed) N	0.011 0.943 46	-0.11 0.47 45	-0.098 0.517 46	-0.101 0.506 46	-0.245 0.109 44	-0.274 0.105 36	0.129 0.392 46

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

<b>Bold</b>
<b>Bold</b>

**Table 7. Building Materials - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova	1	1	1	1	1	1	1	1	1
<b>df</b>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
<b>Mean Square</b>	0.00	4.08E+16	925,929.80	0.11	168.89	851,776.01	1.08E+11	2,162,196.49	3.00
<b>F</b>	0.32	0.43	0.56	0.65	0.16	0.41	0.05	0.02	0.02
<b>Sig.</b>	0.81	0.74	0.64	0.58	0.93	0.74	0.99	1.00	0.17

Means Normalized

		Financial Performance				Descriptive Variables				
		Operating Ratio	Return on Assets	PWR_UNIT	Gross_Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Avg. Driver Wage	Wages as % of Op. Exp.
<b>Satisfactory</b>	Mean	0.98	0.05	417.57	80,086,028.38	515,714,029.32	15.67	709.37	32,891.42	0.32
	N	115.00	115.00	115.00	115.00	115.00	109.00	66.00	105.00	115.00
	Std. Deviation	0.07	0.16	1,443.55	347,480,204.04	2.18E+09	36.33	1,212.32	9,597.43	0.16
<b>Non-Satisfactory</b>	Mean	0.99	0.03	93.43	11,856,134.43	59,311,258.64	10.94	1,025.68	32,985.91	0.33
	N	28.00	28.00	28.00	28.00	28.00	26.00	16.00	25.00	28.00
	Std. Deviation	0.10	0.17	568.38	9.62E+12	67,600,336.25	10.80	2,186.41	40,584,109.05	0.17

Table 8. Building Materials - Correlation Analysis

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	0.05	-0.032	-0.008	-0.021	0.052	0.023	-0.024
	Sig. (2-tailed)	0.543	0.696	0.925	0.8	0.545	0.837	0.769
	N	148	148	148	148	140	85	148
<b>DRSEA</b>	Pearson Correlation	-0.099	0.053	-0.157	-0.076	-0.076	0.175	<b>-0.301</b>
	Sig. (2-tailed)	0.231	0.519	0.056	0.358	0.374	0.108	<b>0</b>
	N	148	148	148	148	140	85	<b>148</b>
<b>ACSEA</b>	Pearson Correlation	-0.121	-0.051	-0.084	-0.026	0.13	0.1	0.019
	Sig. (2-tailed)	0.144	0.535	0.311	0.752	0.125	0.362	0.819
	N	148	148	148	148	140	85	148
<b>DRM</b>	Pearson Correlation	-0.091	-0.005	-0.004	-0.178	-0.155	-0.093	-0.146
	Sig. (2-tailed)	0.586	0.975	0.981	0.286	0.374	0.696	0.38
	N	38	38	38	38	35	20	38
<b>SMRM</b>	Pearson Correlation	0.036	-0.065	-0.146	-0.108	0.238	-0.084	0.082
	Sig. (2-tailed)	0.832	0.696	0.38	0.52	0.168	0.725	0.623
	N	38	38	38	38	35	20	38
<b>RAR</b>	Pearson Correlation	0	<b>-0.334</b>	0.004	-0.025	0.077	-0.154	0.057
	Sig. (2-tailed)	1	<b>0.04</b>	0.982	0.88	0.66	0.516	0.736
	N	38	<b>38</b>	38	38	35	20	38
<b>ESM</b>	Pearson Correlation	-0.07	-0.056	-0.07	-0.205	-0.114	-0.057	0.315
	Sig. (2-tailed)	0.677	0.737	0.678	0.216	0.513	0.811	0.054
	N	38	38	38	38	35	20	38

