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Driver safety and motor carrier profitability: Identifying and understanding drivers in the fleet

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DRIVER SAFETY AND MOTOR CARRIER PROFITABILITY: IDENTIFYING AND UNDERSTANDING DRIVERS IN THE FLEET

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ABSTRACT

The objective of the study was to quantitatively explore truck driver safety records in an effort to determine and classify various types of drivers. Six safety variables relating to the number of safety points each driver had accumulated were analyzed using a cluster analysis procedure on 368 active drivers. The results of the study identified three clusters of drivers. Over 49.3 percent of the drivers were identified in a cluster labeled as the "Best Drivers." The label "Ticket Magnets" was given to 23.6 percent of the drivers, and 27.1 percent of the sample was given the label "Accident Prone." The individual clusters were also profiled on additional variables. The study findings indicate that most drivers are very good in all aspects of driver safety. Other drivers have some deficiencies which are addressed as managerial implications in the manuscript.

INTRODUCTION

At a time when companies are looking for ways to trim costs, many are seeking to limit layoffs and to preserve talent. Most will cut employee salaries, hours, and benefits, but they are concerned about preserving talent for the eventual economic recovery (Tuna, 2009). During the same time period, motor carriers have faced record high fuel costs and litigation attorneys eagerly eyeing trucking accidents as potential billing revenues, but until recently they have also faced the rapid turnover of drivers willing to move to a new motor carrier for almost no salary increases. How does management decide which drivers should be kept at all costs and which drivers should be allowed to leave if they so desire? Even in tough economic times, motor carriers strive to remain profitable and thus sustainable. Two issues are very relevant in a motor carriers' ability to remain profitable: the costs of replacing drivers and the costs associated with the consequences of unsafe drivers.

Drivers who shift from one carrier to another create additional costs as motor carriers have to find, hire, and train new drivers to maintain their fleet. It requires additional training costs and often results in short-term service delays and other problems. These concerns all relate to lower carrier profitability. A variety of studies have been conducted to determine why drivers move from carrier to carrier, and what can be done to retain drivers. Most researchers agree that the issue is complex and critical to the long-term success of trucking firms. The next logical step for a motor carrier is to determine which drivers have more desirable characteristics than other drivers and thus should receive more incentives and attention by management to keep them in the fleet.

Another key profitability issue related to drivers is their safety record. Safe drivers are less likely to involve the motor carrier in latent cost problems including litigation. For example, safe drivers, by definition, will be involved in fewer accidents and other incidents, resulting in fewer traffic violations, and more on-time deliveries. This makes safe drivers more valuable to a motor carrier than drivers who receive more citations and are involved in more safety-related incidents. In short, safe drivers allow carriers to be more profitable and thus are more valuable to

the company. The most tangible indicator of how safe a driver is will be found in the safety record of the driver, which should be a part of a motor carrier's database.

The purpose of the present study is to determine if natural groupings or segments of drivers exist in a motor carrier's database safety records, and thus to identify the firm's best drivers. Research questions to be answered include: what safety variables are relevant in determining more desirable drivers than those less desirable drivers, and what are other related characteristics of the best drivers in the fleet. By identifying the best drivers, companies can determine which drivers to expend the most effort and resources to retain. Such an approach should be based on data normally kept by motor carriers on their drivers. The development of such a methodology can help existing carriers more fully utilize their company databases to make informed driver retention decisions. The study examines data from a Midwestern motor carrier's driver population database in an attempt to answer these relevant questions.

BACKGROUND LITERATURE

For any company to survive in the motor carrier industry the bottom line is profitability. A variety of issues relate to profitability for motor carriers, including maintaining a quality fleet of safe drivers and equipment, an organizational culture promoting high levels of safety, and being in compliance with the federal department of transportation motor carrier regulations. Therefore, this literature review will examine the issues of driver recruitment and retention, as well as driver safety. Driver safety issues as they relate to motor carrier profitability, and the use of carrier databases to classify drivers on a variety of safety issues will also be examined. Two key issues that relate to the quality and profitability of the drivers in a motor carrier's fleet are driver turnover and retention, and the drivers' past safety record.

Driver Turnover and Profitability

Since the late 1980s one key issue facing the motor carrier industry has been the shortage of qualified drivers (Lemay and Taylor, 1989). Only recently have drivers stopped jumping from one carrier to another as the economy has slowed and carriers have had less business requiring fewer drivers (Watson, 2008). While the economic situation has eased the driver turnover problem, the situation is not expected to last as it has been estimated that driver shortages will exist for the next ten years (American Trucking Association, 2005; Kilcarr, 2005; Watson, 2008). As the economic recovery begins, carriers will again need more drivers, and driver retirements and fewer new drivers entering the industry will only magnify the problem. A concern for motor carriers is that they may have an excessive turnover of "desirable" drivers (Richard, et. al., 1994).

