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Delta Nu Alpha Transportation Fraternity



Journal of Transportation Management

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1. First Page—Title of the paper, name and position of the author(s), author(s) complete address(es) and telephone number(s), e-mail address(es), and any acknowledgment of assistance.
2. Second Page—A brief biographical sketch of each author including name, degree(s) held, title or position, organization or institution, previous publications and research interests.
3. Third Page—Title of the paper without author name(s) and a brief abstract of no more than 100 words summarizing the article. The abstract serves to generate reader interest in the full article.

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3. Accepted articles, in final form, are also submitted via email (in WordPerfect or Microsoft Word format as described above). Note: Macintosh versions of WordPerfect and Microsoft Word are NOT acceptable.
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$$y = c + ax + bx \quad (1)$$

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Wilson, J. W. (2003), "Adapting to the Threat of Global Terrorism: Reinventing Your Supply Chain," [On-line]. Available: <http://georgiasouthern.edu/coba/centers/lit/threat.doc>. Accessed: 11/12/03.

MANUSCRIPT SAMPLE

A FRAMEWORK FOR EVALUATING SUPPLY CHAIN PERFORMANCE

Terrance L. Pohlen, University of North Texas

ABSTRACT

Managers require measures spanning multiple enterprises to increase supply chain competitiveness and to increase the value delivered to the end-customer. Despite the need for supply chain metrics, there is little evidence that any firms are successfully measuring and evaluating interfirm performance. Existing measures continue to capture intrafirm performance and focus on traditional measures. The lack of a framework to simultaneously measure and translate interfirm performance into value creation has largely contributed to this situation. This article presents a framework that overcomes these shortcomings by measuring performance across multiple firms and translating supply chain performance into shareholder value.

INTRODUCTION

The ability to measure supply chain performance remains an elusive goal for managers in most companies. Few have implemented supply chain management or have visibility of performance across multiple companies (Supply Chain Solutions, 1998; Keeler et al., 1999; Simatupang and Sridharan, 2002). Supply chain management itself lacks a widely accepted definition (Akkermans, 1999), and many managers substitute the term for logistics or supplier management (Lambert and Pohlen, 2001). As a result, performance measurement tends to be functionally or internally focused and does not capture supply chain performance (Gilmour, 1999; *Supply Chain Management*, 2001). At best, existing measures only capture how immediate upstream suppliers and downstream customers drive performance within a single firm.

Table 1 about here

Developing and Costing Performance Measures

ABC is a technique for assigning the direct and indirect resources of a firm to the activities consuming the resources and subsequently tracing the cost of performing these activities to the products, customers, or supply chains consuming the activities (La Londe and Pohlen, 1996). An activity-based approach increases costing accuracy by using multiple drivers to assign costs whereas traditional cost accounting frequently relies on a very limited number of allocation bases.

$$y = a^2 - 2ax + x^2 \tag{1}$$

REFERENCES

- Manrodt, Karl (2003), "Drivers of Logistics Excellence: Implications for Carriers," In J. W. Wilson (Ed.), *Logistics and Transportation Yearbook 2003* (pp. 126-154) Englewood Cliffs, NJ: Prentice-Hall, Inc.
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The **Delta Nu Alpha Foundation** is a not-for-profit organization, with a sole purpose of supporting education in the fields of transportation, distribution and logistics. Since its inception in 1987, the Foundation has provided numerous scholarships, research grants, and the sponsorship funding for *The Journal of Transportation Management*, published by Georgia Southern University.



The Foundation provides continuous support of education in a changing industry. Scholarships, in excess of \$1000, are granted annually to students pursuing careers in transportation and logistics and currently studying in schools, colleges, and universities with established programs in these fields. Recent recipients have included students at Western Illinois University, Penn State, Iowa State University, University of North Texas and Arizona State University,

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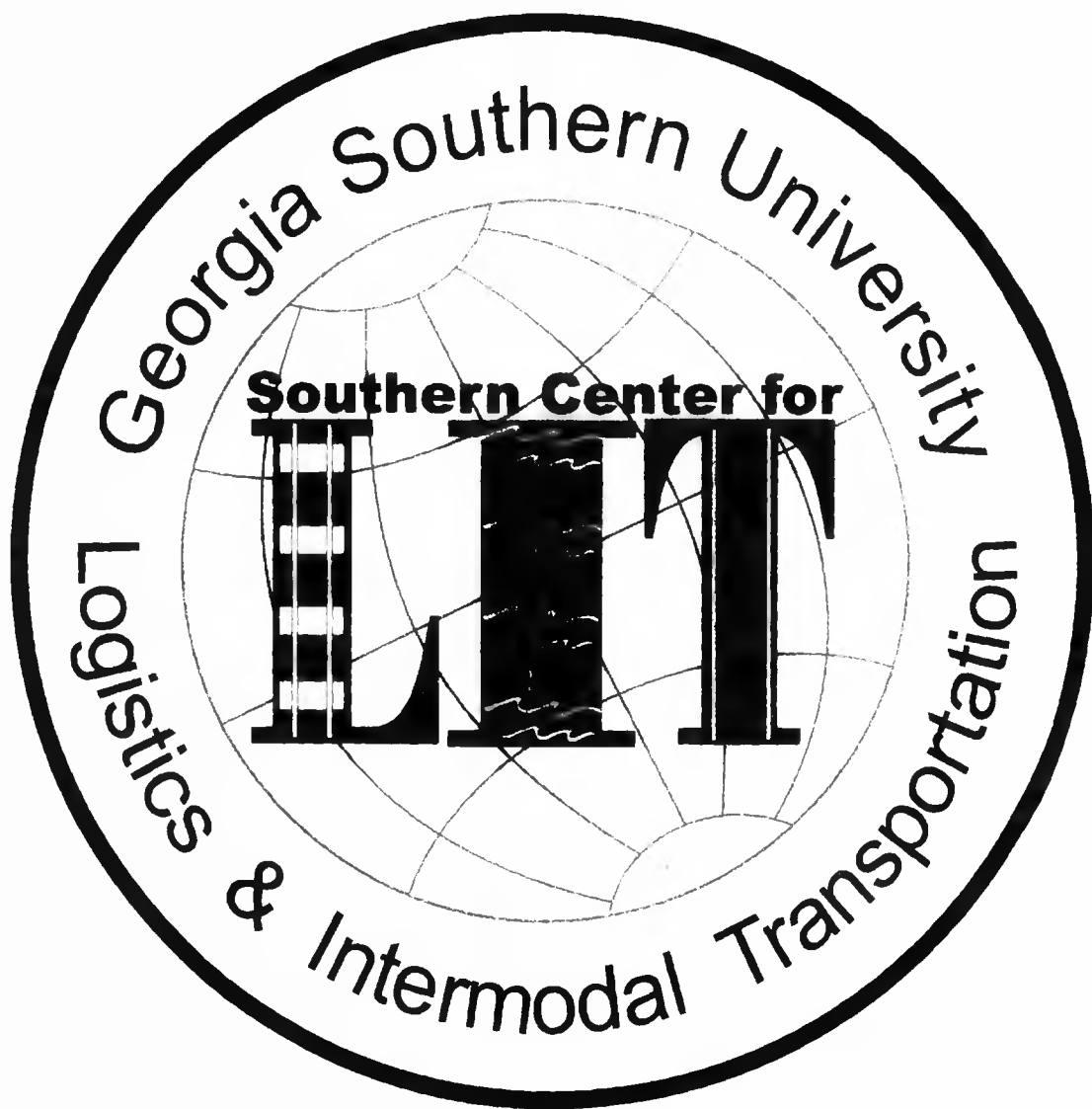
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OBJECTIVES

Editorial Policy. The primary purpose of the *JTM* is to serve as a channel for the dissemination of information relevant to the management of transportation and logistics activities in any and all types of organizations. Articles accepted for publication will be of interest to both academicians and practitioners and will specifically address the managerial implications of the subject matter. Articles that are strictly theoretical in nature, with no direct application to the management of transportation and logistics activities, would be inappropriate for the *JTM*.

Acceptable topics for submission include, but are not limited to carrier management, modal and intermodal transportation, international transportation issues, transportation safety, marketing of transportation services, domestic and international transportation policy, transportation economics, customer service, and the changing technology of transportation. Articles from related areas, such as third party logistics and purchasing and materials management are acceptable as long as they are specifically related to the management of transportation and logistics activities.

Submissions from industry practitioners and from practitioners co-authoring with academicians are

particularly encouraged in order to increase the interaction between the two groups. Authors considering the submission of an article to the *JTM* are encouraged to contact the editor for help in determining relevance of the topic and material.

The opinions expressed in published articles are those of the authors and do not necessarily reflect the opinions of the Editor, the Editorial Review Board, Delta Nu Alpha Transportation Fraternity, or Georgia Southern University.

PUBLISHING DATA

Manuscripts. Submit the manuscript, along with all tables, figures, and references to the editor by email attachment to kmanrodt@georgiasouthern.edu. Manuscripts should be no longer than 25 double-spaced pages. Guidelines for manuscript submission and publication can be found in the back of this issue.

Subscriptions. The *Journal of Transportation Management* is published twice yearly. The current annual subscription rate is \$50 domestic and \$65 international in U.S. currency. Payments are to be sent to the editor at Southern Center for Logistics and Intermodal Transportation, Georgia Southern University, P. O. Box 8154, Statesboro, GA 30460-8154.



From the Editor Designee.....

I am honored that the DNA Board has selected Wayne State University and me to serve as the new Publisher and Editor of the *Journal of Transportation Management* effective with the start of this new decade. The *Journal* has made great progress since its founding in 1989. With the help of the Editorial Review Board we hope to continue to enhance the reputation of the *Journal* for both academic and practitioner audiences in the transportation and supply chain worlds.

This issue of the *Journal* is the last under the capable leadership of Karl Manrodt. We owe a large debt of gratitude to Karl and the Georgia Southern University team for their work over many years. Karl was an Associate Editor from 2000 to 2007, and became the Editor in 2007. Karl has worked tirelessly to increase the quality of the *Journal*. He did an outstanding job of bridging the academic and practitioner worlds and assuring a mix of articles and authors that added great value to the study and practice of transportation and logistics. Over the last few months Karl has also been of great help to me and that is much appreciated. On behalf of the Editorial Review Board and myself, I would like to offer our heartfelt thanks to Karl and Georgia Southern for their work on the *Journal*.

Going forward the *Journal* will be published by Wayne State University's School of Business Administration in Detroit, Michigan. With the help of Wayne State we will be able to continue printing and distributing two issues of the *Journal* per year, and we may add some electronic special issues. George C. Jackson, recently retired from the Wayne State faculty, will be assisting me as an Associate Editor. I have also been in contact with our Editorial Review Board and look forward to them continuing their work on behalf of the *Journal*. Finally, we plan on taking several steps to increase the visibility of the *Journal* in libraries and other forums but more on those initiatives next issue.

We will continue to publish both policy and managerial articles that are relevant to academics and practitioners in the transportation, logistics and supply chain fields. We will be looking for conceptual, theoretical and applied research that contributes to better understanding and management of transportation and logistics. Saying that, we will maintain the policy that requires articles to be of interest to both academics and practitioners, and that they specifically address the managerial implications of the subject matter. Articles related to any and all types of organizations, and of local to global scope, will be considered for publication.

I look forward to serving you as the Editor of the *Journal*, and hope to hear from you our readers, with questions, comments and article submissions.

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From the *Old* Editor...

This issue is the last that I will serve as editor. Ending my efforts as editor of the *Journal* was a difficult decision, but one I feel is best for all. As other editors will tell you, it is more work than ever expected.

At the same time, it has been a very rewarding experience, both on a personal and professional level. Being a part of determining the content of the *Journal* was exciting, as well as working with an excellent group of writers.

While two years as an editor seems to be a long time, it is not nearly as long as the eleven years that saw Dr. Jerry Wilson at the helm of the *Journal*. He was, and continues to be, a steadfast supporter, editor and cheerleader for the *Journal*. His energy and commitment to the *Journal* will be hard to match, not just for me, but for other editors as well. His support of my efforts while being the editor is much appreciated.

Thanks too to a wonderful group of reviewers, whose timeliness was most appreciated. Their insights and comments for the authors were helpful in improving the research, and the status of the *Journal*.

And, we cannot forget the hard work of Carol Waller, who was responsible for the actual production of the *Journal*. Carol has been indispensable for the last decade, taking care of all the final production details.

Finally, a warm welcome to Dr. John Taylor for stepping up and taking the task. I hope that he receives the same level of support for DNA, the editorial board, reviewers, authors and support staff that I received these two years.

Karl B. Manrodt, Editor
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A TRIADIC VIEW OF TRUCK DRIVER SATISFACTION

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Dalton State College

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Central Michigan University

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ABSTRACT

In this research, the authors surveyed three groups concerning job satisfaction: experienced drivers, new drivers, and managers. Statistical tests were conducted using a sample of 196 new drivers, 145 experienced drivers, and 59 managers from a large TL firm based in the U.S. The results suggest that many discrepancies exist on driver satisfaction among the three perspectives. In particular, new drivers provide managers with opportunities and challenges for satisfaction. Given the current state of the trucking industry, managers will likely benefit from approaching this segment of drivers differently to meet their expectations and keep them from leaving their firms.

INTRODUCTION

Driver turnover has persistently plagued for-hire truckload (TL) motor carriers since deregulation in 1980. Many trucking firms have tried higher wages, bonus programs, family incentives, guaranteed time-home schedules, and a variety of other plans, but the problem persists—drivers switch firms or leave the industry, a process that costs trucking firms \$6,000-\$15,000 per driver lost (Min and Lambert 2002; ATA 2007). Although driver turnover fluctuates, on average it has risen to 121% average for large TL firms and 102% for small firms (annual revenue of \$30 million or less) (ATA 2007). Some large firms have turnover rates above 200% annually. To put this in perspective, the annualized turnover rate for all jobs in the U.S. was 23.7% in 2006 (BLS 2007).

Driver turnover adds to the cost of consumer goods, cuts profits for trucking firms, and lowers logistics productivity. In 2005, Ozark Motor Lines reported a

66% annual turnover rate for 750 drivers. They hired 495 drivers that year, estimating the turnover cost to be \$2.5 million (Paz-Frankel 2006) and those costs were likely passed down the supply chain.