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

<b>Bold</b>
<b>Bold</b>

**Table 9. Cold Food - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova	1	1	1	1	1	1	1	1	1	1
<b>df</b>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
<b>Mean Square</b>	0.34	1.02E+16	191,003.16	0.11	512.31	150,981.67	1.15E+10	143,042,651.60	3.00	3.00
<b>F</b>	1.49	0.48	0.39	0.72	0.56	0.15	0.12	1.07	0.02	0.02
<b>Sig.</b>	0.22	0.70	0.76	0.54	0.64	0.93	0.95	0.36	2.25	0.09

**Means Normalized**

	<b>Financial Performance</b>					<b>Descriptive Variables</b>					<b>Wages as % of Op. Exp.</b>
	<b>Operating Ratio</b>	<b>Return on Assets</b>	<b>PWR_UNIT</b>	<b>Gross Revenue</b>	<b>Total Ton-Miles</b>	<b>Avg. Load (tons)</b>	<b>Avg. Length of Haul (miles)</b>	<b>Avg. Driver Wage</b>			
<b>Satisfactory</b>	Mean	0.97	0.07	281.22	46,327,611.77	330,575,017.10	16.86	801.36	30,865.79	0.30	
	N	98.00	98.00	98.00	98.00	98.00	90.00	64.00	83.00	98.00	
	Std. Deviation	0.08	0.34	777.35	169,897,740.57	744,746,417.77	34.73	1,049.94	11,755.61	0.15	
<b>Non-Satisfactory</b>	Mean	1.17	(0.15)	160.62	13,001,690.12	89,911,388.19	8.64	826.86	31,964.47	0.27	
	N	32.00	32.00	32.00	32.00	32.00	30.00	18.00	26.00	32.00	
	Std. Deviation	0.97	0.80	672.71	6.85E+12	5.07E+14	13.99	51,296.56	23,634,993.87	0.13	



**Table 10. Cold Food - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	-0.038	-0.07	-0.063	-0.06	0.133	<b>-0.256</b>	-0.142
	Sig. (2-tailed)	0.665	0.421	0.471	0.486	0.14	<b>0.019</b>	0.1
	N	135	135	135	135	125	<b>84</b>	135
<b>DRSEA</b>	Pearson Correlation	-0.08	0.036	-0.126	-0.05	-0.096	0.083	<b>-0.223</b>
	Sig. (2-tailed)	0.358	0.678	0.145	0.566	0.287	0.451	<b>0.009</b>
	N	135	135	135	135	125	84	<b>135</b>
<b>ACSEA</b>	Pearson Correlation	0.105	-0.135	-0.042	0.113	0.03	-0.104	0.036
	Sig. (2-tailed)	0.224	0.118	0.626	0.19	0.742	0.345	0.679
	N	135	135	135	135	125	84	135
<b>DRM</b>	Pearson Correlation	0.11	-0.1	-0.03	0.003	-0.048	0.058	-0.168
	Sig. (2-tailed)	0.457	0.497	0.841	0.985	0.762	0.766	0.255
	N	48	48	48	48	43	29	48
<b>SMRM</b>	Pearson Correlation	0.178	-0.119	-0.167	-0.115	-0.072	-0.023	0.022
	Sig. (2-tailed)	0.227	0.42	0.258	0.438	0.647	0.905	0.88
	N	48	48	48	48	43	29	48
<b>RAR</b>	Pearson Correlation	0.172	-0.191	<b>-0.371</b>	-0.234	-0.084	-0.054	-0.063
	Sig. (2-tailed)	0.241	0.192	<b>0.009</b>	0.11	0.594	0.781	0.672
	N	48	48	<b>48</b>	48	43	29	48
<b>ESM</b>	Pearson Correlation	0.094	-0.07	0.007	-0.084	-0.093	-0.248	0.075
	Sig. (2-tailed)	0.525	0.636	0.964	0.57	0.551	0.194	0.613
	N	48	48	48	48	43	29	48