Driver Turnover Issues

Success in the trucking industry is closely related to the critical role played by drivers (McElroy et. al., 1993). Drivers are the essence of a motor carrier, and they represent the trucking industry to the public. They constitute the largest operating cost for any carrier's operations, and as such they are the easiest way for a carrier to control costs (Stephenson and Fox, 1996). For nearly three decades there has been a shortage of drivers, which has allowed some drivers to move from one carrier to another with little concern about carriers. The term "churning" was coined by the American Trucking Association (Spillenger, 1997) to describe the phenomena. Early researchers believed drivers were leaving or moving from carrier to carrier because of low pay, being away from home for days at a time, and irregular schedules (Lemay, et. al., 1993), but later research revealed that drivers were often leaving one firm to go to another for little pay differences and similar working conditions (Richard et. al., 1995).

Researchers have approached the problem from a variety of angles including: attitude congruence between drivers and management (Adam, 1979); the use of expectations theory to see if carriers were meeting the expectations of their drivers (Richard et. al., 1994), and use of relationship theory which specifically examined the interaction of the dispatcher and his or her drivers (Keller and Ozment, 1999a; 1999b). They argued that dispatchers who communicate well with drivers and provide them with respect, essentially treating them as customers, should have lower driver turnover levels than dispatchers who do a poor job of handling their drivers. Suzuki (2007) developed a modeling decision tool to help motor carriers determine an acceptable level of truck driver turnover; essentially stating that some rate of driver turnover was inevitable for every carrier and could be determined.

Costs of Driver Turnover to Motor Carriers

Replacing existing drivers has a negative effect on carrier profitability. Min and Emam (2003) have argued that profitability in the trucking industry has clearly been undermined by the driver shortage. The costs of attracting new drivers, and providing incentives to keep existing drivers has been very high, especially given the highly competitive nature of the deregulated trucking industry and its narrow profit margins. Driver costs to carriers become extreme when the company has to replace drivers. The cost to replace a single driver has been estimated to be anywhere from $3,000 to $12,000 (Richard et. al., 1994; Stephenson and Fox, 1996; Keller and Ozment, 1999a; 1999b).

Just as service marketers discovered it was more expensive to find new customers than to retain existing customers (Zurburg, 1994), motor carriers have also recognized the high costs of replacing their current drivers who choose to leave them for another carrier (Keller and Ozment, 1999a). Therefore, it is clearly in a motor carrier's best interest to retain its best drivers. The relevant question then becomes, how does a carrier determine which drivers are "quality" drivers before deciding how to retain them. Safe driving records are an important characteristic of a motor carrier's best drivers. As Stephenson and Fox (1996) have stated, "Companies must not tolerate unsafe driving practices by any driver, no matter how severe the driver shortage problem is." High quality, desirable drivers help motor carriers remain profitable with lower accident rates, lower associated lawsuits, and lower insurance costs (Richard, et. al.,1994). These factors are all reflected in higher levels of motor carrier profitability.

Higher driver turnover rates have been shown to be associated with higher accident rates (Corsi and Fanara, 1988). Thus, carrier safety is related to driver turnover. Accidents result in insurance claims, bad publicity, higher insurance rates, and additional costs associated with litigation and negative legal judgments. Drivers who have longer tenures with a single motor carrier are thus more likely to help their carriers be profitable (Bruning, 1989). As such their carriers should want to retain them in their fleets. Younger drivers are however needed for the future as old drivers retire or move to other carriers. The crux of the issue is that the only way young drivers can become better drivers is with good carrier training and driving experience. Thus the literature has indirectly again and again indicated that some drivers as a market have characteristics more desirable to motor carriers than do others. This would argue for the use of some type of classification approach to learn which drivers are more desirable than others, and would therefore justify higher expenditures to attract and retain them for the carrier.

Driver Safety and Motor Carrier Profitability

The importance of safety in the motor carrier industry cannot be understated. Essentially, almost every aspect of safety is related to company drivers in one form or another. Besides driving loads from one point to another,

drivers' must be sure their equipment is in good operating condition, they must drive in a responsible manner, and they must represent the carrier to its customers. Yet some drivers may be more willing than others to stretch operational rules and policies.

Driver Safety

The past few years of slow growth, which has decreased motor carrier business and temporarily reduced the driver shortage, does provide carriers with an opportunity to evaluate the current drivers in their fleet and to determine which are more valuable than others. Thus motor carriers can evaluate existing fleet drivers, and thus decide which drivers they should make a more concentrated effort to retain. While the "churning" of drivers has been a major concern to motor carriers over the past 30 years, the retention of quality or "desirable" (Richard, et. al.,1994) drivers, who have a strong emphasis on safety, is also an important aspect of driver selection and retention. Therefore it is imperative for drivers to place a high level of importance on safety, and to realize their actions as drivers represent their employers to the public. Related to this issue is a feeling that drivers must understand that when they are on the road they are responsible not only for their safety and the safety of their carrier, but also for the safety of the general public as well (Roetting et. al., 2003).

Prior research has indicated that the main causes of most commercial vehicle-related accidents are driver-related factors (Beilock, 1995; Lantz and Loftus, 2005). Equally relevant is the importance management places on safety and how drivers internalize safety (Arboleda, et. al., 2003). It is generally believed that drivers are viewed as being the motor carrier to the general public; and thus, carrier safety is synonymous with driver safety given that 95 percent of all carrier accidents are related to driver actions (Dole, 1991).