As the U.S. economy faltered in 2008, an influx of workers from other industries alleviated the driver shortage and slowed turnover (CSCMP 2008). The trucking industry welcomed the new hires, but experienced managers know that bringing in new drivers puts additional pressure on training and education. New, less-experienced drivers are more likely to miss customer appointments and disrupt operations. Even experienced drivers can create these problems when they are new to a company and unfamiliar with local procedures.

An important gap in the literature revolves around understanding the differences between experienced drivers and new drivers. Managers often struggle to understand drivers' perspectives and attitudes

concerning job satisfaction. But no research to date has compared different perspectives between new drivers, experienced drivers, and managers. What attitudes do they share? What attitudes are different? Does management understand one group better than the other? Understanding the difference between these groups and how management perceives this situation is important for retention strategies.

The purpose of this research is to compare job satisfaction for new drivers and experienced drivers, and then to compare to them to perceptions of management. In short, we will attempt to answer the following question: For different job satisfaction attributes, are there differences between new drivers and experienced drivers, and managers' interpretation of driver satisfaction?

To reach these objectives, we report our findings of a literature review. Then, we discuss our research method and analysis, followed by our results. Finally, we discuss both theoretical and managerial conclusions, and outline the next steps to further this research stream.

TRUCK DRIVER TURNOVER RESEARCH

Research on turnover has taken three primary approaches: 1) surveys of managers that focus on characteristics of the firm and how management decisions affect turnover; 2) surveys of drivers that focus on attitudes, job satisfaction, and how they impact retention; and 3) surveys of drivers that focus on career commitment and the likelihood of staying in the industry. This research will bridge the gap among these different research streams, bringing together research results of both managers and drivers, comparing and contrasting the results.

Surveys of Managers

Southern et al. (1989) analyzed 148 responses to a survey questionnaire sent to managers of truckload (60%), less-than-truckload (21%), truckload and less-than-truckload combined (10%), and other (9%). The questionnaire asked personnel directors what methods they used to recruit drivers, what benefits they stressed in recruiting, and what experience and other qualifications they demanded of drivers. Most relevant to the current research, they asked personnel directors to rank "What incentives . . . are most important to drivers in choosing a company to work for?" (Southern et al. 1989, p. 43). The findings are in

Table 1, where the results are compared to a later study conducted by Dobie et al. (1998).

Dobie et al. (1998) reproduced this research, advancing this stream significantly. Although fewer firms responded—62—the carrier profile was similar: 63% truckload, 29% truckload and less-than-truckload, and 8% less-than-truckload only. They asked personnel directors the same questions as the 1989 study. Table 1 compares the rankings of driver incentives from the two studies. The 1998 study asked about more incentives, so the two results are not directly comparable, but the top five were the same with some changes in order. Pay was ranked first by the personnel directors each time. Carrier reputation increased in importance, changing from fourth most important (1989) to second most important (1996).

Respondents in both studies reported turnover problems. In the 1989 study, 89% of the respondents reported problems with turnover (Southern et al. 1989). In the 1996 study, researchers asked more specific questions. More than 50% of respondents reported turnover of over 50% (Dobie et al. 1998). These turnover rates may seem less dramatic than those in other studies, but they were lower because of the mixture of carrier types.

The same situation applies to another major study in this tradition. Min and Lambert (2002) analyzed 480 responses from a survey questionnaire sent to a mixture of carriers. Like the two earlier studies of managers, they found pay to be the most important factor affecting driver recruitment and retention. Their top four factors in importance coincide with results from the earlier research. These factors were competitive pay scales, condition of equipment, company reputation, and amount of time not on the road. Consistent with the earlier research, this study stressed recruitment methods, finding that the most frequently used methods were also the methods the respondents believed to be the best.

Min and Lambert (2002) found no systematic relationship between driver wages and turnover, except when the firm paid substantially higher salaries. Still, managers in this study were convinced that drivers considered wages and pay rates foremost in choosing where to work.

Works by Keller (2002) and Keller and Ozment (1999) are in a distinct subcategory of surveys of managers. These studies were based on survey questionnaires distributed to first-line managers—dispatchers—to

TABLE 1
RANKING OF DRIVER INCENTIVES BY MOTOR CARRIER PERSONNEL DIRECTORS

Incentive	1996 Rank	1989 Rank
Pay	1	1
Condition of the Equipment	3	2
Time at Home	4	3
Carrier Reputation	2	4
Health Benefits	5	5
Vacation Time	10	6
Freedom from Direct Supervision	9	7
Sick Leave	14	8
Advancement Opportunities	12	9
Extra OJT	13	10
Equipment Type	6	-
Access to Management	7	-
Pension	8	-
Expenses	11	-
Sign-up Bonus	15	-

Adapted from Dobie, Rakowski, and Southern (1998)

identify sources of the turnover problem and potential solutions. Keller and Ozment (1999) analyzed responses from 149 dispatchers in five truckload carriers to test Hirschman's concept of Exit, Voice, and Loyalty (Hirschman 1970). They also gathered monthly turnover data for each dispatcher, so they could associate sensitivity to voice, sensitivity to exit, and responsiveness scores with turnover. In testing a structural equation model, they found a strong, negative relationship between a dispatcher responsiveness and monthly, voluntary driver turnover. Sensitivity-to-voice and sensitivity-to-exit had no statistically significant, direct effect on turnover, so responsiveness was an essential moderating variable.

In a related study, Keller (2002) found turnover to mediate the relationship between driver pay and driver relationships with customers, the relationship between time home and driver relationships with customers. Turnover also mediates the relationships

between pay and performance and time home and performance. If turnover is lower, drivers build better relationships with customers and perform better. Also, drivers who build strong relationships with customers perform better. It is no surprise that drivers work harder for people they know and like.

These studies bridged the gap between external studies, which surveyed managers, and the internal studies, which surveyed drivers. Taylor (1991) also discussed dispatchers as critical to controlling driver turnover, but his work was normative, informing trucking managers on how to use performance appraisals of dispatchers to help lower turnover.

Surveys of Drivers About Their Intent to Quit

LeMay and Taylor (1988) and Taylor (1991) offered normative approaches to driver recruitment and retention, laying a foundation for later empirical work on driver attitudes, job satisfaction, and intent to quit

(Taylor and LeMay 1991; LeMay et al. 1993; Richard et al. 1994; Richard et al. 1995). This research tied truck driver attitudes and job satisfaction to intent to quit. They included driver attitudes towards the company, dispatchers, top management, pay administration, time home, equipment, other companies, and other drivers. They used the Minnesota Satisfaction Questionnaire (MSQ) to measure intrinsic, extrinsic, and overall job satisfaction. In this body of work, the researchers built a variety of models that linked these attitudes and the MSQ to intent to quit, an indirect measure of likely turnover. This work was conducted with drivers from a large truck-load carrier, but included responses from 426 drivers. Other research in this tradition analyzed more responses from more carriers.

McElroy et al. (1993) analyzed 3,405 responses from drivers for thirteen TL firms. They studied the effects of career stage and time away from home on driver attitudes. They used component measures for job satisfaction, asking whether drivers liked or disliked driving the truck, relationships with customers, paperwork, meeting safety requirements, and so on. They also delved deeply into driver attitudes toward their equipment, interest in training, job enlargement, recognition, adequacy of benefits, supervisors, and perceived attitudes of the company to drivers. They found that late career drivers had more negative attitudes and saw little chance for advancement. Early career drivers were more positive and saw more chances for advancement. They used scales that were developed specifically for their project. In other words, even though scales existed for the constructs of interest, McElroy et al. (1993) developed their scales independently and did not utilize scales developed in prior research.

The most comprehensive work in this stream of research also did the most to span the boundaries between surveys of drivers and surveys of managers. Stephenson and Fox (1996) surveyed drivers from 57 truckload motor carriers, getting 1,791 usable responses, 1,464 from company drivers. They developed extensive work demographics on the respondents—annual income, hours worked a week, miles driven a week, frequency getting home, number of companies worked for, and age.

Surveys of Drivers Commitment to the Trucking Industry

Corsi and Martin (1982) developed a model to explain turnover among owner-operators. Data for the study were collected in 1978 from 323 owner-operators

under permanent lease and 156 trip-leased owner-operators. One year later, the same owner-operators were surveyed again, yielding 287 and 139 responses. From 1978 to 1979, 20% of the permanent-lease respondents were no longer under permanent lease; of those, 39% had left the trucking industry—an exit rate of about 5%. Most left the industry for economic reasons. In the same period, 18% of the trip-leased respondents were no longer owner operators; of those, 23% had left the industry, an exit rate of about 4%. Other respondents had changed status in the industry, becoming employee drivers for carriers or private fleets. This study differs from most in this review because it dealt with owner operators and because it was based on data gathered before motor carrier deregulation in 1980. Nonetheless, it was important because it was the first systematic, academic attempt to explain driver turnover.

The next empirical work on driver turnover came from Beilock and Capelle (1990). They analyzed responses from 878 drivers on career commitment—the likelihood that they would still be driving in five years. They studied the relationship between drivers' ages, status as a driver—owner-operator or company driver—years of driving experience, years of experience in other jobs, recent income trends, and training. They found that opportunity costs most heavily influenced whether a driver said he would stay in the business for the next five years. Drivers with more education and work experience outside driving were more likely to leave the industry.

Beilock (2003) updated this work thirteen years later, partly in response to Belzer's book, *Sweatshops on Wheels: Winners and Losers in Trucking Deregulation* (Belzer 2000). In a survey with 1,642 responses, Beilock found truck drivers of refrigerated trucks rated their jobs as better than a sweatshop and were more likely to stay in the industry than to leave it. The 2003 results were similar to those from earlier work.

Beilock's work relied on an economic tradition and ignored research that took a managerial approach. This research neither measured turnover directly, as did researchers who surveyed managers, nor did he use scaled approaches to assess driver attitudes, job satisfaction, and intent to quit. Other surveys of drivers concentrated on these issues.

Summary of the Literature on Truck Drivers

Each of these streams of research offers valuable information that should help researchers and

managers. The surveys of managers showed how a firm's policies and practices can tie directly to turnover. They were based on many responses from cross-sections of the industry. The surveys of drivers should help managers understand how drivers think, potentially leading to better policies and practices. The other surveys of drivers focused on intent to stay in the industry. This work gave a valuable view of turnover throughout the industry, concentrating on the work demographics of the drivers and tying them to intent to leave the industry.

In the past, these streams of research have been difficult to compare. The surveys of managers drew responses from several categories of carriers—truckload, less-than-truckload, and mixed. The surveys of drivers drew responses from truckload carriers only, while the driver surveys on exit from the industry drew from refrigerated truckload and less-than truckload carriers. Only the work by Keller and Ozment (1999) tied turnover to dispatcher behavior at the micro level. Research needs to bridge the gap more, explaining truck driver attitudes as well as managerial beliefs about these attitudes.

No research studies to date have examined the difference between new drivers and experienced drivers. Given the influx of new drivers to the trucking industry, an understanding of new drivers is now needed more than ever. Even more important, researchers need to examine whether or not there is a difference between the perspectives of new drivers and experienced drivers in their job satisfaction.

A final gap in the literature is gaining the perspective of management in regards to job satisfaction of both new and experienced truck drivers. Can management accurately interpret job satisfaction of their truck drivers?

RESEARCH METHOD

In this section, we will first address the research question, followed by data collection, survey measures, and the analysis and results.

Research Question

To better understand some of the gaps left by previous research, this research will address the following research questions:

Research question: For different attributes of truck driving job satisfaction,

are there differences between new drivers, experienced drivers, and managers?

Data Collection

We partnered with a large Midwestern truckload carrier to distribute copies of the survey to drivers and management. At the company's request, eight hundred hard-copy surveys were distributed through five of the firm's larger terminals. The firm notified experienced drivers about the research through its driver communications system, so drivers could pick up the surveys if they chose to participate. Experienced drivers were asked to complete the survey concerning their current levels of satisfaction. They were asked to return the finished surveys to secure collection boxes in the terminals. New drivers were asked to complete the hard copy surveys at new driver orientations at various locations. These drivers were asked to complete the survey as to their expected levels of satisfaction. This perspective was requested because new drivers would not have the ability to fully answer all items because they had not yet been driving yet.

After all surveys were collected, the secure boxes were returned to the researchers. Responses came from the firm's largest division, the van division. This group included 2,800 company drivers and 400 owner operators.

Three hundred and seventy four of the 800 driver surveys were returned. Thirty two were incomplete or deemed unusable, and thirteen more were cut out as the respondent failed to identify themselves as experienced or new drivers, leaving 328 usable surveys for a response rate of 41 percent. This included 196 responses who identified themselves as new drivers and 145 as experienced drivers. We did not try to investigate non-response bias for two reasons: first, surveys were completely confidential, with no way to identify respondents; second, the surveys were collected by the sponsoring firm and mailed back to the researchers in batches, so there was no way to identify early or late respondents, a common way to assess non-response bias (Armstrong and Overton 1977).

To fulfill the objectives of this research, we asked company managers to participate in the survey. The managers were asked to respond to the questionnaires as they thought most truck drivers would respond (i.e., relying on their experiences with interacting with drivers). We contacted 97 managers (from Vice

Presidents to Dispatchers) and received 59 responses, for a response rate of 60.8 percent.

Data were analyzed with SPSS 15.0. We approached the data pairwise to allow for missing data on an item by item basis.

Measures

In this study, we used the Minnesota Satisfaction Questionnaire (MSQ) to assess truck drivers' satisfaction with their jobs. The MSQ is considered one of the best constructed, most useful measures of job satisfaction (Henneman and Schwab 1985; Thompson and Blain 1992). For this research, a 5 point Likert scale (1 strongly disagree – 5 strongly agree) was used mimicking previous applications of the MSQ.

The MSQ has a long form and a short form, both with extensive validation studies (Weiss et al. 1967). The long form has over 100 items, too long to fit this research program. We instead used the 20 item MSQ short form with a twenty-first question that asked about satisfaction with fringe benefits (Weiss et al. 1967). The MSQ has shown strong ties between facet measures and overall satisfaction, a link lacking in other measures of job satisfaction such as the Job Descriptive Index or the Hoppock Scale (Scarpello and Campbell 1983). The MSQ has also shown strong convergent validity, discriminant validity, and reliability in studies comparing methods for measuring job satisfaction (e.g., Dunham et al. 1977).