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

<b>Bold</b>
<b>Bold</b>

**Table 11. Bulk - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova		1	1	1	1	1	1	1	1
<b>df</b>		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
<b>Mean Square</b>		0.84	5.60E+15	2.00	2.00	2.00	2.00	2.00	2.00
<b>F</b>		3.55	0.27	45,861.27	0.03	317,530.70	1.89E+10	31,422,437.10	0.00
<b>Sig.</b>		0.03	0.77	0.10	0.20	1.26	0.38	0.23	0.29
				0.91	0.82	0.29	0.68	0.80	0.75

Means Normalized

		Descriptive Variables									
		Financial Performance									
		Operating Ratio	Return on Assets	PWR_UNIT	Gross_Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Avg. Driver Wage	Wages as % of Op. Exp.	
<b>Satisfactory</b>	Mean	0.96	0.06	241.13	37,503,487.12	258,929,357.83	15.41	471.76	32,635.52	0.33	
	N	110.00	110.00	110.00	110.00	110.00	102.00	65.00	97.00	110.00	
	Std. Deviation	0.13	0.32	719.14	157,593,157.25	565,802,171.15	30.44	527.36	12,530.58	0.15	
<b>Non-Satisfactory</b>	Mean	1.27	(0.21)	216.50	14,111,908.70	87,808,622.10	8.11	284.42	30,706.35	0.35	
	N	20.00	20.00	20.00	20.00	20.00	18.00	10.00	19.00	20.00	
	Std. Deviation	1.23	1.07	513.59	18,106,755.18	168,924,763.36	10.67	340.31	6,769.50	0.16	

**Table 12. Bulk - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	-0.035	-0.075	-0.088	-0.112	0.113	-0.144	-0.017
	Sig. (2-tailed)	0.692	0.393	0.311	0.199	0.214	0.21	0.847
	N	133	133	133	133	123	78	133
<b>DRSEA</b>	Pearson Correlation	-0.031	0.028	-0.054	0.037	-0.102	<b>0.245</b>	<b>-0.238</b>
	Sig. (2-tailed)	0.722	0.75	0.538	0.67	0.263	<b>0.031</b>	<b>0.006</b>
	N	133	133	133	133	123	<b>78</b>	<b>133</b>
<b>ACSEA</b>	Pearson Correlation	0.108	-0.14	-0.09	0.07	0.097	0.028	-0.073
	Sig. (2-tailed)	0.215	0.109	0.303	0.426	0.285	0.809	0.401
	N	133	133	133	133	123	78	133
<b>DRM</b>	Pearson Correlation	-0.013	-0.076	0.083	0.258	0.185	0.316	0.11
	Sig. (2-tailed)	0.933	0.623	0.591	0.091	0.273	0.163	0.476
	N	44	44	44	44	37	21	44
<b>SMRM</b>	Pearson Correlation	0.163	-0.122	-0.158	-0.191	-0.166	-0.108	0.078
	Sig. (2-tailed)	0.29	0.429	0.306	0.215	0.327	0.64	0.615
	N	44	44	44	44	37	21	44
<b>RAR</b>	Pearson Correlation	0.041	-0.161	-0.233	-0.16	-0.006	0.136	-0.06
	Sig. (2-tailed)	0.79	0.295	0.128	0.299	0.973	0.557	0.698
	N	44	44	44	44	37	21	44
<b>ESM</b>	Pearson Correlation	-0.002	-0.049	0.162	0.106	-0.067	-0.204	0.135
	Sig. (2-tailed)	0.988	0.754	0.294	0.492	0.695	0.374	0.384
	N	44	44	44	44	37	21	44

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

<b>Bold</b>
<b>Bold</b>

**Table 13. Farm Combined - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova		1	1	1	1	1	1	1	1	1
<b>df</b>		3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
<b>Mean Square</b>		0.27	5.39E+15	0.39	214.94	425,290.48	8.62E+10	157,057,652.38	3.00	3.00
<b>F</b>		1.79	0.41	2.47	0.33	0.35	0.03	1.00	1.00	0.47
<b>Sig.</b>		0.15	0.75	0.06	0.80	0.79	1.00	0.40	0.40	0.70