Motor carriers, therefore, have both an ethical and an economic obligation to hire and retain the safest, most qualified drivers. Mejza and his colleagues (2003) indicated that prior research efforts have pointed to driver selection as an important activity that might affect driver performance. A variety of negative outcomes for the motor carrier related to poor driver safety include: liability lawsuits related to driver accidents, higher insurance carrier premiums, more worker compensation claims for injuries by on the clock drivers, lower public image perceptions of the carrier, and lower company productivity levels. Driver safety characteristics also play an extremely important role for on time deliveries, damage losses, insurance rates, and the ultimate profitability of the company (Richard et. al., 1994). It would therefore seem logical that one of the most important issues to motor carriers is the retention of their best drivers (Keller and Ozment, 1999; Richard et. al., 1994).

A number of researchers have examined the potential effects of variables on driver safety. They include the effects of government regulations, such as hours of service, etc. (Corsi et. al., 1984; Saltzman and Belzer, 2002; Hanowski et. al., 2007; Chen, 2008); and carrier/ dispatcher scheduling practices (Beilock, 1995; Braver et. al., 1999; Lemay et. al., 1993; Morrow, 2002); but the bottom line still resides in the actual safety records of the individual drivers.

Mejza, Bernard, Corsi and Keane (2003) surveyed the safest motor carriers in the United States. They concluded that the safest motor carriers emphasized pre-service and in-service training for both drivers and owner-operators. The training covered many topics and the drivers were evaluated using a variety of methods. Finally, the safest carriers provided their safe drivers with an array of different types of rewards. In essence, drivers of the safest carriers were aware of the level of importance placed on safety by their companies. As such, motor

carriers with pre-service and in-service training for their drivers should, in theory, create the safest drivers found in their respective fleets.

More research effort should be undertaken to understand how carriers can identify their best drivers. As stated by Stephenson and Fox (1996) "Companies need to focus on retention of quality drivers as a long-range strategy to enhance corporate profitability." Lower quality drivers can lead to increased costs to firms in the form of operations difficulties, service problems for shippers, and other hidden costs due to safety issues such as down time due to accidents and higher reliability insurance rates (Richard et. al., 1994). Profitability remains a major concern to motor carriers in the highly competitive, deregulated, motor carrier industry.

Driver Safety and Profitability

Motor carrier safety is perhaps the most important consideration related to motor carrier profitability and sustainability (Corsi and Fanara, 1988). Safety as it relates to profitability is an important factor, because to some degree it is controllable, while fuel costs and other variables are generally not controllable. Driver training can help to maintain higher safety standards and lower overall operating costs. A driver's attitude toward safety is also an important consideration, but the most tangible indicator is likely to be the safety record of the driver. This should be an important part of any motor carrier's database.

It has been reported that a large proportion of motor carrier accidents are the responsibility of a small number of drivers (Murray and Whiteing, 1995). The Federal Motor Carrier Safety Administration (FMCSA, 2008) has estimated that for a motor carrier to pay for a $25,000 accident, it would be required to generate an additional $1,250,000 in revenue, assuming an average profit of only 2 percent. It has also been reported that in "2005 dollars," the average cost per truck crash from 2001 to 2003, was $91,112 (Miller et. al., 2006). Direct expenses include actual costs to replace equipment and personnel, medical expenses, higher insurance premiums and potential litigation expenses. Indirect costs include lost clients, lost sales, poor public relations/ publicity, and increased public relations costs (FMCSA, 2008). Both direct and indirect cost situations are related to lower levels of profitability and thus are detrimental to the long-range success of the carrier. It is clearly in the best interests of a motor carrier who wants to be profitable not to retain unsafe drivers.

Richardson (1994) indicated that lower profits related to drivers are associated with operation difficulties, service problems and other hidden costs. These problems are often due to safety issues linked to down time resulting from accidents and higher liability insurance rates. Besides the direct costs related to carrier accidents, indirect costs in the form of lost clients, lost sales, and poor publicity are also serious carrier concerns (FMCSA, 2008). Other driver safety factors involve costs associated with items damaged in transit, vehicle inspection problems, moving vehicle citations, and even complaints called in by the public about a driver. All of these variables may be useful in understanding differences between the safest drivers and other less desirable drivers. As a relatively controllable dimension, safety should be an important consideration to motor carriers in the selection and retention of drivers.

Carrier safety and profitability are related constructs when emphasized by management. Previous research has examined this relationship often positing that as financial conditions decrease so does safety performance. Research conducted by Corsi, Fanara, and Roberts (1984) reported a positive relationship between accident rates and the use of owner-operators. Chow and his colleagues (1987) found that a carrier's safety performance was related to the carrier's financial condition, in that less was spent on safety and maintenance of equipment as a carrier's financial position disintegrated. These findings were supported by Bruning's (1989)

research when he reported that a carrier's accident rate was inversely related to its profitability. He also reported that a firm's accident rate was inversely related to a driver's tenure with the carrier. This is consistent with Corsi and Fanara's (1988) finding that higher driver turnover rates were associated with higher accident rates. Once again, safety is related to driver retention.