The original research showed three factors: extrinsic satisfaction, intrinsic satisfaction, and general satisfaction. Extrinsic satisfaction measures satisfaction with the environment of the work—pay, supervision, advancement, and so on. Intrinsic satisfaction measures satisfaction with the work itself—accomplishment, serving others, trying ideas, and so on. These factors aligned with Herzberg's concepts of extrinsic and intrinsic dimensions of work (Herzberg 1966; Herzberg et al. 1959). General satisfaction includes satisfaction with working conditions and coworkers (Weiss et al. 1967).

Subsequent research has frequently, but not always, validated this structure with factor analysis. Two factors have typically been reported, again aligning with Herzberg (See, for example, Weiss et al. 1967; Bledsoe and Baber 1979; Hauber and Bruininks 1986). Tan and Hawkins (2000) found three factors in a study of people with psychiatric disabilities who were participating in vocational rehabilitation programs.

Hancer and George (2004) found four factors in a study of hourly restaurant workers in the Midwestern United States.

In addition to the many issues of factor structure of the MSQ scale, the researchers find that the factors are too broad, which can mask valuable results. In addition, previous experience with MSQ scales suggests that managers find the information at the item level to be more actionable and meaningful. Thus, this research will keep the MSQ measurements items at the item level, instead of using the items to create factors.

RESULTS

In review of the mean satisfaction scores, a couple things become apparent. On most of the satisfaction measures, the new drivers expected levels of satisfaction are higher than the other two groups. Also apparent is that the management group anticipated levels of driver satisfaction was much lower than what drivers reported. The new drivers reported the lowest expected satisfaction levels with "Your pay and the work you have to do," and the highest with "The chance to do something that uses your abilities." Experienced drivers lowest current satisfaction levels were with the same item as the current drivers. The highest was with "The freedom you have to use your own judgment." The management team also scored the lowest levels of satisfaction with the pay and work satisfaction item (although the mean value was much lower than both driver groups). The highest level of satisfaction came with "Being able to do things that don't hurt your conscience." Table 2 shows all the mean values for each item.

The data was analyzed in two ways to better gain insight for the stated research questions. First, ANOVA was utilized on the MSQ items to understand if significant differences exist between job satisfaction of new drivers, experienced drivers, and managers' perceptions. Second, Bonferroni analysis within ANOVA was used to understand the specific differences among the three perspectives. If the overall ANOVA suggests that there is a difference among the three groups, the Bonferroni analysis will pinpoint exactly where the difference exists.

The ANOVA results in Table 3 indicate multiple differences among the mean scores. At the .05 level of significance, 13 of the 21 MSQ items were significantly different among the three groups surveyed. With all significant differences, the management expected

TABLE 2
MEANS FOR MSQ ITEMS BY GROUP

MSQ Item	ND Mean	ED Mean	MGT Mean
Your pay and the work you have to do	3.09	2.74	2.15
The chance to work alone	3.16	3.36	2.66
The praise you get for doing a good job	3.18	2.92	2.81
The chance to tell people what to do	3.21	3.30	2.81
The fringe benefits you receive	3.22	2.82	2.53
The way your coordinator handles employees	3.26	3.39	3.32
The way your co-workers get along with each other	3.26	3.29	3.41
The chance to do something different from time to time	3.27	3.42	2.98
The competence in your coordinator in making decisions	3.27	3.40	3.49
Being able to keep busy all the time	3.29	3.11	2.80
The way company policies are put into practice	3.30	3.01	2.86
The chances for advancement on this job	3.31	3.00	2.58
The chance to be somebody in the community	3.33	3.21	2.68
The working conditions	3.37	3.58	3.09
The chance to do things for other people	3.45	3.47	3.24
The way your job provides steady employment	3.48	3.65	3.36
The feeling of accomplishment you get from the job	3.50	3.62	3.00
Being able to do things that don't hurt your conscience	3.51	3.71	3.70
The chance to try your own methods of doing the job	3.54	3.81	2.75
The freedom you have to use your own judgment	3.55	3.87	3.09
The chance to do something that uses your abilities	3.57	3.66	3.36

TABLE 3
MSQ ANOVA RESULTS

MSQ Item	ND Mean	ED Mean	MGT Mean	F- Value	Sig Level
Your pay and the work you have to do	3.09	2.74	2.15	18.58	0.001
The chance to work alone	3.16	3.36	2.66	10.74	0.000
The praise you get for doing a good job	3.18	2.92	2.81	5.47	0.005
The chance to tell people what to do	3.21	3.30	2.81	8.63	0.000
The fringe benefits you receive	3.22	2.82	2.53	12.98	0.000
The way your coordinator handles employees	3.26	3.39	3.32	0.89	0.413
The way your co-workers get along with each other	3.26	3.29	3.41	0.85	0.429
The chance to do something different from time to time	3.27	3.42	2.98	5.14	0.006
The competence in your coordinator in making decisions	3.27	3.40	3.49	1.85	0.158
Being able to keep busy all the time	3.29	3.11	2.80	6.61	0.002
The way company policies are put into practice	3.30	3.01	2.86	6.81	0.000
The chances for advancement on this job	3.31	3.00	2.58	13.87	0.000
The chance to be somebody in the community	3.33	3.21	2.68	13.22	0.000
The working conditions	3.37	3.58	3.09	6.41	0.002
The chance to do things for other people	3.45	3.47	3.24	2.07	0.128
The way your job provides steady employment	3.48	3.65	3.36	2.58	0.077
The feeling of accomplishment you get from the job	3.50	3.62	3.00	10.77	0.000
Being able to do things that don't hurt your conscience	3.51	3.71	3.70	2.60	0.076
The chance to try your own methods of doing the job	3.54	3.81	2.75	35.27	0.000
The freedom you have to use your own judgment	3.55	3.87	3.09	15.29	0.000
The chance to do something that uses your abilities	3.57	3.66	3.36	2.15	0.118

Level of significance = .05

levels of satisfaction were much lower than reported by drivers. Also, in most instances, the new drivers and experienced drivers satisfaction scores were paralleled. All results are shown in Table 3.

The 13 items that were identified as significantly different were then analyzed post-hoc with the Bonferroni technique to indentify the specific differences. Those differences are categorized as differences between new drivers and management, differences between experienced drivers and management, and finally, differences between new drivers and experienced drivers. As before, the .05

level of significance was used as a threshold to determine significance.

Differences Between New Drivers and Managers

Managers' perceptions differed significantly from new drivers' expectations on 11 of the 21 items in the MSQ. Table 4 highlights the differences between new drivers and managers.

On each of the 11 significantly different measures, managers significantly underrated the new drivers' expectations. This suggests that managers do not

necessarily have a great understanding of the satisfaction expectations of new drivers. In other words, new drivers expect to be much more satisfied than managers think they will be..

Specifically, the major item that stood out as having major difference was "Your pay and the work you have to do." This shows the largest mean difference between new drivers and managers. This discrepancy might suggest that new drivers expect to have satisfactory levels of pay for the work they are expected to do. On the other hand, managers may have answered in a way that they expect drivers to never be happy with their levels of pay.

Differences Between Managers and Experienced Drivers

Managers' perceptions differed from experienced drivers on many issues as well. The results show that significant differences on nine of the 21 items. Table 5 highlights those differences.

As with the new drivers, managers greatly underestimated the satisfaction levels of the experienced drivers. Surprisingly, the major difference between experienced drivers and management was not

over pay. Rather, it was on the item "The chance to try your own methods of doing the job." This suggests that management may not have a good feel for experienced driver's method of performing the job. Experienced drivers expressed very high levels of satisfaction with this measure.

Not surprisingly, there were seven MSQ items in which manager's misinterpreted both drivers groups on satisfaction levels:

- the chance to work alone;
- the chance to be somebody in the community;
- the chance to tell people what to do;
- pay for the work they do;
- the freedom to use judgment;
- the chance to try your own methods;
- feelings of accomplishment drivers get from their jobs

Differences Between New Drivers and Experienced Drivers

The new drivers and experienced drivers satisfaction responses mirrored one another, except for three items. The differences are highlighted in Table 6.

**TABLE 4
DIFFERENCES AMONG NEW DRIVERS AND MANAGEMENT**

MSQ ITEM	ND Mean	MGT Mean	Mean Difference	Sig Level
Being able to keep busy all the time	3.29	2.80	0.49	0.001
The chance to work alone	3.16	2.66	0.50	0.002
The chance to be somebody in the community	3.33	2.68	0.65	0.000
The chance to tell people what to do	3.21	2.81	0.39	0.002
The way company policies are put into practice	3.30	2.86	0.44	0.005
Your pay and the work you have to do	3.09	2.15	0.94	0.000
The chances for advancement on this job	3.31	2.58	0.73	0.000
The freedom you have to use your own judgment	3.55	3.09	0.47	0.003
The chance to try your own methods of doing the job	3.54	2.75	0.79	0.000
The feeling of accomplishment you get from the job	3.50	3.00	0.50	0.000
The fringe benefits you receive	3.22	2.53	0.69	0.000

Level of significance = .05

TABLE 5
DIFFERENCES AMONG EXPERIENCED DRIVERS AND MANAGEMENT

MSQ ITEM	ED Mean	MGT Mean	Mean Difference	Sig Level
The chance to work alone	3.36	2.66	0.70	0.000
The chance to do something different from time to time	3.42	2.98	0.44	0.005
The chance to be somebody in the community	3.21	2.68	0.53	0.000
The chance to tell people what to do	3.30	2.81	0.49	0.000
Your pay and the work you have to do	2.74	2.15	0.59	0.001
The freedom you have to use your own judgment	3.87	3.09	0.79	0.000
The chance to try your own methods of doing the job	3.81	2.75	1.06	0.000
The working conditions	3.58	3.09	0.49	0.002
The feeling of accomplishment you get from the job	3.62	3.00	0.62	0.000

Level of significance = .05

TABLE 6
DIFFERENCES AMONG NEW DRIVERS AND EXPERIENCED DRIVERS

MSQ ITEM	ND Mean	ED Mean	Mean Difference	Sig Level
Your pay and the work you have to do	3.09	2.74	0.35	0.004
The freedom you have to use your own judgment	3.55	3.87	-0.32	0.007
The fringe benefits you receive	3.22	2.82	0.40	0.001

Level of significance = .05

In two cases, the new drivers expressed much higher levels of satisfaction than did the experienced drivers ("Your pay and the work you have to do;" "The fringe benefits you receive"). Interestingly, experienced drivers expressed higher levels of satisfaction on "The freedom you have to use your own judgment." This suggests that once driving, the driver has the ability to make their own decisions, which drivers like.

DISCUSSION

The results of the statistical tests show that drivers and managers differ on perceptions of job satisfaction. The following will present discussion on those findings.

The short answer to the research question is that the three interpretations differ significantly on job satisfaction, but the most compelling differences are between the driver groups and managers. Unfortunately managers perceived both new and experienced drivers to be much less satisfied than they really are. New drivers and experienced drivers reported higher satisfaction on most of the twenty-one items on the scale than managers projected. From the perspective of mean scores, managers missed badly on a majority of satisfaction measures (13 of 21 items; 62%) for each driver group. Based on these results, managers appear to understand little about what expected levels of satisfaction are (new drivers) and how satisfied drivers are (experienced drivers).

When comparing their responses to new drivers, it becomes apparent that managers feel that new drivers expect less satisfaction than they do. This resulted in differences on 11 of the MSQ items, the most differences between any two groups. This suggests that managers do not know their new drivers very well. New drivers are entering the firm with high job satisfaction expectations – expectations that decline over time. By understanding and managing new driver expectations, managers are likely to retain qualified and experienced drivers.

Managers did have a better view of their experienced drivers, only missing significantly on nine of the MSQ items. However, the manner in which they missed was intriguing. They again greatly underestimated the satisfaction that their experienced drivers enjoy. This would suggest that managers have a perception that drivers are unhappy, which will likely lead to turnover. The contrary is true: on these nine items, the mean scores from the experienced drivers were actually quite high. The notion that managers do not fully understand the satisfaction levels of their experienced drivers may be a fundamental reason as to why turnover among TL drivers is so high.

A subsequent finding was that expectations of new drivers and satisfaction among experienced drivers were very similar. Managers may need to note where the three differences existed: pay, freedom to use judgment, and fringe benefits. New drivers expect higher satisfaction with pay and work levels and with fringe benefits. Experienced drivers were more satisfied with freedom to use their own judgment than new drivers expected to be.

IMPLICATIONS AND SUMMARY

The findings of the current study have important implications for managers and for the existing body of knowledge about truck drivers and satisfaction, which ultimately impacts turnover. This research took a triadic view of job satisfaction, giving perspectives from new drivers, experienced drivers, and managers' perceptions of driver attitudes. This is the first research to adopt this perspective in transportation research.

Perhaps the most important implications in this research are about new drivers. A new driver is either the driver of the future or the turnover statistic of the future. Managers can alter long-term turnover statistics by bringing drivers into the firm with greater care and with greater honesty. This means

assuring that drivers hear the same messages in orientation that they hear from recruiters, and that the message they hear from recruiters gives them a realistic idea of what to expect on the job. Long term, this will help the firm build a reputation for truthfulness with drivers—for the oddest of reasons—because it is true. This will give a firm a competitive advantage, but only as long as they retain the reputation.

The new drivers' scores showed greater uncertainty about the job, a rational result based on little experience with the firm. The scores from this group show that they expect high job satisfaction with the new firm. This optimism may be the result of career changes; many new drivers have come to the industry from other economically depressed industries, such as construction. This may be why new drivers differed from the experienced drivers. Managers should be cognizant of these differences. Training and orientation should help new drivers understand and manage expectations. More important, trucking firms should work to help new drivers keep their higher levels of expected satisfaction as they move into the experienced driver group. This should help to cut turnover.

Experienced drivers' levels of satisfaction were higher than managers expected them to be. This is good news for trucking firms, given that job satisfaction impacts ITQ. But the analysis showed significant differences that suggest managers may not be in touch with drivers, meaning that managers may commit to programs that mean little to drivers and little to controlling turnover, or to programs that actually raise turnover and dissatisfaction. Also, satisfaction was higher for new drivers than for experienced drivers, suggesting that over time, drivers are becoming less satisfied. Managers use these findings to better understand the expectations of drivers and manage those expectations over time.