**Means Normalized**

		<b>Financial Performance</b>					<b>Descriptive Variables</b>					<b>Wages as % of Op. Exp.</b>	
		Operating Ratio	Return on Assets	PWR_UNIT	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Avg. Driver Wage				
<b>Satisfactory</b>	Mean	0.97	0.05	201.90	31,877,138.04	219,942,052.31	14.90	732.25	32,509.95				0.30
	N	164.00	164.00	164.00	164.00	164.00	154.00	106.00	143.00				164.00
	Std. Deviation	0.10	0.28	603.13	131,580,548.07	520,154,805.34	28.44	1,159.47	13,259.67				0.15
<b>Non-Satisfactory</b>	Mean	1.11	(0.08)	134.37	11,780,534.27	90,812,080.21	10.69	813.98	29,850.14				0.27
	N	48.00	48.00	48.00	48.00	48.00	46.00	27.00	41.00				48.00
	Std. Deviation	0.79	0.67	445.47	2.78E+12	2.39E+14	14.45	38,250.93	16,877,834.00				0.14

**Table 14. Farm Combined - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	-0.021	-0.079	-0.07	-0.072	0.058	-0.126	-0.1
	Sig. (2-tailed)	0.759	0.244	0.303	0.293	0.413	0.143	0.143
	N	217	217	217	217	205	136	217
<b>DRSEA</b>	Pearson Correlation	-0.042	0.004	-0.093	-0.02	-0.133	0.131	<b>-0.186</b>
	Sig. (2-tailed)	0.541	0.949	0.173	0.767	0.057	0.13	<b>0.006</b>
	N	217	217	217	217	205	136	<b>217</b>
<b>ACSEA</b>	Pearson Correlation	0.09	-0.13	-0.052	0.059	0.033	-0.041	0.062
	Sig. (2-tailed)	0.188	0.056	0.449	0.387	0.635	0.636	0.364
	N	217	217	217	217	205	136	217
<b>DRM</b>	Pearson Correlation	0.091	-0.075	-0.067	0.08	0.038	0.088	-0.15
	Sig. (2-tailed)	0.447	0.531	0.574	0.504	0.755	0.554	0.209
	N	72	72	72	72	68	48	72
<b>SMRM</b>	Pearson Correlation	0.163	-0.13	-0.117	-0.127	-0.062	-0.045	0.028
	Sig. (2-tailed)	0.17	0.277	0.328	0.288	0.618	0.76	0.815
	N	72	72	72	72	68	48	72
<b>RAR</b>	Pearson Correlation	0.154	-0.2	0.014	-0.163	-0.173	-0.049	0.079
	Sig. (2-tailed)	0.198	0.093	0.904	0.171	0.159	0.739	0.509
	N	72	72	72	72	68	48	72
<b>ESM</b>	Pearson Correlation	-0.018	-0.023	-0.119	-0.157	0.002	-0.082	0.108
	Sig. (2-tailed)	0.881	0.849	0.321	0.188	0.988	0.581	0.365
	N	72	72	72	72	68	48	72

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

<b>Bold</b>
<b>Bold</b>

**Table 15. Produce - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova	1	1	1	1	1	1	1	1	1	1
<b>df</b>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
<b>Mean Square</b>	0.30	8.76E+15	131,934.18	0.31	448.23	352,113.46	6.51E+11	94,710,597.39	0.73	3.00
<b>F</b>	1.24	0.39	0.26	2.09	0.48	0.43	0.11	0.73	0.34	0.00
<b>Sig.</b>	0.30	0.76	0.85	0.11	0.70	0.73	0.95	0.54	0.80	0.00