Motor Carrier Database Strategies to Improve Safety and Profitability

Database management has been touted as the next logical step in the analysis of motor carrier safety information. As such, researchers have argued that databases can be useful in managing safety. Murray and Whiteing (1995) were early proponents of employing accident databases as a way to help reduce motor carrier accidents. They argued that accident reduction strategies could operate at two levels: the national policy level and at the individual company level. Both strategies exist, as the federal government's Department of Transportation keeps data on motor carrier audits and roadside vehicle inspections including specific directives related to truck driver hours of service regulations. Safety reports also include accident reports, so carriers could use carrier databases to systematically analyze accident levels, as well as their causes and costs. It is likely that at the individual company level, the safest firms likely maintain in-depth databases containing safety and compliance data for both the firm and for the individual drivers in their fleet. Murray and Whiteing (1995) argued that by employing a systematic database strategy, motor carriers could examine both human elements and vehicle management issues to reduce commercial vehicle accidents.

Moses and Savage (1996) developed and tested a methodology for predicting the safety performance of motor carriers based upon the U.S. government's audit of carrier management safety practices and roadside safety compliance inspections. Specific carrier characteristics were also studied. The study examined 20,000 carriers in an attempt to identify the most dangerous firms so government agencies could prioritize which companies to target for educational programs and enforcement actions. The most dangerous firms they identified were generally small, for-hire companies, which is consistent with Corsi, Fanara, and Roberts (1984) previous findings. They also concluded that those dangerous carriers who rated low on both audits and roadside inspections have significantly higher accident rates, even though they comprised only about 10 percent of the sample.

In a 2003 study, Mejza and his colleagues conducted a large survey of the safest motor carriers in the United States. The results of the study indicated that: (1) the safest firms have a standard, consistently-applied screening criteria to use in hiring drivers; (2) both company-drivers and owner-operator drivers receive important pre-service and in-service training; (3) their training programs are comprehensive and drivers are evaluated using a variety of methods; and (4) safe drivers are rewarded in a variety of ways to support their efforts. In essence, the safest motor carriers, with high compliance and safety records, have a safety strategy they constantly monitor to ensure they remain effective in implementing a culture of organizational safety. The researchers' study implied, "that driver selection could impact the carrier's driver performance if drivers with certain characteristics are not selected" (Mejza et. al. 2003). Database usage would be a logical and important management tool for individual carriers interested in retaining drivers demonstrating high levels of safety performance.

The use of data mining technology to profile truck drivers as a way to identify and develop a driver recruitment and retention strategy was proposed and demonstrated by Min and Emam (2003). They sent a mail survey to 3000 American motor carriers and received 422 valid

responses for a response rate of 14.14 percent. They applied a data mining procedure to the data set and drew four conclusions from their results. The first conclusion was that smaller firms having less than 50 drivers were better able to retain their drivers when compared to larger firms. Second, drivers who had been with a firm less than six years were more likely to leave than drivers who had been with the firm for over six years. Third, unionized or full-time drivers were less likely to leave than were non-unionized or part-time drivers. Finally, drivers with limited driving experience, less than six years, were more likely to leave than were other drivers. Likely because they have less invested in a specific carrier and the cost of switching was low.

Based upon the driver profiles they developed, they suggested that carrier firms should formulate some type of recruitment and retention strategy based upon a multitude of attributes including "a driver's demographic profile (e.g. age), longevity, prior driving experiences, union status, and the trucking firm's organizational settings." Driver safety performance variables in a carrier's database provide hard evidence of past safety records for drivers.

Lantz and Loftus (2005) argued for the importance of developing and implementing a driver safety history indicator into the federal roadside selection system to target unsafe carriers. Like previously reviewed research, this suggestion argues for improved carrier safety at the national policy level. While other studies have also employed a macro approach, examining many carriers and drivers, no published studies have examined the database of a single large motor carrier. From a managerial perspective, this micro approach would allow single motor carriers to examine the drivers in their individual firms. The present study presents such an approach.

The present study argues that the carrier can actually employ database information to better understand the driver's in the fleet. Most of the previous studies have examined safety characteristics from a macro approach. The present study will be a micro approach using the existing database of a single motor carrier and its drivers. Most carriers will collect and retain needed information for their own needs as well as to be in compliance with government regulations. As Murray and Whiteing (1995) indicated, the use of a simple accident database to monitor and analyze the causes of carrier vehicle accidents can benefit individual companies. Accurate and complete management database information is clearly important in understanding how to reduce motor carrier accidents, as well as which drivers are higher "quality" drivers, and thus more attractive to retain should they decide to leave. This concept is consistent with Stephenson and Fox's (1996) earlier described belief that motor carriers should retain "quality" drivers tempered by the concern for safety in their statement that "Companies must not tolerate unsafe driving practices by any driver, no matter how severe the driver shortage problem is."