New drivers and experienced drivers also differed on pay, freedom to use judgment, and fringe benefits. This suggests that new drivers come to the firm looking for a better deal than they had at their previous job, whether it was in the transportation industry or outside of it. If managers better understand the driver as he or she joins the firm, then they will find it easier to continue to understand the driver who remains with the firm. The broad sweep of these results is consistent with other research: drivers expect to be treated as human beings, not truck numbers or replaceable parts. Too often that is what

they perceive. In effect, managers must 'get' the driver's job, and drivers must perceive that the managers 'get' it.

Managers underrated job satisfaction among drivers. Managers often judge a job from their own perspective: it is not something they would like to do, so others must not like it either. This suggests that these managers still need to work on understanding the drivers' jobs from the drivers' perspective. This may require more research, but can be improved through simpler programs like having managers regularly eat lunch in the drivers' lounge, frequently riding along with drivers, and other techniques for more work-related contact between managers and drivers.

Many of these ideas transcend the current labor economy. Managers must always address the problems and opportunities of the moment, but a better understanding of drivers will help them make better decisions, whether the labor pool is growing or shrinking, and whether turnover is high or low. The industry is unlikely to return to the conditions of the union-dominated 1960s, but the labor market could tighten for other reasons. Managers must seek to educate themselves on the labor pool they have, which will change.

Limitations, Future Directions, and Summary

This research clearly has limitations. First, it was conducted in one firm, so results should not be generalized to every firm. The firm's management also volunteered to participate, another factor that distinguishes it from a firm or firms selected at random. Also, managers were asked to respond how they thought "most" drivers would respond, not

segmenting and asking them to respond for new drivers and experienced drivers separately (for parsimony). Finally, given the study design, assessing non-response bias was not an option.

However, the research does provide directions for further research in the single firm tradition, collecting these same kinds of data from more firms and comparing the results, or gathering the same kind of data from drivers from multiple firms simultaneously, in keeping with other traditions in this arena. Multi-firm studies using similar methods would assist managers in decision-making and would also help researchers further refine the methods for capturing satisfaction information and assessing its relationship to driver turnover. Future research should also do more to address the differences in the information needed to recruit drivers, and the information needed to retain them. Future research should address job attribute importance for these different groups as well. Based on this research, the messages managers need to send to different groups of drivers should differ significantly.

The driver labor market remains problematic for TL firms. They face competition from other industries, from one another, and from other parts of the trucking industry. The difficulties are magnified by rising fuel costs, which add to the problem of paying driver wages that draw drivers away from alternative careers. Still managers must compete and must understand the difference between the information they need to recruit new drivers and the information they need to retain drivers they already have. Managers should attempt to understand drivers the way marketers attempt to understand customers, because both compete for a critical resource.

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PRIVATE WAREHOUSE INVESTMENT STRATEGIES IN SMALL VERSUS LARGE MANUFACTURING FIRMS

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ABSTRACT

The research reported in this manuscript empirically compares the private warehouse investment strategies of small and large manufacturing firms. Mail surveys were administered to independent samples of small and large United States manufacturing firms. This research is based on a series of identically worded questions administered to both samples. Data was factor analyzed and cluster analyzed to identify three private warehouse investment strategies for small and large firms and two strategies for large firms. Analyses of three independent variables further evaluated differences in private warehouse investment strategies. Finally, the warehouse mix of small and of large firms was compared. This study identified specific private warehouse investment strategies, and warehouse mixes, in small and large United States manufacturing firms. Small firms were found to be less likely to use formal capital budgeting techniques and were less likely to consider strategic issues than large firms. Small firms were also found to be more likely to use private warehousing than large firms. This research increases the awareness of differences in logistics practice between small and large manufacturing firms and suggests that generalizations regarding logistics strategy should be approached with caution.

INTRODUCTION

Historically, warehousing performed the function of long term-storage for raw materials, goods in process, and finished goods. Manufacturers fabricated products for storage in warehouses and then sold from inventory. Many warehouses were required to have inventory levels of 60 to 90 days supply to meet production needs, customer needs, and avoid stock outs. Warehousing of the past was perceived as an

inescapable cost center that functioned as a large stock-keeping unit (Coyle et al, 2003).

As a result of global competition warehousing has become an important function in the supply chain for maintaining a competitive advantage in customer service, lead-times, and costs (De Koster, 1998). Warehouses have been redesigned and automated for high speed, high throughput rate, and high productivity in order to shrink processing and

inventory carrying costs. With the arrival of just-in-time, strategic alliances, and logistical supply chain philosophies in the 1990s, the role of warehousing changed to facilitate the supply chain's goals of shorter cycle times, lower inventories, lower costs, and better customer service. Warehouses are now less likely to be long term storage facilities. They are more likely to be fast paced facilities with greater attention focused on high levels of stock turnover and meeting customer service objectives. In most cases the product is in the warehouse for only a few days or hours (Nynke et al, 2002). More emphasis is now focused on flow-through warehouses where products remain in the warehouse for a short period of time and then move on to their destination (Nynke et al, 2002).

An additional influence on warehouse management is the importance of maximizing financial performance in all areas of the firm. Stock and Lambert (2001) use a Strategic Profit Model which emphasized the importance of logistics/supply chain management to organizational financial performance. They demonstrate the impact of investments in inventory and other assets (including warehouse investment), fixed and variable costs, and cost of goods sold on return on net worth.

One choice that can impact the firm's financial performance is whether to use private or for-hire (public or contract) warehousing. In addition to affecting financial performance, Stock and Lambert (2001) discuss the advantages and disadvantages of these two warehousing strategies. This discussion is summarized as follows; private warehouses provide a high level of control, flexibility to design and operate the facility to meet specific product and customer needs, are less costly if utilization is high, may make greater use of specialized human resources, and provide tax benefits. However, private warehouses offer less flexibility to respond to fluctuations in demand and require substantial investment.

Public (or for-hire) warehousing conserves capital, provides flexibility in responding to changes in market demand, avoids the risk of obsolescence of private facilities, offers a wide range of specialized services, may provide tax advantages, and may enable a manufacturer to better manage its storage and handling costs. Disadvantages of public (for-hire) warehousing include communication problems, uneven availability of specialized services, and space availability problems during peak demand. A hybrid of the above choices is contract warehousing. Here the firm and provider enter into a long-term agreement to outsource some, or all, of the manufacturer's

warehousing requirements. When contract warehousing works well the advantages of both private and public warehousing can be realized. When it does not work well the disadvantages of both may dominate.

In a 1990 manuscript (McGinnis, Kohn, and Myers) examined a wide range of topics related to private warehouse investment decisions in large manufacturing firms. The research examined factors affecting private warehouse investment decisions, private warehouse investment strategies, items affecting private warehouse investment strategies, and the warehouse mix. In reviewing this study the authors recognized two challenges. First, the study has not been replicated so that changes in warehouse strategies have not been examined. Second, the logistics managers sampled were from large national firms. As a result little is known about how private warehouse investment strategies in small manufacturing firms differ (or are similar) from those of large firms. The research reported in this manuscript focuses on the second challenge.

The balance of the manuscript is composed of five sections. The first section presents an overview and brief up-date of the literature associated with private warehouse investment. Next the methodology, survey used, and data collection process are discussed. The third section presents the data analysis. Findings based on the analysis section are discussed in the fourth section. The final section discussed the authors' conclusions and the implications of this research for practitioners, educators and researchers.

LITERATURE REVIEW

McGinnis, Kohn, and Myers (1990) have written about private warehouse investment decisions in large manufacturing firms and have provided some conclusions about firms' decision making processes. They found that 59.1% of the firms surveyed selected an Analytic-Intuitive approach to warehouse investment strategy that blended formal capital budgeting techniques with strategic considerations, subjective issues, and decisions in other logistics activities. 40.9 % followed an Intuitive Private warehousing Investment strategy that focused on subjective, strategic considerations, subjective issues, and decisions in other logistics activities with only modest consideration of capital budgeting techniques.

Other work, such as Thai and Grewal (2005), focused on location selection process for distribution centers. They recognized the importance of investment in

warehouse logistical operations and argue for its inclusion in the firm's strategic planning. Thai and Grewal argued that investment in warehousing is not a simple exercise, but that it requires choosing the right location with careful consideration to the firm's unique needs. Certainly mathematical models can do a comprehensive analysis of the financial alternatives and location schemas, but good investment decisions have to include a variety of factors such as customer access, manufacturing facility nearness/farness and the availability of transportation facilities (Anonymous, 2004). These arguments are supported by Sanchez (2005) who indicated that location tops the list of considerations in buying or leasing a warehouse. Nearness to major transportation routes-highways, arterial roads, airports, rail yards, ports and labor pools are critical, however, they raise the investment cost and considerations.

When considering investment in warehousing, paying too much can create a competitive disadvantage. Warehouse building budgets, as with all capital expenditures budgets, are always tight and hence there is little space for overruns. If the warehouse logistics market is tight and if costs are too high the firm will not be able to compete (Sanchez, 2005). A more contemporary approach is to use quantitative finance models to analyze the return on invest (ROI) or return on asset (ROA) from warehouse investment (McLemore, 2004). When dealing with small and medium size firms (SMEs), however, these organizations generally deal with a different quantitative approach to capital investment analysis.

The criterion for small businesses generally revolves around balancing wealth maximization alongside other business objectives such as maintaining the independence of their business. Moreover, small businesses do not have the human resources as large firms. This means that managers do not have the time or the expertise to analyze projects in the same depth as larger firms (Danielson and Scott, 2006). SME firms also have special capital constrains making project liquidity a major concern. In addition, SMEs frequently function in environments that do not fit the general theories of capital budgeting. Finally, SMEs may have to operate within capital market imperfections that create additional obstacles for the evaluation process, and constrain the financing (Danielson and Scott, 2006).

Capital constraints make it necessary for small firms to maintain sufficient cash balances in order to react to potentially profitable investments when they become available. Capital constraints provide small

firms a valid economic reason to be worried about how rapidly the project will produce cash flows (Danielson and Scott, 2006). Therefore, while quantitative analysis is a key analytical technique for evaluating warehouse investments among SMEs, they must be careful that they use the proper assessment criteria within the capital constraints that they encounter.

In summary, warehousing or distribution center capabilities are very important consideration to an efficient supply chain management system. The key to successfully achieving this objective will depend upon how managers evaluate the qualitative and the quantitative aspects of the investment decision. This process will have implications on the direction of their warehouse investment strategies.

After reviewing the literature the authors developed a series of research questions. They are listed as follows:

- a. Do private warehouse investment decisions in small manufacturing firms differ from large firms?
- b. How are private warehouse investment decisions in small manufacturing firms similar to large firms?
- c. If there are differences why might they be occurring?
- d. What lessons can be learned from private warehouse investment decisions in small manufacturing firms?

METHODOLOGY

In 2006 a four-page, 41-item questionnaire was mailed to 700 small manufacturing firms selected randomly from the Directory of Manufacturers. The focus was on firms with annual sales of \$5,000,000 or less. Ninety-nine (14.1%) usable responses were received for this questionnaire. While the response rate was low, one-way analysis of variance by order of response quartile found no significant differences at $\alpha = 0.05$ among the eight questionnaire items that related to private warehouse investment decisions. The authors concluded that the data was adequate for use as study of private warehouse investment strategies in United States small manufacturing firms.

In 2008 a four-page, 46-item questionnaire was electronically sent to 905 to members of a large national supply chain management organization who worked for manufacturing firms in the United States.

One hundred and twenty-three were undeliverable for a net sample of 782 subjects. After two follow-ups at total of forty-nine (6.3%) usable responses were returned. While the response rate was low, it is understandable given the results of similar recent studies reported in the supply chain management literature (Flint, Larsson, and Gammelgaard, 2008).

ANALYSIS

The number of respondents, means, and standard deviations for the eight questionnaire items related to private warehouse investment decisions in this study were for this sample were calculated and is summarized as Table 1. A comparison of eight means from the two independent samples (small manufacturing firms and large manufacturing firms) indicated that five pairs of means did not differ by an amount greater than due to chance ($\alpha < 0.05$) and that there was no systematic direction of change among the three means that were significantly different (one mean from the 2006 data was larger and two means from the 2008 data were larger). In addition the pattern of differences among the eight questions was not systemic among the groups of items used in subsequent analyses. The authors concluded that the data was suitable for the subsequent analyses reported in this research.

The balance of analysis was conducted in three stages as described by McGinnis, Kohn, and Myers (1990). In the first stage five questionnaire items that addressed the private warehouse investment decision process were factor analyzed. Factor analysis is useful for identifying any underlying constructs that explain the variance in a set of questions. The factor analysis method was principle components. Factors with eigenvalues of one or greater than one were rotated orthogonally. These results are presented as Table 2.

In the second stage of the analysis scores were calculated for each factor for each respondent. The values for all questionnaire items loading on a factor at 0.5 or greater were added and the sum divided by the number of items loading on the factor. Based on the factor scores of each respondent, cluster analysis was used classify the subjects into mutually exclusive groupings. Each grouping was then examined and then named based on its factor score average values. Each name reflects the "Private Warehouse Investment Strategy" based on its average factor scores. Table 3 presents the results of this stage of analysis.

The third stage of analysis was comprised of two evaluations using the identified warehouse strategies as independent variables. The first evaluation assessed mean differences of three questionnaire items concerned with market/product mix uncertainties, perceived availability of warehouse providers, and auditing of warehouse decisions. Next, perceived warehouse mixes were identified and evaluated relative to warehouse strategies. These results are shown as Tables 4 and 5.

FINDINGS

Any analysis and findings must be presented as tentative given the response rates to the two surveys. However, these findings provide insights into similarities and differences of warehouse investment strategies in small and large USA manufacturing firms.

Patterns of Responses

An examination of Table 1 provides an overview of the response patterns from respondents from small (2006 data) and large (2008 data) USA manufacturing firms. It is interesting to note that five of eight means between small and large firms (WH-3, WH-4, WH-5, WH-7, and WH-8) were not significantly at the 0.05 level. The other three means (WH-1, WH-2, and WH-6) were significantly different but the direction of those differences was not systematic (i.e. the 2006 data's means were not all larger or smaller than the 2008 data). Based on these results the authors concluded that results would not be systematically skewed due to fundamentally different perspectives from the large and small firm respondents.