**Means Normalized**

	<b>Financial Performance</b>				<b>Descriptive Variables</b>						<b>Wages as % of Op. Exp.</b>	
	<b>Operating Ratio</b>	<b>Return on Assets</b>	<b>PWR_UNIT</b>	<b>Gross Revenue</b>	<b>Total Ton-Miles</b>	<b>Avg. Load (tons)</b>	<b>Avg. Length of Haul (miles)</b>	<b>Avg. Driver Wage</b>				
<b>Satisfactory</b>	Mean	0.97	0.07	261.78	44,849,183.78	261,923,344.62	16.71	785.07	30,711.33			0.29
	N	90.00	90.00	90.00	90.00	90.00	81.00	61.00	81.00			90.00
	Std. Deviation	0.07	0.34	795.30	175,982,956.26	613,614,189.38	35.35	898.57	11,423.18			0.14
<b>Non-Satisfactory</b>	Mean	1.15	(0.14)	162.79	13,428,877.67	90,677,386.39	9.17	968.29	30,702.92			0.25
	N	33.00	33.00	33.00	33.00	33.00	31.00	18.00	27.00			33.00
	Std. Deviation	0.95	0.78	598.31	5.34E+12	3.90E+14	15.66	63,023.49	24,661,969.78			0.12

**Table 16. Produce - Correlation Analysis**

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	-0.041	-0.079	-0.07	-0.028	0.139	-0.158	<b>-0.267</b>
	Sig. (2-tailed)	0.651	0.375	0.436	0.754	0.136	0.159	<b>0.002</b>
	N	127	127	127	127	116	81	<b>127</b>
<b>DRSEA</b>	Pearson Correlation	-0.106	0.053	-0.151	-0.037	-0.158	0.145	<b>-0.203</b>
	Sig. (2-tailed)	0.238	0.555	0.089	0.68	0.091	0.197	<b>0.022</b>
	N	127	127	127	127	116	81	<b>127</b>
<b>ACSEA</b>	Pearson Correlation	0.105	-0.149	-0.082	0.022	0.029	-0.132	0.112
	Sig. (2-tailed)	0.24	0.094	0.358	0.807	0.759	0.24	0.212
	N	127	127	127	127	116	81	127
<b>DRM</b>	Pearson Correlation	0.082	-0.071	-0.076	0.15	0.133	0.275	-0.122
	Sig. (2-tailed)	0.588	0.641	0.615	0.321	0.4	0.142	0.419
	N	46	46	46	46	42	30	46
<b>SMRM</b>	Pearson Correlation	0.151	-0.119	-0.124	-0.116	-0.055	-0.047	0.085
	Sig. (2-tailed)	0.318	0.432	0.41	0.442	0.73	0.804	0.576
	N	46	46	46	46	42	30	46
<b>RAR</b>	Pearson Correlation	0.238	-0.216	0.035	-0.083	-0.059	-0.172	0.106
	Sig. (2-tailed)	0.111	0.15	0.817	0.585	0.712	0.364	0.485
	N	46	46	46	46	42	30	46
<b>ESM</b>	Pearson Correlation	0.119	-0.085	-0.141	-0.102	0.071	-0.151	0.028
	Sig. (2-tailed)	0.431	0.572	0.351	0.498	0.653	0.425	0.852
	N	46	46	46	46	42	30	46

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

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**Table 17. Large Machinery - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova		1	1	1	1	1	1	1	1
	<b>df</b>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	<b>Mean Square</b>	0.00	1.45175E+16	0.12	251.51	335,399.02	4.90045E+11	36,139,475.90	3.00
	<b>F</b>	1.09	0.19	0.35	0.22	0.30	1.65	0.38	0.01
	<b>Sig.</b>	0.36	0.91	0.79	0.89	0.83	0.18	0.77	0.95
									0.42