Market Segmentation and Database Usage

Morgan and Hunt's (1994) commitment-trust theory of relationship marketing led to a variety of marketing studies approaching employees as internal customers (Berry, 1981; George, 1990; Gronroos, 1981, 1990; Taylor and Cosenza, 1998). In a previously discussed study of ways to retain drivers, Keller and Ozment (1999a, 1999b) applied the theory to examine the relationship between dispatchers and drivers, concluding that drivers could be viewed as "internal customers who may be marketed to as firms traditionally market to customers." Their application expanded the use of the theory to motor carriers and indicated that motor carriers should consider looking at their employees as internal customers if they desire to retain them.

An important basic marketing approach associated with organizations and their markets is segmentation theory (Haire, et. al., 1995).

Segmentation theory argues that natural groupings of consumers may exist in a market or population. Each segment will have different characteristics, wants, and needs when compared to other segments. As such the firm can select those segments it wants to target for its customers, based upon a match of the company's strengths and abilities to profitably service the selected segments. Organizations often classify and segment their markets based upon characteristics that will allow them to better identify and serve subpopulations of the total market. Businesses have segmented their markets based upon a variety of variables including: demographics, psychographics, attitudes and customer-relevant benefits.

Using a similar analogy, motor carriers looking at their population of drivers as an internal market might choose to better understand driver differences through segmentation theory. By segmenting internal driver markets, carriers might better understand different natural groupings of drivers to help them decide which individuals are "quality" drivers that they would want to retain at all costs, while other driver segments might not be as important to retain due to safety considerations. A motor carrier example would be TL and LTL motor carriers, who have decided they can best serve their respective markets using different approaches. Thus a logical extension of both theories is the use of segmentation techniques to better understand and explain differences in internal motor carrier customers (i.e. drivers). The purpose of the present study is to examine the segmentation concept and how it can be applied by motor carriers in their efforts to retain their best drivers.

Motor carriers can theoretically segment their market of fleet drivers using the information they have on each driver in their databases. Especially relevant database information would be driver safety data. Segmentation techniques can thus help motor carriers decide which drivers in their fleets are helping them to meet their organizational goals of profitability and sustainability using safety and other types of data in their databases. The present study will demonstrate a segmentation approach for a large Mid-western motor carrier to examine its fleet of drivers from a safety perspective.

METHODOLOGY

Driver data for the study were provided by a Midwest-based motor carrier that has a combination of owner-operators and company drivers. Data were provided on the Midwest trucking company's drivers. Specific data included their identification (unit) number, their addresses, age, gender, number of children, education level, marital status, race, location of residence type, division, seat classification, whether they were Hazardous Materials certified, the number of jobs they had in the last three years, whether they were graduates of the local national trucking corporation's driver school, and their longevity in months with the company. Data were also provided for each trucker's number of service failures, number of loads hauled, total revenue, and fuel mileage. Specific safety variables included accident points, cargo damage points, citation points, incident report points, inspection problem points, and motorist call-in complaint points (MOTO). These were added to provide a total safety point total. A total of 368 cases were provided for examination. A demographic profile of the truckers in the study is presented in Table 1.

The data base was dominated by male drivers, comprising over 90 percent of the sample. Nearly 73 percent of the database was Caucasian, followed by nearly 20 percent African American, over four percent Hispanic Americans, and just over three percent were classified in the "other" category. Over 41 percent of the drivers lived in urban areas, nearly 32 percent were from suburban residences, and over 26 percent lived in rural areas. The demographic findings were considered representative and acceptable for the purposes of the study.

TABLE 1
DEMOGRAPHIC PROFILE OF MOTOR CARRIER DRIVERS

	Frequencies	Percentage
1. Gender		
Male	333	90.5
Female	35	9.5
2. Race		
Caucasian	268	72.8
African American	72	19.6
Hispanic American	16	4.3
Other	12	3.3
3. Residence Location		
Urban	153	41.7
Suburban	117	31.9
Ruran	97	26.4

FINDINGS

The six safety variables relating to the number of points each driver had accumulated were initially analyzed using a cluster analysis procedure. The first variable measured the number of points accumulated by the driver due to accidents, the second variable were points acquired by the driver for items damaged in transit within the trailer, the third variable counted citation points for tickets received by the driver, and the fourth safety variable measured incident points (for example incidents occurring in the loading areas without formal reporting to law enforcement). The fifth variable was inspection points where the driver's vehicle had violations at inspection checkpoints, and the final variable was accumulated points from motorists who called the trucking company to report bad driving by the driver. The larger the number of accumulated points in each category, the more negative the driver was in that category.

Ward's clustering algorithm was employed with squared Euclidian distance measures to analyze the data. The resulting clustering criterion scores, and a visual examination of the resulting dendogram, indicated that a three-cluster solution should be selected for further testing and analysis. Discriminant analysis was next performed to determine how well the three clusters discriminated between the six original safety variables and to interpret the meaning of the three groups. Tukey tests were also conducted to determine exactly which cluster members were significantly different from other cluster members on each of the six safety variables. The results of that analysis are presented in Table 2. It should be noted that no significant differences were detected for any cluster solutions for Cargo points, the second safety variable. It would appear that this variable has very little variance across the clusters of drivers. It is also a variable that the driver may have less control over, given that as

drivers they do not load the trailers, they simply move the trailers from one geographic location to another. Demographic and other variables were also examined across cluster membership to profile each cluster. The significant findings are presented in Tables 3 and 4.