Further examination of the results from Table 1 suggest that formal financial analysis (WH-1) are more likely to influence private warehouse investment decision making in small manufacturing firms, strategic considerations (WH-2) are more likely to influence these decisions in large manufacturing firms, and that uncertainties in markets and product mix (WH-6) make private warehouse planning more difficult in small firms.

Continued inspection of Table 1 indicates that small and large USA manufacturing firms do not differ significantly when considering service issues (WH-3), tempering cost analysis with subjective factors (WH-4), and mingling private warehouse investment decisions (WH-5) with decisions in other logistics

TABLE 1
COMPARISON: MEANS/STANDARD DEVIATIONS OF QUESTIONNAIRE ITEMS:
2006 (SMALL USA MANUFACTURING FIRMS) & 2008 (LARGE USA MANUFACTURING FIRMS)

		N/Means*/ Standard Deviations		Mean Differences Significant
		2006	2008	< 0.05?
WH-1	Formal capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity. (24)	114 3.04/ 0.911	49 2.57/ 1.021	Yes
WH-2	Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.	114 2.75/ 0.948	49 2.16/ 0.800	Yes
WH-3	My company/division explicitly considers subjective, hard to measure, service issues when considering whether to invest in private warehousing. (27)	115 2.96/ 0.882	48 2.92/ 0.919	No
WH-4	Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division. (28)	117 2.33/ 0.871	49 2.18/ 0.727	No
WH-5	Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities. (31)	112 2.86/ 0.793	48 2.18/ 0.945	No
WH-6	Market and/or product mix uncertainties make it difficult to plan for future private warehouse needs. (26)	114 2.52/ 0.895	49 2.98/ 1.090	Yes
WH-7	The use of contract warehousing by my company/division is limited by the number of good providers that are available. (29)	111 3.24/ 0.789	49 3.43/ 1.080	No
WH-8	In my company/division private warehouse investment decisions are audited after the project is in place. (30)	111 3.10/ 0.852	48 2.71/ 1.031	No

**Scale: 1 = Strongly Agree, 2 = Agree 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree

TABLE 2
FACTOR ANALYSES:
2006 (SMALL USA MANUFACTURING FIRMS) & 2008 (LARGE USA MANUFACTURING FIRMS)

2006 – National Sample of Small Manufacturing Firms

Factor 1: Integrated Analysis

Questions	Factor Loadings
WH-1 Formal capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity.	0.751
WH-2 Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.	0.844
WH-3 My company/division explicitly considers subjective, hard to measure, service issues when considering whether to invest in private warehousing.	0.705
WH-4 Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division.	0.583
WH-5 Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities.	0.687

(51.7% of variance, reliability coefficient = 0.761)

2008 – National Sample of Large Manufacturing Firms

Factor 1: Strategic/Subjective

WH-2 Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.	0.755
WH-3 My company/division explicitly considers subjective, hard to measure, service issues when considering whether to invest in private warehousing.	0.689
WH-4 Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division.	0.801

(37.5% of variance, reliability coefficient = 0.6333)

Factor 2: Analytical/Integrative

WH-1 Formal capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity.	0.857
WH-5 Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities.	0.856

(29.9% of variance, reliability coefficient = 0.651)

Amount of variance explained by both factors = 67.4%

TABLE 3
PRIVATE WAREHOUSE INVESTMENT STRATEGIES:
2006 (SMALL USA MANUFACTURING FIRMS) &
& 2008 (LARGE USA MANUFACTURING FIRMS)

2006 – National Sample of Small Manufacturing Firms

Factor Score*			
Factor 1			
Private Warehouse Investment Strategies	Integrated Analysis	Number of Respondents	Percentage of Respondents
1. Moderate Analysis	2.77**	77	70.0
2. Minimal Analysis	3.94	14	12.7
3. Intense Analysis	1.91	19	17.3
		110	100.0

*Scale: 1 = Strongly Agree, 2 = Agree, 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree

**Differences among means significant, alpha = 0.05.

2008 – National Sample of Large Manufacturing Firms

Factor Scores*				
Private Warehouse Investment Strategies	Factor 1	Factor 2	Number of Respondents	
	Strategic/ Subjective	Analytical/ Integrative		
1. Analytical	3.18**	1.81**	11	23.4
2. Strategic/Subjective	2.18	2.71	36	76.6
			47	100.0

*Factor Scores are the value (means) of the questionnaire item(s) loading on the factor

Scale: 1 = Strongly Agree, 2 = Agree, 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree

**Differences between factor means significant, alpha = 0.05.

TABLE 4
COMPARISON OF MEANS (OF SELECTED ITEMS)
AMONG WAREHOUSE INVESTMENT STRATEGIES:
2006 (SMALL USA MANUFACTURING FIRMS) & 2008 (LARGE USA MANUFACTURING FIRMS)

2006 – National Sample of Small Manufacturing Firms

		Factor Score Means*			
		Strategy 1: Moderate Analysis	Strategy 2: Minimal Analysis	Strategy 3: Intense Analysis	
Questions		N = 77	N = 14	N = 19	Significance
WH-6	Market and/or product mix uncertainties make it difficult to plan for future warehousing needs.	2.55	2.71	2.37	0.553
WH-7	The use of contract warehousing by my company/division is limited by the number of good providers that are available.	3.19	4.07	2.95	0.000**
WH-8	In my company/division, private warehouse investment decisions are audited after the project is in place.	3.01	4.14	2.61	0.00**

*Scale: 1 = Strongly Agree, 2 = Agree 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly

**Differences of means between Strategies 1 & 3 not significant, alpha = 0.05, according to Tukey B post hoc test.

2008 – National Sample of Large Manufacturing Firms

		Mean Responses*			
		Strategy 1: Analytical	Strategy 2: Intuitive		
Questions		N = 11	N = 36	Significance	
WH-6	Market and/or product mix uncertainties make it difficult to plan for future warehousing needs.	3.27	2.89	Not Significant	
WH-7	The use of contract warehousing by my company/division is limited by the number of good providers that are available.	3.45	3.47	Not Significant	
WH-8	In my company/division, private warehouse investment decisions are audited after the project is in place.	2.45	2.78	Not Significant	

*Scale: 1 = Strongly Agree, 2 = Agree 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree

TABLE 5
WAREHOUSE MIX BY PRIVATE WAREHOUSE INVESTMENT STRATEGY:
2006 (SMALL USA MANUFACTURING FIRMS) & 2008 (LARGE MANUFACTURING FIRMS)

2006 – National Sample of Small Manufacturing Firms

Warehouse Mix Percentages*					
N	Private	Contract	Public	Other	Total
88	89.1	2.6	1.0	7.3	100.0

*Warehouse Mix Percentages were not significant among the three warehouse investment strategies at alpha = 0.05

2008 – National Sample of Large Manufacturing Firms

Warehouse Mix Percentages						
Strategy	N	Private	Contract	Public*	Other	Total
1. Analytical	11	51.4	31.4	15.9	1.4	100.1
2. Intuitive	34	54.2	37.1	3.0	5.7	100.0
Overall	46***	53.2	35.7	6.2	4.7	100.1

*Means for Public Warehousing significantly different at alpha = 0.05

**Total varies from 100% due to rounding.

***Respondents whose totals did not equal 100% were not included.

activities. These results suggest that private warehouse investment decision making processes in are generally independent of firm size. Finally, perceptions of availability of good providers (WH-7) and decisions to conduct post hoc auditing of private warehouse decisions (WH-8) were also independent of firm size. Overall, inspection of the results shown in Table 1 suggest that private warehouse investment decisions in large and small USA manufacturing firms are not fundamentally different. Rather, differences are specific rather than systematic.

After inspecting the pattern respondents' perceptions of private warehouse investment decisions processes (WH-1 through 5) and factors related to warehouse decisions (WH-6 through 8) the authors concluded that (a) small and large USA manufacturing firms were similar in their responses, and (b) that further analysis would be useful in responding to the research questions. The authors did not conclude that responses suggested that the respondents in either

small or large firms were more knowledgeable or more competent than the other sample.

Factor Analyses

Examination of the factor analysis results, as shown in Table 2, suggest small USA manufacturing firms approach private warehouse investment decisions with an approach that blends quantitative and qualitative aspects of the decision process. All five warehouse decision questions loaded on one factor at the 0.500 level or higher. This factor explained 51.7% of the variance in the five questions. This factor was named "Integrated Analysis".

The factor analysis of large USA manufacturing firm respondents identified two factors, or constructs. One factor was comprised three questions that focused on subjective and strategic considerations (WH-2 through 4) and accounted for 37.5% of the items' variance. The other two questions (importance of capital budgeting

techniques, WH-1, and intermingling of private warehouse investment decision with decisions in other logistics activities, WH-5) were interpreted as having an analytical-integrative emphasis. The two factors were named "Strategic/Subjective" and "Analytical/Integrative" respectively. These results are similar to the results of the earlier (McGinnis, Kohn, and Myers, 1990) where the results identified two factors, "Intuitive Decisions" and "Analytical Decisions."

Overall, the results of this research suggests that decision makers in small USA manufacturing firms visualize the private warehouse decision process as a *gestalt* where subjective, strategic, integrative, and analytical issues are considered in totality while large USA manufacturing firm decision makers visualize the process as having two components, one blending subjective and strategic considerations and the other blending analytical and integrative concerns. One possible explanation for these differences may be due to the number of individuals included in decision making in small versus large firms. In the small firms, annual sales of \$5,000,000 or less, it is likely that warehouse investment decisions are made by a relatively small team, or by a single individual. As a result issues are likely to be considered, and tradeoffs made, simultaneously. Conversely, in large manufacturing firms warehouse investment decisions are likely made by an array of decision makers at different organizational levels. In this scenario it is likely that various dimensions of decision making would be considered separately. These differences contribute to additional insights when the factors cluster analyzed.

Cluster Analyses

Examination of the cluster analyses results provides the preponderance of insights into private warehouse investment decisions for small and large USA manufacturing firms. As shown in Table 3 three private warehouse investment strategies were identified for small USA manufacturing firms. The majority of firms (70.0%) pursue a "moderate" level (mean = 2.77) of analysis that is on the "agree" of "neither" on the scale. This suggests that the level of analysis is moderate, indicating that capital budgeting, strategic considerations, subjective issues, formal cost analysis, and integration of warehouse decisions are considered, but intensely. The balance of small manufacturing strategies were roughly divided between an "intense" (mean = 1.91) and "minimal" (mean = 3.94) levels of analysis.

These results indicate the small USA manufacturing

firms make private warehouse investment decisions with a modest level of analysis. This may be because a) these decisions are infrequently made, b) information is readily available and easily understood, c) warehouse investment decisions are less important than other business decisions, and/or d) past warehouse decisions are seldom revisited.

Further examination of Table 3 indicates that large USA manufacturing firms pursue two different private warehouse investment strategies. A majority (76.6%) of respondents pursue a "Strategic/Subjective" strategy that emphasizes the integration of strategic and subjective (qualitative) considerations. A minority (23.4%) of respondents places heavy emphasis (mean = 1.81) on capital budgeting and integrating the warehouse investment decision with other logistics activities. These results are substantially different from the results of the 1989 results of McGinnis, Kohn, and Myers (1990) where much greater emphasis was placed on "Analytical-Intuitive" strategies (59.1%) than on "Intuitive" strategies (40.9%) and suggest a decrease emphasis on quantitative analysis and an increase in strategic considerations during this 19 year interval. Possible reasons for this shift include a) less emphasis on private warehousing investments due to outsourcing to third-party providers, b) an increasing importance of integrating investment decisions within a strategic context, c) less environmental uncertainty on which to base capital budget estimates, d) an increased emphasis on moving assets off the balance sheet rather than investing in fixed assets, and e) a greater need to integrate investment decisions across business units and channel members.

Overall, the results of the cluster analyses indicate that small USA manufacturers vary in their private warehouse investment strategies along a continuum of integrated analysis that ranges from minimal (12.7%) to intense (17.3%) with the majority (70.0%) of respondents at the moderate level. This suggests that most small manufacturing firms approach private warehouse investment decisions with some degree of quantitative, subjective, integrative, and strategic assessment. However, the intensity of these assessments is not exhaustive. By contrast the majority (76.6%) of large USA manufacturing firms pursue an integrated analysis that emphasizes strategic and subjective issues to a greater extent than analytical and integrative concerns. However, this strategy (Strategic/Subjective) is more intense than that found in most small manufacturing firms. A

minority of large manufacturing firms (23.4%) pursue strategies (Analytical) that emphasize analysis and integration with modest emphasis on strategic and subjective issues. The findings of these strategies are examined further in the following paragraphs.

Strategies: Additional Findings

Three additional questions included in the McGinnis, Kohn, Myers (1990) study were assessed to determine whether market/product mix uncertainties, availability of good warehouse providers, and post hoc analysis of private warehouse investment decisions a) differed between small and large manufacturing firms and b) differed among strategies within small and large firms. While market and/or product uncertainties made it more difficult for small manufacturing firms to plan for private warehouse needs (See Table 1) this issues was not significant among small firm strategies or between large firm strategies (See Table 4).

As shown in Table 1 respondent means regarding a) whether the use of contract warehousing was limited by the number of good providers and b) post audits of warehouse investment decisions were not significant at the 0.05 level between small and large manufactures. However, as shown in Table 4, small manufacturing firms following Minimal Analysis Strategies (N = 14, 12.7%) were less concerned about the availability of good contract providers and were less likely to conduct post audits of warehouse investment decisions. Overall, the authors concluded that (except for a small percentage of small firm respondents) the availability of good contract providers is a minor problem for small and large manufacturing firms. Similarly, post audits of private warehouse investment decisions occur with at a comparable level of frequency in small and large and large manufacturing firms.

Inspection of Table 5 led to the conclusion that the blend of private, contract, public, and other (usually supplier or customer storage) was substantially different between small and large USA manufacturing firms. As seen from Table 5 the percentage of "permanent" (private plus contract) warehousing was 91.7% in small firms and 88.9% in large firms. However, the mix of this "permanent" warehousing is about 97% private/3% contract in small firms and about 60% private/40% contract in large firms. The overall importance of public and other warehousing were relatively minor in both large and small manufacturing firms. The relevance of these results will be discussed further in the following section.

CONCLUSIONS AND IMPLICATIONS

While tentative, given the response rates to both questionnaires, the following paragraphs respond to the first three research questions. Later in this section the manuscript addresses the final research question, presents additional conclusions, and discusses the implications of this research.