**Means Normalized**

		<b>Descriptive Variables</b>									
		<b>Financial Performance</b>									
		<b>Operating Ratio</b>	<b>Return on Assets</b>	<b>PWR_UNIT</b>	<b>Gross Revenue</b>	<b>Total Ton-Miles</b>	<b>Avg. Load (tons)</b>	<b>Avg. Length of Haul (miles)</b>	<b>Avg. Driver Wage</b>	<b>Wages as % of Op. Exp.</b>	
<b>Satisfactory</b>	Mean	0.97	0.04	367.76	65,328,258.06	433,270,847.96	17.61	730.18	32,816.27	0.33	
	N	79.00	78.00	79.00	79.00	79.00	78.00	49.00	71.00	79.00	
	Std. Deviation	0.06	0.13	1,148.48	3.09E+08	1.31E+09	37.04	1,128.53	10,181.75	0.16	
<b>Non-Satisfactory</b>	Mean	0.99	0.00	104.56	13,876,599.44	50,864,765.12	10.35	489.67	29,934.37	0.35	
	N	16.00	16.00	16.00	16.00	16.00	14.00	8.00	15.00	16.00	
	Std. Deviation	0.09	0.08	1,161.94	2.44E+13	1.37E+15	27.98	60,743.31	66,331,526.92	0.16	



Table 18. Large Machinery - Correlation Analysis

		Operating Ratio	ROA	Gross Revenue	Total Ton-Miles	Avg. Load (tons)	Avg. Length of Haul (miles)	Driver Wages as % of Operating Expenses
<b>VHSEA</b>	Pearson Correlation	0.144	-0.09	0.023	0.012	<b>0.204</b>	-0.048	<b>-0.23</b>
	Sig. (2-tailed)	0.155	0.378	0.822	0.905	<b>0.046</b>	0.717	<b>0.022</b>
	N	99	98	99	99	<b>96</b>	59	<b>99</b>
<b>DRSEA</b>	Pearson Correlation	-0.019	0.044	-0.152	-0.119	-0.061	0.157	<b>-0.36</b>
	Sig. (2-tailed)	0.855	0.664	0.133	0.239	0.553	0.236	<b>0</b>
	N	99	98	99	99	96	59	<b>99</b>
<b>ACSEA</b>	Pearson Correlation	-0.141	0.005	-0.079	-0.039	0.116	0.158	-0.025
	Sig. (2-tailed)	0.162	0.96	0.439	0.703	0.26	0.232	0.808
	N	99	98	99	99	96	59	99
<b>DRM</b>	Pearson Correlation	-0.101	0.06	-0.083	-0.09	-0.033	-0.033	-0.049
	Sig. (2-tailed)	0.576	0.74	0.648	0.618	0.863	0.897	0.786
	N	33	33	33	33	30	18	33
<b>SMRM</b>	Pearson Correlation	-0.074	0.15	-0.115	-0.122	0.09	-0.068	0.068
	Sig. (2-tailed)	0.682	0.406	0.524	0.5	0.637	0.789	0.705
	N	33	33	33	33	30	18	33
<b>RAR</b>	Pearson Correlation	<b>-0.357</b>	0.276	0.002	-0.201	0.012	0.037	0.15
	Sig. (2-tailed)	<b>0.042</b>	0.12	0.99	0.263	0.952	0.885	0.406
	N	<b>33</b>	33	33	33	30	18	33
<b>ESM</b>	Pearson Correlation	-0.037	-0.119	0.162	0.253	-0.022	-0.026	0.343
	Sig. (2-tailed)	0.84	0.508	0.367	0.156	0.91	0.919	0.051
	N	33	33	33	33	30	18	33

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

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**Table 19. General Freight LTL - Means Comparison (Satisfactory vs Non-satisfactory)**

Anova		1	1	1	1	1	1	1	1	1
	<b>df</b>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	<b>Mean Square</b>	0.00	4.91E+16	822,133.98	0.04	2,554.70	142,210.97	2.40E+09	457,807,203.67	3.00
	<b>F</b>	0.87	0.44	0.57	0.28	0.06	0.36	0.26	3.49	0.02
	<b>Sig.</b>	0.46	0.72	0.64	0.84	0.98	0.78	0.85	0.02	0.04