Cluster 1

The first cluster was the largest group and consisted of 169 drivers. This represented 49.3 percent of the sample. Members of this cluster were given the label of "Best Drivers." These respondents had very low accident points when compared to drivers from the other two clusters. Tukey tests showed that all three groups were significantly different from each other on this variable. As previously stated, no significant differences were found between the three clusters on cargo damage points. Members of Cluster 1 also had the a low number of citation points, which were significantly lower than those drivers in Cluster 2, but not for drivers in Cluster 3. Cluster 1 was significantly lower in incident reports when compared to the other two clusters. While drivers in Cluster 1 did not have the lowest overall inspection point means, they were significantly lower than drivers in Cluster 2, but not significantly different than drivers in Cluster 3. On the final variable of motorist's call complaints, drivers in Cluster 1 again had the lowest mean score, which was statistically lower than the scores from Clusters 2 and 3.

Cluster 2

Eighty-one drivers, 23.6 percent of the sample, were assigned to the second cluster. They were given the label of "Ticket Magnets" because of the high average numbers they received for

TABLE 2
CLUSTER INTERPRETATION OF WARD'S 3 GROUP SOLUTION OF TRUCKER SAFETY VARIABLES

	Cluster					
	1. Best Overall Drivers	2. Ticket Magnets	3. Accident Prone	Overall	F-Ratio	Sig.
1. Accident Points	1.84	6.93	18.60	7.58	235.80	.000
2. Cargo Points	.92	.99	1.02	.96	.08	.923
3. Citation Points	.75	2.1	.82	1.09	8.39	.000
4. Incident Points	.82	11.0	2.0	3.55	188.17	.000
5. Inspection Points	1.36	8.73	1.05	3.02	85.44	.000
6. MOTO	.19	.51	.37	.32	9.70	.000
	n=169	n=81	n=93	N=343		

citation, incident, inspection, and motorist complaint points. While they were slightly under the overall average for all drivers' accident points, members of this cluster had significantly more points than drivers in Cluster 1, but significantly fewer accident points than drivers in Cluster 3. Cluster 2 drivers had significantly more citation points than members of the other two clusters. They also had significantly higher means for incident points and inspection points when compared to the scores of drivers in Clusters 1 and 3. Drivers from Cluster 2 had the highest average of motorist call-in complaints, which was statistically higher than the average for Cluster 1, but not for Cluster 3.

Cluster 3

The last cluster was comprised of 93 drivers, or 27.1 percent of the sample. The label of "Accident Prone" was given to this driver segment. Drivers in this cluster were distinguishable from drivers in the other two clusters based upon their high mean score for accident points. The average score for accident points was significantly higher for this group when compared to the other two clusters. This group also had the largest mean score for cargo points, but as previously stated, it was not significantly different from drivers in the other two groups. Citation points for Cluster 3 drivers were below the average for the overall drivers' mean scores, significantly lower than Cluster 2 drivers, but not Cluster 1 drivers. The same pattern held for incident points. Drivers in Cluster 3 had the lowest mean score for inspection points, which again was significantly lower than drivers in Cluster 2 but not for drivers in Cluster 1. Finally, Cluster 3 drivers had slightly above average mean scores for motorists' complaints which were not significantly different from Cluster 2 driver's scores, but significantly higher than drivers in Cluster 1.

Profiling Other Characteristics Across the Three Driver Clusters

Table 3 provides a profile analysis of other metric demographic and service variables not originally employed to create the three driver clusters. Seven variables were analyzed in the Table. Three variables were statistically significant ($p<.05$), two variables had practical significance ($p> .05$ but $< .10$), and two other variables did not differ across the three clusters.

Measured in months, the mean longevity scores of the drivers working for the company was statistically different across the three driver segments. The drivers in Cluster 1, the "Best Drivers," had a significantly higher mean score (41.45 months) with the company when compared to the drivers in Cluster 2 (33.07 months) and drivers in Cluster 3 (32.99 months). There was no statistical difference between the means for drivers in Cluster 2 and Cluster 3 on this variable.

The second variable, the average age of drivers, was not significantly different across the three clusters. Variable 3 examined the number of jobs held by the drivers over the last three years. Mean scores on this variable were also not statistically significant across the three clusters. All drivers had held approximately three jobs in the last three years.