The answer to the first question "Do private warehouse investment decisions differ in small manufacturing firms, compared to large firms?" is yes, to some extent. The results shown in Table 1 indicate that small manufacturing firms are less likely to use formal capital budgeting techniques, and less likely to consider strategic issues than large firms. In addition small manufacturing firms are more likely than large firms to perceive that market/product mix uncertainties are likely to increase the difficulty of planning for warehouse needs. The factor analysis of five questionnaire items, shown in Table 2, indicates that small manufacturing firms are less prone to make distinctions among capital budgeting, strategic, service, subjective, integration issues than large firms. This suggests that either (a) small firms more effectively blend these issues, or (b) large firms more effectively identify unique constructs relevant to private warehouse investment decisions. The authors suspect the latter.

Examination of the clusters shown in Table 3 indicate that small manufacturing firm strategies differ along a one-dimensional continuum with the majority of respondents (70.0%) placing moderate emphasis on integrated private warehouse investment analysis. Large USA manufacturing firm strategies grouped into clusters that were distinct. One cluster of strategies (76.6% of respondents) balanced the two dimensions, analytical/integrative and strategic/subjective, while the other cluster (23.4%) placed greater emphasis on the analytical/integrative dimension than the strategic/subjective dimension. These finding indicate that private warehouse investment decisions in large manufacturing firms are more likely to use a wider range of strategies than small firms. This finding suggests that, overall, large manufacturing firms may be more sophisticated than small firms in their approach to evaluating private warehouse investment decisions.

The final area of difference between small and large USA manufacturing firms is in warehouse mix, as shown in Table 5. Small firms are much less likely to use contract warehousing than large firms, and more likely to place heavy emphasis on private

warehousing. There are several possible reasons for this difference. First the scale and scope of small firms may not be adequate to justify for-hire warehousing (note that the percentages of contract and public warehousing are small). Second, the higher use of "other" – which usually means supplier or customer storage – may reduce the need to seek for-hire warehouse alternatives. Finally, short channels of distribution may alleviate the need for for-hire warehousing. Large firms may be more likely to use contract warehousing because of several factors. First, fluctuating market and seasonal demand may make contract—and to some extent public—warehousing attractive. Second, a need to manage assets may make contract warehousing financially attractive. Finally, complex channels of distribution may make contract warehousing an attractive choice in the warehouse mix.

In response to the second research question "How are private warehouse investment decisions in small manufacturing firms similar to large firms?" the results indicate several similarities. First the results, as shown in Table 1, do not suggest a pattern of systematic differences in item means between small and large USA manufacturing firms. This suggests that neither group of respondent has a better grasp of the issues relevant to private warehouse investment decisions. One interpretation is that the differences may be due to genuine dissimilarities faced by small and large manufacturing firms. An alternate interpretation is that respondents in large firms benefit from a greater understanding of the issues than do small firm respondents. The authors lean toward the former interpretation.

Except for a small percentage (14/12.7%) of small manufacturing respondents that choose a strategy of minimal analysis, see Table 4, the differences in means of the three questions (market/product uncertainties, limited choices of contract warehouse providers, and post audit of private warehouse investment decisions) did not vary within small and within large USA manufacturing firms. These results suggest that each group of respondents is internally homogenous. Finally, while the percentages differ substantially, as shown in Table 5, both small and large USA manufacturing firms use private warehousing for more than half their storage needs. This indicates that private warehouse investment decisions are major concerns for both small and large manufacturing firms.

Overall, private warehouse investment strategies vary between large and small manufacturing firms more in

degree than in type. In both instances, the same questionnaire items entered into the factor analysis results, variations between private warehouse investment strategies of small and large manufacturing firms were not dramatically different, and the differences of item means on questionnaire items did not indicate substantial differences in respondent perceptions. The major differences between private warehouse decisions in small and large USA manufacturing firms are shown in differences in approaches to evaluating private warehouse investment decisions, and in the mix of private and for-hire warehousing.

Several implications can be identified for practitioners, educators, and researchers. First, the process of evaluating private warehouse investment decisions is similar for large and small manufacturing firms. The differences, as discussed above, are more of form rather than substance. As a result it appears that insights gained from logistics research may be relevant to a wide range of firm sizes. Because the subjects of this research were USA manufacturing firms, extrapolations of these findings to other sectors of the economy, such as retailing, health care, and services should be conducted with caution. The similarities of results of this research among USA manufacturing firms of differing sizes suggests that they can be a beginning point for the evaluation of private warehouse investment decisions in other sectors of the economy. Specifically, the results of this research suggest that practitioners from manufacturing firms of all sizes could find insights that provide information and guidance to their own organizations.

Because the subject of this research was USA manufacturing firms the applicability of these results to other countries would be dependent on a wide range of factors being similar to the United States. For example, the legal, economic, regulatory, and business customs can vary widely among countries that are similar in forms of government, forms of legal systems, and extent of private enterprise. As a result the results of this research should be applied to private warehouse investment decisions in situations outside the United States with caution.

Logistics/supply chain management educators can benefit from the insights that processes, such as private warehouse investment decisions, are relevant to a wide range of firm sizes. While this research has focused on manufacturing firms, analogies in reselling, retail, and health care are likely to be relevant for instructional purposes, especially when the supply

chains of non-manufacturing firms are integrated with suppliers that are manufacturers.

Logistics/supply management would benefit from a wider range of comparative research, including, but are not limited to, transportation choice, customer service measures and standards of performance, the effectiveness of multinational supply chains, the

importance of financial performance versus logistics/supply chain performance, and integration of supply chains versus maintaining independence. While this study focused on small and large manufacturing firm in the United States, comparative studies of logistics strategy in different economies would further increase the understanding of logistics/supply management thought and practice.

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ROLES AND CAPABILITIES OF THE RETAIL SUPPLY CHAIN ORGANIZATION

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ABSTRACT

Supply chain management (SCM) has become a critical strategic function in recent years. Research in the discipline has been focused toward the upstream side of the supply chain on functions such as warehousing, transportation, procurement and production. As power has shifted downstream toward retailers and their customers, SCM research has been slow to respond. This represents a significant gap, and a significant opportunity. Retailers face challenges that differ from those found in upstream suppliers and manufacturers. We present findings from a study of senior supply chain executives in the retail industry that focuses on the supply chain challenges of greatest importance to retailers, and the evolving capabilities used to address these issues.

Supply chain management (SCM) has become a critical strategic function in many industries during the past 20 years. SCM has developed into an integrative discipline incorporating strategic elements with process and collaboration (Gibson et al. 2005). Further, SCM has become a critical competitive weapon favored by C-level executives searching for competitive advantage (Manrodt et al. 2005). Supply chain research has increased significantly in recent years, and many techniques have been suggested for achieving supply chain goals including collaboration (Sinkovics and Roath 2004), process integration (Min and Mentzer 2004), information sharing (Sanders and Premus 2005), standardization (Bowersox et al. 1999),

and aligning measures and rewards (Mentzer 2004). In addition, SCM research is now acknowledged as providing theoretical and practical insight into a variety of areas including collaboration in production (Nativi and Barrie 2006; Pfohl and Buse 2000), new product innovation (De Luca and Atuahene-Gima 2007; Zacharia and Mentzer 2007), quality (Harding 1998; Liker and Choi 2004), transportation (Lieb and Butner 2007; Van Hoek 1999) and just-in-time manufacturing (Giunipero et al. 2005; Sillince and Sykes 1993). The importance of SCM to business strategy, and ultimately business success, appears to be on solid footing.

During this same period there has been an increasing awareness of a fundamental shift in marketplace power from production to retail (LaLonde and Masters 1994; Maloni and Benton 2000). Where product and production once dominated (e.g., Procter and Gamble, General Motors), organizations closer to the consumer (e.g., Wal-Mart, Target) have taken a leadership role in the supply chain. Entire streams of research have picked up on the shift from a product to customer orientation (Kirca et al. 2005; Kohli and Jaworski 1990; Slater and Narver 1995). Retailers face unique supply chain challenges, and require distinct capabilities not required of upstream suppliers and manufacturers. Great retailers survive and thrive through outstanding supply chain capabilities (Brown et al. 2005), but the penalty for disappointing customers because of a single glitch in the supply chain can be steep. One study shows retailer's share prices fell an average of 9 percent on the day a supply chain problem was disclosed, with an additional 9 percent drop recorded over the next 90 days (Morrison and Assendelft 2006). Yet from a supply chain perspective, the power shift to retail and the recognition of retail as a critically important supply chain area has been neglected, revealing a substantial gap in research. Our understanding of retail supply chain management (R-SCM) may be limited at a time when effective management of the retail supply chain is more important now and into the future than in the past (Davies 2009).

The goal of this research is to address the knowledge gap identified by the relative lack of research in the area and provide insight into the supply chain capabilities developed by best-in-class retail organizations.¹ A slowing economy suggests this need is more critical today than ever before. We address two primary research questions. First, what supply chain challenges are driving strategic actions in the retail industry? Second, what are the capabilities retailers leverage to perform the role of SCM? Neither of these questions have been explored in great depth in previous research. Initially, the literature is reviewed to clarify the knowledge gap. Next, we describe the study approach built on a robust grounded theory methodology including interviews with 25 senior retail SCM executives and follow-on survey execution. Then we reveal our key findings in the areas of R-SCM role definition and best-in-class capabilities. Results of our interviews confirm the importance of SCM to long-term retail success.

LITERATURE REVIEW AND STUDY RATIONALE

It is surprising that the retail supply chain has been given so little attention in both the logistics and retail disciplines. Over the past 15 years less than a dozen articles focusing on supply chain related topics associated with retailers are found in top logistics journals (JBL, IJPD&LM, IJLM, and SCMR). Many of these articles provide a deep dive into specific issues such as in-stock position (Taylor and Fawcett 2001), inventory error rates (Waller et al. 2006), or direct product profitability (Bookbinder and Zarour 2001), and thus do not take a big picture look at retail supply chain issues. Other micro-oriented articles look at the supplier to retailer link for a single product (e.g., Hines et al. 2006 examined pineapple distribution in Australia), or describe the supply chain for a given type of retail outlet or region (e.g., Fernie et al. 2000; Mejias-Sacaluga and Prado-Prado 2002 review grocery logistics in Spain and the UK respectively). Kahn and colleagues (2008) use a retailer as a case study in their study of supply chain risk. Mukhopandhyay and Setaputra (2006) suggest the value to retailers of outsourcing costly reverse logistics activities. Kent and Mentzer (2003) develop the concept of relationship strength using retailers as part of the sample. Despite the claim that research of the supplier to retailer link in the supply chain is important to the marketing and retailing disciplines, coverage is no better when taken from the retail journal perspective. Only nine relevant articles have been published in the *Journal of Retailing* (JR), with a near-majority of those found in a single special issue on SCM in 2000. The JR articles also tend to be point-focused dealing primarily with traditional inter-firm relationship issues including power (Bloom and Perry 2001), dependence (Gassenheimer and Lagace 1994), conflict management (Bradford et al. 2004; Brown et al. 1983), coordination (Ingene and Parry 2000), and partnering (Mentzer et al. 2000). Automatic replenishment (Levy and Grewal 2000) and guaranteed profit margin programs (Lee and Rhee 2008) have also been reviewed.

We do not find fault in any of the articles mentioned above. Our concern is the lack of coverage of the issues and potential strategies available to organizations that occupy the retail node. In fact, only two studies over this time frame examine broader, strategic supply chain issues from a retail perspective.

Lawson (2001) explored the operational strategies used by 82 retailers in the U.S. and Europe and found many strategic options being used including Quick Response, time-based competition, lean, and postponement among many others. More recently Morrison and van Assendelft (2006) recap the results of an IBM Institute for Business Value study of 795 retailers worldwide. The best performing retailers demonstrated revenue growth more than twice that of retailers at the median, with operating income margins one-third higher, while holding a third less inventory.

The few available studies focusing on retail supply chain issues is the first rationale for undertaking this research. The second extends from the fact that annual studies are common in both the retail industry and the supply chain discipline. Retail studies focusing on consumer satisfaction issues, sales and cost benchmarks, and infrastructure development are often conducted by consulting firms or industry publications (Frazelle 2008; National Retail Federation and IBM 2009). Existing SCM studies of outsourcing trends, general supply chain strategies, and transportation metrics are most frequently led by universities (Holcomb and Manrodt 2008; Langley 2007; Lieb and Butner 2007). Interestingly, only two

of the annual studies fully address the intersection of retailing and SCM. One study addresses only Internet-based and direct retailing methods. The other touches upon supply chain management in the midst of an annual study of nine diverse retailing topics. Figure 1 highlights the existing gap in the research. The lack of one-time research and ongoing studies into retail supply chains suggests a significant gap exists. We believe the retail industry's supply chain leadership role, impact, and trends are largely under-studied and ripe for investigation. Our research is targeted at this knowledge gap.

METHODOLOGY

This paper uses grounded theory (GT) to create greater understanding of the role of SCM in the retail industry. By combining archival research, expert advice, executive interviews, and surveys we bring greater understanding to macro-level challenges and best practices that extend across the retail supply chain. We generated our finding using extensive open ended interview with 25 retail executives, and a follow up quantitative survey of 36 supply chain executives. Using field observation makes this research timely as retail supply chain manager struggle with the currently constrained global economy.

FIGURE 1
RETAIL INDUSTRY/SCM DISCIPLINE ANNUAL STUDY MATRIX
Is the annual study SCM specific?