**Means Normalized**

		<b>Financial Performance</b>					<b>Descriptive Variables</b>				
		<b>Operating Ratio</b>	<b>Return on Assets</b>	<b>PWR_UNIT</b>	<b>Gross Revenue</b>	<b>Total Ton-Miles</b>	<b>Avg. Load (tons)</b>	<b>Avg. Length of Haul (miles)</b>	<b>Avg. Driver Wage</b>	<b>Wages as % of Op. Exp.</b>	
<b>Satisfactory</b>	Mean	0.98	0.03	519.50	122,783,975.43	333,924,568.16	32.13	337.84	40,246.98	0.49	
	N	74.00	74.00	74.00	74.00	74.00	72.00	54.00	68.00	74.00	
	Std. Deviation	0.05	0.12	1,297.41	359,896,465.35	1.33E+09	213.59	484.21	11,697.55	0.17	
<b>Non-Satisfactory</b>	Mean	0.98	0.05	87.69	15,962,689.00	19,607,495.62	5.60	515.83	30,143.88	0.43	
	N	13.00	13.00	13.00	13.00	13.00	11.00	7.00	12.00	13.00	
	Std. Deviation	0.13	0.05	1,463.14	4.62E+13	7.61E+13	12.87	4,863.88	71,880,047.13	0.16	

**Table 20. General Freight LTL - Correlation Analysis**

		<b>Operating Ratio</b>	<b>ROA</b>	<b>Gross Revenue</b>	<b>Total Ton-Miles</b>	<b>Avg. Load (tons)</b>	<b>Avg. Length of Haul (miles)</b>	<b>Driver Wages as % of Operating Expenses</b>
<b>VHSEA</b>	Pearson Correlation Sig. (2-tailed) N	<b>0.287</b> <b>0.006</b> <b>89</b>	<b>-0.232</b> <b>0.029</b> <b>89</b>	0.038 0.724 89	0.072 0.503 89	-0.002 0.985 85	0.064 0.625 61	0.114 0.286 89
<b>DRSEA</b>	Pearson Correlation Sig. (2-tailed) N	0.1 0.351 89	-0.019 0.862 89	-0.194 0.068 89	-0.155 0.147 89	-0.116 0.288 85	<b>0.29</b> <b>0.024</b> <b>61</b>	<b>-0.312</b> <b>0.003</b> <b>89</b>
<b>ACSEA</b>	Pearson Correlation Sig. (2-tailed) N	-0.14 0.19 89	-0.005 0.965 89	-0.041 0.706 89	-0.039 0.716 89	-0.147 0.181 85	-0.121 0.352 61	0.024 0.823 89
<b>DRM</b>	Pearson Correlation Sig. (2-tailed) N	-0.272 0.26 19	0.312 0.193 19	-0.096 0.695 19	-0.352 0.14 19	-0.252 0.313 18	-0.142 0.643 13	0.061 0.805 19
<b>SMRM</b>	Pearson Correlation Sig. (2-tailed) N	-0.106 0.665 19	0.189 0.439 19	-0.203 0.404 19	-0.266 0.271 19	-0.022 0.932 18	0.24 0.429 13	0.049 0.842 19
<b>RAR</b>	Pearson Correlation Sig. (2-tailed) N	-0.369 0.12 19	0.264 0.275 19	0.1 0.684 19	0.009 0.972 19	-0.018 0.943 18	0.235 0.439 13	0.228 0.348 19
<b>ESM</b>	Pearson Correlation Sig. (2-tailed) N	-0.034 0.89 19	0.017 0.945 19	-0.153 0.531 19	-0.259 0.283 19	-0.187 0.458 18	-0.278 0.357 13	-0.292 0.225 19

**Notes:**

Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

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