Variable 4, number of service failures, was not significant at the .05 level, but was close with a probability of .056. It is examined as having practical significance. Drivers in Cluster 1 had a lower mean average (1.18) of service failures when compared to drivers in Cluster 2 (1.89) and in Cluster 3 (1.78). This finding is related and similar to the average percentage of service failures across the three groups. Again, the average number of service failures was visibly lower for the best overall drivers in Cluster 1 when compared to drivers in the other two clusters. The number of loads hauled, Variable 5, provided results similar to those found for

TABLE 3
CLUSTER PROFILING OF WARD'S 3 GROUP SOLUTION ON TRUCKER SAFETY VARIABLES

	Cluster					
	1. Best Overall Drivers	2. Ticket Magnets	3. Accident Prone	Overall	F-Ratio	Sig.
1. Longevity in Months	44.95	37.27	37.07	41.00	5.74	.004
2. Age	41.99	40.43	42.52	41.77	.980	.377
3. Jobs in 3 years	3.01	3.10	3.30	3.11	.783	.458
4. Service Failures	1.18	1.89	1.78	1.51	2.911	.056
5. Loads Hauled	498.1	434.95	430.90	464.77	4.386	.013
6. Total Revenue	695,302.06	586,346.18	575,534.09	636,787.44	6.317	.002
7. Percent Service Failures	.0025	.0043	.0035	.0032	2.700	.069
	n=169	n=81	n=93	N=343		

Variable 4. Drivers in Cluster 1, the best overall drivers, hauled a significantly larger average number of loads than drivers from Cluster 2 and Cluster 3. Related to this finding, drivers in Cluster 1 had significantly larger mean total revenue, Variable 6, when compared to drivers in the other two clusters. While only practically significant with a p-value of .069, the percent of service failures found in Variable 7, showed that the drivers in Cluster 1 again had the lowest percentage of service failures, followed by members of Cluster 3 and then Cluster 2.

Finally, Table 4 looks at two contingency tables across the three cluster segments. The first examined whether any differences exist across the clusters related to whether the drivers were certified to handle hazardous materials. Practical significance for the Chi Square test (p=.090) indicated that 46.7 percent of the drivers from Cluster 1 were hazmat trained, while drivers from Cluster 2 and Cluster 3 respectively had only 38.3 percent and 33.3 percent of drivers who were hazmat trained. The second contingency table reflected whether drivers from the three groups had received their training from the local motor carrier affiliated trucking school or whether they had received their driver training from another organization. Again, the findings had only practical significance with a significance level of .081. Drivers in Cluster 1 were nearly equally divided as to where they had received their training, while drivers from Clusters 2 and 3 were more than twice as likely to have received their training from the local trucking school.

DISCUSSION

The present study has employed marketing segmentation theory associated with the belief that differences in the drivers of a motor carrier

can be identified and organized into groups by employing existing company data base information related to driver safety and other descriptive variables. Cluster analysis assumes that natural groupings of objects or individuals exist in a population. This is a logical assumption for a motor carrier's fleet of drivers, as Richard et. al. (1994) and Stephenson and Fox (1996) have indicated that some drivers are more desirable than others. If carriers treat their drivers as customers to establish better understanding and long-term relationships, they are in effect looking to meet the needs of their drivers. The application of cluster analysis to a large Midwestern motor carrier's driver safety database was successfully employed to identify the existence of three segments of drivers.

The first cluster was given the name "Best Overall Drivers". This segment represents the best quality drivers in the carrier's fleet. They are dependable, they avoid accidents, as well tickets and other citations. Even though they present no problems for their employers, they still should be offered any additional training and safety programs. These will probably be the drivers most likely to appreciate and use new safety technologies as they become available, as they have the largest number of months invested in the carrier. Related to these drivers' positive contributions to the motor carrier's profitability is the need to continually recognize drivers in this segment and to reward them. These are drivers who have generally been with their carrier for a long period of time (Bruning, 1989; Min and Emam, 2003). The drivers in this segment are the best drivers in the fleet and carrier management should consider all alternatives and incentives to keep them driving for the company.

TABLE 4
CROSS TABULATIONS OF VARIOUS DEMOGRAPHIC VARIABLES ACROSS 3 TRUCKER CLUSTERS

	Cluster					
	1. Best Overall Drivers	**2. Ticket Magnets**	**3. Accident Prone**		**ChiSquare**	**Sig.**
1. HazMat Certified						
					4.81	.090
Yes	79	31	31			
No	90	50	62			
2. Truck School Graduate						
					5.023	.081
Local School	84	52	54			
Other School	85	29	39			
	n=169	n=81	n=93	N=343		

As Keller and Ozment (1999a; 1999b) and others have indicated, dispatchers and other company employees must do a good job communicating and managing the company's drivers. The relationship is symbiotic for both parties as the drivers recognize the carrier is interested in their needs, and the carrier can identify and implement strategies to retain the highest quality drivers so as to to be more profitable. Surprisingly, those drivers who were in the best driver category were the least likely to have been trained by their current employer. This may be related to the fact that drivers in the best overall driver category are older and likely had good driving experiences before they were employed by their current carrier. Another possibility may be related to specific generational differences in attitudes and learning styles. Clearly more research is needed to examine potential training differences and requirements across all driver segments.

Drivers in the second cluster, given the label of "ticket magnets," were actually slightly below the overall average for all drivers on accident points. Drivers in this cluster were most noteworthy for averaging more than twice as many citations as drivers in the other two clusters. They also had significantly higher incident points, inspection points, and complaint calls from other motorists (MOTO) when compared to drivers from any other cluster. Profiling "Ticket Magnets" on other variables indicated that drivers in this cluster had the highest average number and percentage of service failures. They also had the lowest average number of loads hauled as well as lower total revenue. These findings were significantly lower than the averages found for drivers in the first cluster. The relationship of safer drivers to profitability is evident. These drivers also need additional training to stay under the radar of police and patrolmen. By doing so, drivers in this segment can avoid putting points on their driving records, thus helping to lower insurance costs for their company. They will also be less likely to become involved in accidents. The challenge to the carrier is to improve the drivers in this cluster before they possibly slip into the third cluster of "accident prone" drivers.