		YES	NO
<i>Is the annual study retail specific?</i>	YES	*Benchmarks In Operations And Fulfillment / Georgia Tech **Retail Horizons: Benchmarks / National Retail Federation	Brand Awareness Study / Retailing Today Consumer Satisfaction Study / U.S. Census Bureau Global Retailing / Retailing Today Most Common / Retailing Today Order Management / Retailing Today Retail Economics / Retailing Today Retail: A Supply Chain Perspective / Retailing Today State of Retailing / Retailing Today
	NO	Annual Salary Survey / Logistics Management 3PL CEO Study / Transportation Today Distribution Metrics / Logistics Management Global Survey / U.S. Consulting Logistics Challenges / Logistics Management Master of Logistics / Logistics Management State of Logistics Outsourcing / Georgia Tech Transportation Annual Survey / U.S. Census Bureau	Automotive The U.S. Supply Chain / Planning Perspectives Census of Retailing / Retailing Today Enterprise Retailing / Retailing Today National Survey of Retailing / Retailing Today Retail Economics / Retailing Today Process Management / Retailing Today Revenue Management / Retailing Today Service Annual Survey / U.S. Census Bureau

*Addresses only direct-to-consumer retailing
 **Broad ranging annual study of retailer practices—SCM is one of nine major areas investigated

GT is the appropriate method for understanding how human organizations react to their environment and change as that environment evolves (Charmaz 2006; Glaser and Strauss 1967). Support for inductive qualitative techniques, like GT is on the rise in business research (Day and Montgomery 1999; Deighton and Narayandas 2004; Hunt 1992; Kavanagh 1994; MacInnis 2005). This is particularly true in SCM where qualitative research has provided an effective mechanism for understanding key phenomenon (Frankel et al. 2005) such as logistics service driven loyalty (Davis and Mentzer 2006), supply chain management coordination mechanisms (Fugate et al. 2006), logistics management in a transitional economy (Price 2006), logistics outsourcing strategy (Mello et al. 2008), and drivers of inter-organizational relationship magnitude (Golicic and Mentzer 2005). GT has proven successful in supply chain management (Flint et al. 2005; Flint et al. 2002; Mollenkopf et al. 2007; Pappu and Mundy 2002) and marketing research (Kohli and Jaworski 1990; Noble and Mokwa 1999; Parasuraman et al. 1985), and therefore we believe it is an appropriate tool for this exploration.

Analytical Process

Table 1 depicts the steps followed in this investigation. We used the inductive GT technique espoused by Glaser (1998; 1978), and adapted that to SCM research by following the practical guidance of Charmaz (2006).

MAXQDA was the software used to facilitate organizing and filtering the interview data. The software enables word pattern searches (e.g., word combination frequencies), and quantitative statistical analyses through word counts and frequencies. For instance, MAXQDA identified the frequency that "cost" and "service" occurred in the same paragraph (144 times in 19 interviews). Programs like MAXQDA provide efficient coding of text, coding of relationships, code trees, memo writing, and analysis of code intersections, therefore increasing the efficiency of a GT analysis.

The first step in the investigation involved definition of the initial research question. To form that question we met and discussed the project with retail executives, retail consultants, personnel from a major retail trade group, and academic experts. During this process we identified those retail executives that served as the primary data source. Table 2 shows the retail sectors represented by study participants.

At step 2, and again at step 4, interviews were conducted with retail supply chain executives from a wide cross-section of the retail industry. This sampling approach allowed identification of themes that appeared to broadly permeate the retail supply chain environment (Charmaz 2006; Glaser and Strauss 1967). In step 3 we began identifying initial conceptual codes from the interviews. Once identified, we verified the more aggregate applicability and interpretation of those codes by "testing" these codes in follow on interviews. The process involves hypothesizing a relationship based upon one set of interviews and then testing that relationship in follow-on interviews (Charmaz 2006; Glaser and Strauss 1967). As the codes begin to evolve toward categories and constructs, notes (known as memos in GT) were taken within MAXQDA to document the analytical process. Memos captured hypothesized relationships, provided a record for how these relationships developed in subsequent interviews, and were used to keep track of the logic behind the emerging themes, challenges, and best practices (Charmaz 2006). Sifting through transcripts and memos led to increasingly focused follow-on interviews and the adoption of theoretical coding as shown in steps 6 and 7.

Unlike statistical validity, GT is concerned with theory validation. The basis of validation, as shown in step 6, is theoretical sampling (Glaser 1998). Theoretical sampling entails testing not only concepts but relationships in new samples. For example, initial interviews suggested velocity as a key theme in R-SCM. Theoretical sampling provided dimensionality to the variable "velocity" and related that variable to other variables such as "stock keeping unit (SKU) management" and "high fashion-short life product." This suggested that velocity was not only an important characteristic that impacted inventory turn rates, and cost of inventory, SKU specific velocity management was also a best in class capability in the retail industry. Subsequent interviews, as shown in step 6, tested the hypothesized themes, categories and best practices in new samples and validated the predicted relationship. The theoretical sampling process was continued until constant comparison, as shown in step 7, raised codes to theoretical categories. Sorting and theoretical sampling continued until theoretical saturation. Theoretical saturation occurred when follow-on interviews, coupled with team meetings, and survey results demonstrated consistent constructs and relationships. In step 8 and 9 we saturated and related those categories into a theoretical framework.

TABLE 1
ANALYTICAL STEPS

Step 1	Develop the opening research question
Step 2	Begin data collection and initial coding
Step 3	Arrange initial codes (using memos) in tentative categories
Step 4	Data collection aimed at validated tentative categories and defining new categories
Step 5	Refine conceptual categories (using memos)
Step 6	Theoretically sample to validate hypothesized relationships
Step 7	Sort memos and codes into aggregate categories
Step 8	Define relationships between categories (memos and diagrams) saturate concepts
Step 9	Emerge theory
Step 10	Member checking

TABLE 2
RETAIL INDUSTRY SECTORS OF PARTICIPANTS

Global Retail: Super Center	5
Fashion	4
Discounter	3
Grocery	2
Home Improvement / Builder Supply	2
Office Products	2
Retail Auto Supplies	1
Technology	1
Drug Store	1
Pet Products	1
Sporting Goods and Supplies	1
Toy Store	1
Specialty	1

Next (step 10) the team organized the interview findings into a survey. The objective of this survey was to provide robust validation of the themes uncovered through the interview. The survey provided an ordinal ranking among the elements of the emerged categories (e.g., challenges, trends, and best practices) uncovered through analysis of the

interview data. The survey was distributed to 175 senior supply chain executives. A total of 36 surveys were returned. This response rate is acceptable from both a quantitative perspective and additionally this met our object as a satisfactory method for member checking, or validating, the inductively derived interview conclusions (Charmaz 2006; Dillman 2000).

To verify the challenge and best practices themes (step 10) a number of member checking sessions were conducted with senior executives, senior managers, academics, and consultants experienced in R-SCM. Finally, the themes were reviewed by more than 80 retail supply chain executives, suppliers, and consultants at an industry conference. The checking sessions strongly supported the research findings, the generated variables, and their theoretical relationships.

FINDINGS AND DISCUSSION

In this section we describe two areas from the study where the findings appear to be particularly useful to furthering our understanding. Specifically, we explain two challenges R-SCM organizations must deal with, and four capabilities developed by best-in-class retailers that prepare them to compete effectively.

Challenges

One of the main topics of the research interviews and surveys dealt with a series of questions about the future. Despite facing a number of challenges and unfavorable trends, retail SCM executives remain upbeat about their ability to cope and succeed in this difficult environment.

External forces affecting retail SCM. The crisis of confidence among consumers and the continual barrage of bad news from the media create an obvious retail challenge. Compounding these problems are other external issues that impact SC strategy, planning, and performance. Figure 2 suggests that these headaches may linger into the future and make for some sleepless nights among retail SCM executives.

We cut a billion dollars of inventory out of our supply chain. There's another billion to cut, (R-SCM Executive).

It is also notable that the widely discussed SC infrastructure and workforce issues from 2007 are the least of the executives' concerns today.

The executives in the study placed a huge emphasis on cost. Cost is squeezing the retail sector on two fronts. The first is volatility in fuel prices. Increases in the price of diesel fuel significantly increases the cost of moving product through the distribution network to the retail store, either directly in the cost of operating their own fleets or through higher freight bills from carriers. Additionally, the cost of many products also

increases as a result of higher petroleum prices. Retailers were hesitant to pass along the resulting increased cost of doing business to consumers.

We are making cost decisions in the negotiation process with a goal to reduce cost throughout the network.

Second, the global economic downturn created flattening to declining sales across the board for retailers, and reduced consumer spending limited the retailers' ability to adjust prices upward. The combination of these factors drove the executives to search for cost reduction opportunities throughout their supply chain operations.

Retailers place a great deal of importance on creating and maintaining supply chain capabilities that may allow them to out-perform competitors. But, as Figure 3 indicates, a discrepancy exists with actual retailer performance in most of these capabilities. The participants assessed their internal performance as average to slightly above average in each of these key areas. Retailers clearly believe that they have a significant opportunity to further develop exceptional SC capabilities.

The real focus is to lower our net inventory without compromising the in-stock experience for the customer.

The findings point out that cost control is a point of emphasis for retail supply chains. While many retailers strive to find an effective balance between cost and customer service, as the economic outlook for 2009 worsened the importance of controlling costs appears to have heightened.

Responding to market conditions. R-SCM executives are not shying away from the dramatic economic issues facing them. In fact, the economic environment and less than robust consumer spending has prompted R-SCM executives to act decisively. When asked how they are coping with the challenge of eroding consumer confidence, Figure 4 clearly indicates that they are making drastic asset investment reductions.

The retail sector has been a proving ground for many SC strategies over the years. The participants indicate that their inventory flow and fulfillment initiatives have a stronger impact on customer service than cost efficiency. Figure 5 indicates that collaborative planning, forecasting, and replenishment (CPFR), demand driven replenishment, and velocity-based

FIGURE 2
UNCONTROLLABLE ISSUES ARE FUTURE CONCERNS FOR SCM EXECUTIVES

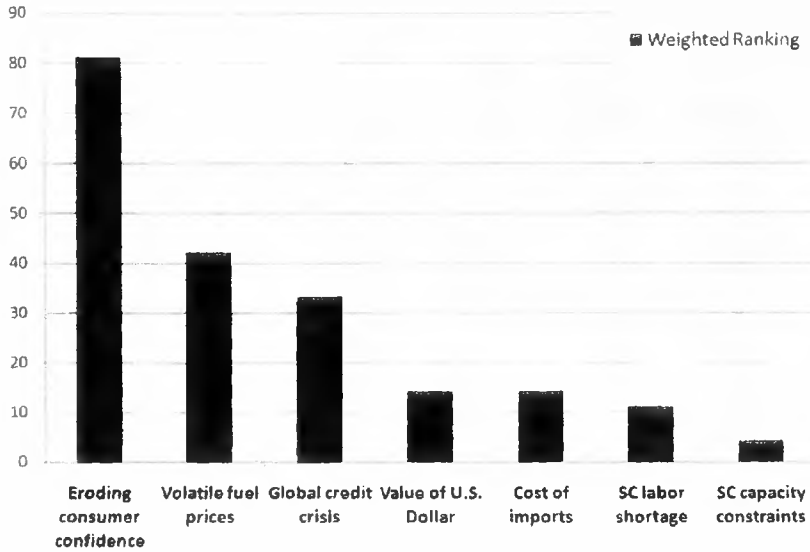


FIGURE 3
DISCREPANCY BETWEEN IMPORTANCE OF CAPABILITIES AND THE RETAILERS' ABILITY TO DEVELOP THE CAPABILITIES

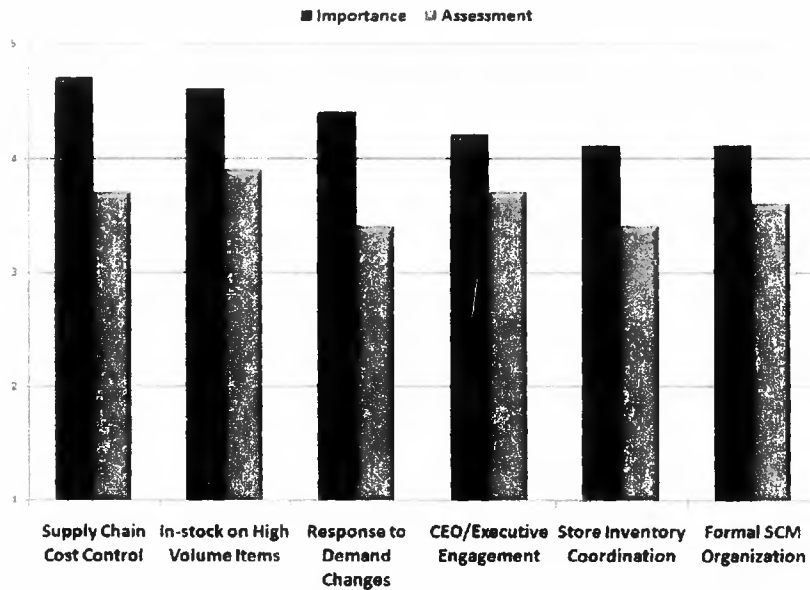


FIGURE 4
REDUCED SPENDING PLANNED AS A RESULT OF SOFT ECONOMY

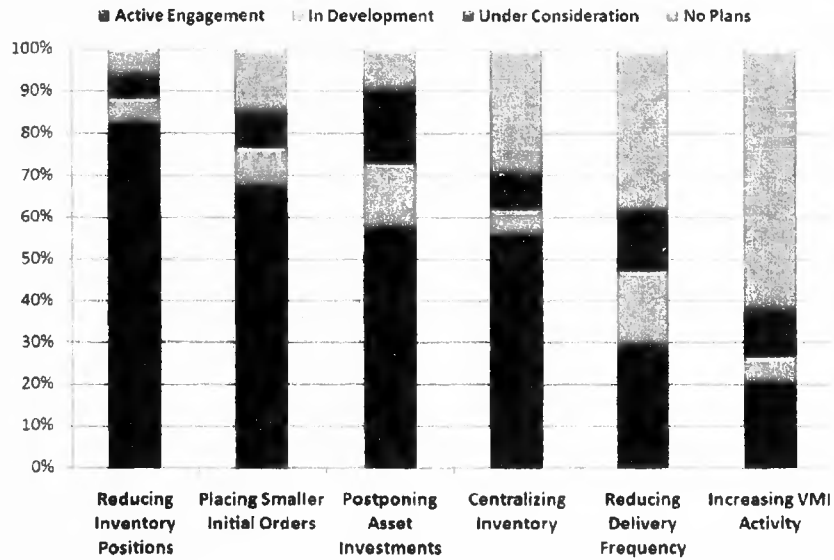
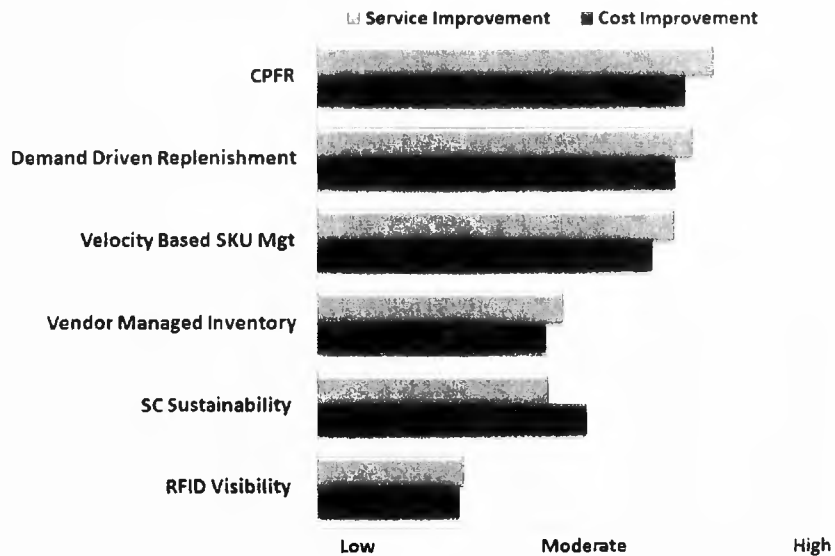


FIGURE 5
STRATEGIC IMPORTANCE OF SERVICE VS. COST IMPROVEMENTS



SKU management are particularly beneficial for pulling assets through the pipeline. In contrast, newer initiatives have not had as great an impact on performance. It will take time for retailers to fully harness the potential of sustainability efforts and RFID technology.