The third cluster of drivers was given the label of "accident prone". They were distinguished from drivers in the other two clusters because of their high average number of accident points. Their accident points were almost nine times greater than drivers in the "Best Overall Drivers" category, and more than twice as many as drivers in the "Ticket Magnet" cluster. Interestingly, drivers in this cluster averaged only slightly more citation points than did drivers in the "Best Overall Drivers" cluster. They also had the lowest overall average of inspection points across the three clusters. With the exception of the high average accident points, as a cluster they were close to the overall average on most of the other safety point variables. Surprisingly, members of this cluster had service failure averages, average loads hauled, and average percentages of service failures similar to those of the drivers in the second "ticket magnet" cluster. They also had the lowest average for total revenue. It is clear that these drivers provide the most risk and challenge for the motor carrier. They also present their company with the most serious concerns related to profitability.

At the very least, the motor carrier must consider providing, or insisting, that these drivers receive additional driver training to avoid future accidents. This should help drivers in this cluster to recognize that the carrier is willing to further invest time and money in them. As previously discussed, accidents severely decrease motor carrier profitability (Corsi and Fanara, 1988; Bruning, 1989; Stephenson and Fox, 1996; FMCSA, 2008). The direct and indirect costs of accidents not only relate to immediate expenses, but also to long-term concerns of lost customers and poor public image (Richardson, 1994). Drivers in this segment are the riskiest in terms of profitability, and thus could be considered by the motor carrier to be the most expendable if any drivers

in this segment should decide to move to another carrier. The motor carrier will have to evaluate the value of each driver in this segment against the potential cost of the driver being retained. How long ago was the last accident of each driver in the cluster, and does the driver seem to be improving, should be a few of the questions asked by motor carrier management. Such a decision will also have to be made in light of the prevailing economic conditions.

MANAGERIAL IMPLICATIONS

The results of this study have demonstrated the use of a micro approach for motor carriers to use with company databases to better understand the drivers in a company's fleet. Drivers that were described as the "best overall" drivers can be identified and encouraged to act as mentors to other drivers who were classified as "ticket magnets" or "accident prone." Some type of reward system should be implemented for the "solid and dependable drivers" to encourage them to be leaders in helping the other drivers to become "solid and dependable" drivers. The reward system will also encourage more risky drivers to become better drivers to receive the advantages of being in the reward system. Reward systems have been described by other researchers as being an important component of any motor carrier's safety strategy for drivers (Mejza, et. al., 2003). The goal is to establish a relationship between the carrier's best drivers to help those that could become better drivers. It has been argued that drivers often jump from carrier to carrier because they have not become invested in their current carrier (Min and Emam, 2003). Such an approach might help to get drivers socialized with the best drivers in a carrier's fleet and help younger drivers develop stronger personal relationships within the organization. The ultimate goal of such a program is to increase carrier profitability by increasing safety and reducing the number of drivers who move from carrier to carrier. Direct and indirect safety costs are ultimately reduced.

Carrier management employing a database segmentation strategy can evaluate drivers who are considering a move to another carrier before they actually move. Drivers who are considered to be in the "best overall drivers" category would likely merit additional company resources to retain them since they are the most profitable drivers in the fleet. The methodology may also allow carriers to better track drivers at risk. By understanding the safety issues they present, company safety programs may help at risk drivers to better internalize the need for safety (Arboleda et.al., 2003) thus making them safer drivers. Drivers who consider moving to another carrier but have a continuing history of moving violations and/or accidents can be evaluated by management and thus may not receive as much consideration and resources to keep them with the firm.

One limitation for this study was that it examined the driver database of a single motor carrier. Future studies should examine the driver databases of additional motor carriers. Examining other carrier databases will also address any regional differences that might exist for motor carriers based in different states and operating in different regions of the country. Future studies should also consider examining personality characteristics of drivers as they relate to drivers safety records.

If the American economy does not improve at a faster rate, motor carriers may be forced to release some drivers until the economy improves. Such a scenario makes it important for motor carriers to preserve the best driver talent in their fleets to have a quality start for the eventual economic recovery (Tuna, 2009). A recently released national survey has indicated that the economy is starting to improve and some fleets are now boosting driver's pay (Watson and Bearth, 2010). Given that some drivers can contribute more to a carrier's profitability than others, the present study has provided motor carriers with a tool based upon usable theory to identify and retain the best

drivers in their fleets. As drivers become aware of the carrier's use of a database classification system, it may help motivate them to become safer drivers and to receive more rewards, and thus make the carrier more profitable. The purpose of employing such a database system is to allow the carrier to make better decisions about its drivers, to retain the best drivers who make the carrier more profitable, and to help those drivers in the fleet who are more of a safety risk to become safer drivers. In the long run everyone wins, including the safety of the general public.

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