Best-in-Class Capabilities

This section describes the capabilities the executives viewed as representing the best practices found in retail supply chains. No single retailer was identified as exhibiting all these capabilities; rather best-in-class retailers have produced outstanding performance by leveraging excellence in one or two of these areas. This is a significant finding and suggests no retailer is in a position to dominate competitors because of they are best-in-class across a wide array of SCM capabilities.

Leverage a strong distribution network. A major advantage of the mature, big box retailers is the existence of fully-deployed, high-volume distribution networks. Wal-Mart, Target, Walgreens, Lowes and others have each built networks with enormous capacity to flow product to their widely dispersed store locations. One of the most frequently mentioned strengths of large retailers described by the executives was the cost efficiency advantage gained from this robust asset. Just utilizing the existing network infrastructure does not create industry leading performance. Best-in-class retailers understand the need to capitalize on past logistics infrastructure investments and continue to drive lower operating costs year-on-year.

As costs go up, we have to get much better at network utilization. We're really trying to sweat our assets.

The survey results supported the importance of leveraging infrastructure to achieve ongoing operating cost reductions. The executives were asked to rate the importance of a dozen capabilities and then classify those that are critical to becoming best-in-class. In each case "supply chain cost control" was the top choice as shown previously by the importance bars in Figure 3. A follow-on question asked the executives to identify their strategic focus. Again, "control supply chain related costs" ranked highest when referencing the current year (2008), and increased in importance when considering the next year (2009).

Despite this feedback the executives made it clear that size alone does not make a retail infrastructure best-

in-class. In many respects, comparing retailers is like comparing apples and oranges. Different product categories require different kinds of support from R-SCM. Electronics, garments, and fresh produce each have very different logistical requirements, and the executives reflected this need for finding an infrastructure that best fit their specific needs.

We have to continue to search for a physical network that is well thought out, rationalized and appropriate for the retail space as our product assortment adjusts to changes in customer demand.

Creating flexible capacity. Several executives touched on the thought that "one size doesn't fit all" in the retail world. In addition, the retail environment was frequently described as "dynamic" and "rapidly changing." The ability to quickly adjust operating capacity in line with changes in demand is a distinguishing capability of the best R-SCM organizations.

Flexibility is the key component, because things are changing constantly.

Being able to change capacity to handle changing demand, cost effectively, and still providing the service your stores and customers want.

Retailers, by the nature of their business have created infrastructures that are already flexible because most have to deal with two, three, or more times the volume increase during the holiday season compared with the rest of the year. However, a key differentiator of the best organizations is the ability to flex capacity in line with *unexpected* changes in the demand. This is especially true in a weakening economy that was already affecting retailers as we were collecting research data.

It is critical that we are able to change capacity to handle changing demand, cost effectively, and still provide the service our stores and customers want.

The importance of flexibility was driven home in the survey results through a series of questions dealing with retailers' capabilities in this area. Retailers responded with a strong belief that their existing supply chain is prepared to cope with the challenges found in the current business environment (4.3 on a 5.0 scale). Similarly, the executives believe

their organizations are positioned to quickly respond to volatile customer demand (4.3 on a 5.0 scale).

Internal alignment. Retailer culture has traditionally been driven out of one of two other organizations: Merchandising or Store Operations. The importance of both is clear. Merchants decide what products to include in the selling assortment, and often determine how the product is to be displayed in the store. Their primary goal is to increase sales, and the incentive structure of the Merchant organization has historically been heavily weighted toward achieving revenue targets by category, with less emphasis on cost. The focus of Store Operations is producing a consistently high-quality shopping experience for the customer by ensuring the products are on the shelf, available for sale, and easy to locate. Stores are evaluated on a variety of metrics, but since they generally do not take part in the item selection process, and often do not have the ability to adjust inventory replenishment levels, they are put in a position of selling what has been given to them, again making revenue a primary measure.

R-SCM has generally been viewed as a support function with the conflicting goals of keeping costs low while achieving high service levels to the stores. Cases exist where the R-SCM organization may already be at the strategic core of these companies, as arguably is the case with Wal-Mart and the world class distribution operation it has used to facilitate its expansion to almost 4,000 stores in the U.S., but this is generally not the case. The executives explained a shift is occurring today as R-SCM has begun to take on a greater role. Retailers are beginning to break down the walls between these three operating silos and manage the process holistically. Several retailers described the existence of ongoing cross-functional teams that meet frequently to ensure Merchandising, R-SCM, and Store Operations stay on the same page.

We manage cross-functionally to ensure the supply chain is as seamless as possible and not silo-driven.

Our supply chain steering committee includes SCM leadership, the chief merchant, the CIO, the merchandise planning exec, and the CEO.

An important tool used to improve alignment across the organization is the elimination of silo-specific

metrics that may be in opposition to aggregate company goals, and the introduction of new, cross-functional metrics used to evaluate all three organizations. However, this is a nascent area where the executives were hesitant to share what they felt was competitively sensitive information. A few comments do provide insight into the value of aligning metrics.

My experience has taught me that if you just think about supply chain cost, you are not taking advantage of optimizing the entire end-to-end process from the customer's customer to the supplier's supplier.

A great retail organization not only understands the cost of running a supply chain, but understands how those costs are cascaded down onto the customer and back upstream to the supplier.

The survey provided interesting results regarding alignment as shown in Figure 6. Current R-SCM involvement with the Store Operations organization is significantly greater than with the Merchant organization, suggesting the importance of extending the supply to cover the "last 100 yards" to the store shelf (Taylor and Fawcett 2001), or as one executive told us:

The most powerful section of the supply chain is the last 50 feet.

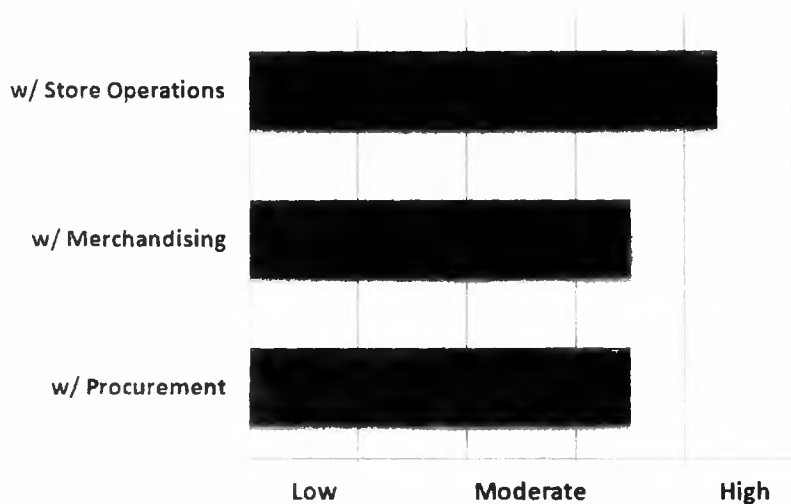
Developing the best people. Another foundational strength of the best R-SCM organizations is the people that keep the operation running. The great majority of executives described their high caliber managers and employees as one of their significant strengths. This was true across all types of retailers we spoke with from discount to high-end.

People are the main success factor behind any organization.

We have the best people in the industry.

We are evolving our culture, so that our associates are engaged in helping us identify where we have process failures, taking waste out, and reducing the number of defects that we produce.

FIGURE 6
R-SCM INVOLVEMENT WITH OTHER INTERNAL FUNCTIONS



An in-depth analysis of the transcripts finds two specific themes underpinning the “best people” comments. First, the best performing R-SCM organizations have developed a culture in which the majority of employees share a core belief in the mission of the organization, and are committed to helping the organization fulfill that mission. Cultural is shaped by company leaders and consistent support of R-SCM from top management is essential, particularly in the retail firms that have been primarily dominated by the merchant organization since the dawn of retailing. This support is often quite active, as multiple executives mentioned the importance of the CEO taking a major role in forming supply chain strategies.

I would argue that in the best supply chains, the architect is the CEO.

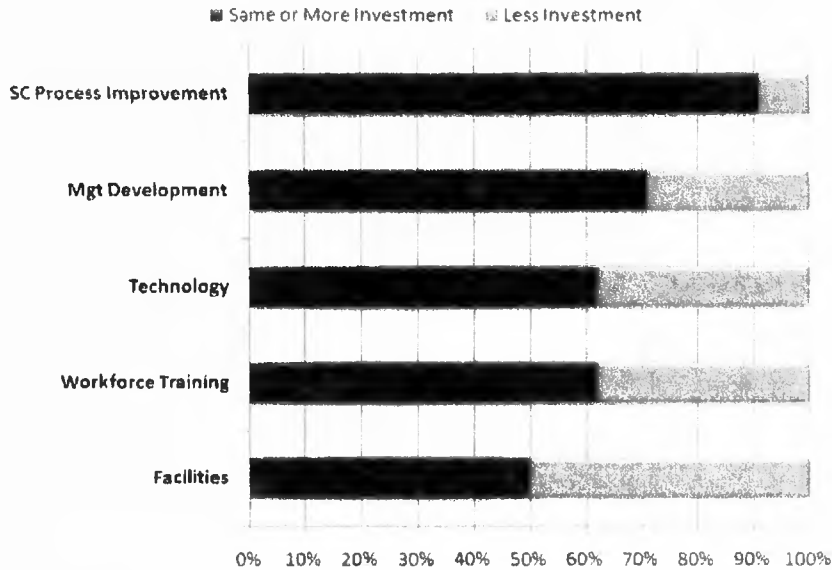
Second, the best-in-class organizations have developed formal training programs that are available to a wide

array of people, not just managers and executives. Existing infrastructure and dedicated people both represent barriers to competitors that are difficult to overcome, and the best retailers leverage these assets continually. Figure 7 shows the areas R-SCM executives are investing in as the economic outlook appears gloomy.

The best-in-class retailers continue to invest strategically as evidenced in 64% of survey respondents stating their supply chain investment plans for 2009 will be consistent with 2008 or greater. Spending is anticipated to be maintained or grow in the areas of process improvement (91%), management development (71%), and workforce training (62%).

We are meeting the current challenges yet preparing for coming out the other side.

FIGURE 7
PROJECTED INVESTMENT LEVELS IN KEY R-SCM AREAS



CONCLUSION

Understanding the role of R-SCM is critical as retailers face tremendous supply chain challenges, increasingly demanding consumers, and an insatiable appetite for reducing cost while maintaining high customer service levels. Meeting these challenges represents a significant obstacle and a significant opportunity, particularly in an environment of flat or negatives sales.

In this paper we have used a grounded theory method, validated using survey results, to identify the challenges R-SCM organizations face and the best practices used to overcome these challenges. Each of these issues represents an opportunity for future research and suggests research questions such as: What is an acceptable logistics cost (as a percentage of gross margin, or revenue)? How do we incorporate fully loaded cost into the sourcing decisions made by merchants? What is the right inventory turn rate by SKU class? What is the tradeoff between global sourcing, velocity, and markdown management? How is velocity best managed in the retail supply chain?

We identified four best-in-class capabilities used strategically by retailers to compete. No one retailer

was seen as possessing all these capabilities, yet many retailers were identified as exemplifying one or more of the capabilities. A possible area for follow-on research involves diving more deeply into each of the capabilities. For example, further study may uncover appropriate combinations of capabilities that provide better performance results than other capability sets. The potential of linking these capabilities across multiple supply chain firms to form inter-organizational capabilities is another area that may be extremely beneficial to practitioners.

Our findings have several implications for transportation providers. Feedback from the study participants demonstrates that each retailer should be treated as a unique group of customers with needs that are different from manufacturers and suppliers. In periods of volatility with respect to shipping volumes and fuel prices carriers may be able to differentiate their offering by understanding the specific requirements and volumes of each retailer they serve. If a retailer cuts inventory levels or reduces delivery frequency to reduce costs, transportation providers must be ready to develop new schedules, alter routes to limit empty miles, and consolidate freight to avoid "shipping air." These types of service modifications will help carriers hold on

to key accounts during a period of retailer belt-tightening.

A best practice of many of the study participants is increasing internal alignment across departments. Transportation providers are in a position to help retailers extend this alignment outside the firm. Aligning goals and performance metrics across both the retailer and the carrier should enhance performance and ultimately the nature of the supply chain relationship.

Also, transportation providers may use our findings in making strategic adjustments they are considering. Surviving the current soft economy requires that carriers focus on efficiencies and be willing to live with reduced volume for the time being. This may mean mothballing rolling assets or reducing some amount of the driver workforce to less than fulltime status, while being prepared to respond quickly when retail sales recover. Carriers with the ability to maintain their fleet and workforce will be positioned to provide additional capacity rapidly when shipping volumes increase at the end of the recession.

A more immediate opportunity may exist for carriers holding onto significant excess capacity. Retailers, and other supply chain members, that own in-house fleets may be interested in reducing or even eliminating the private fleet as a cost saving measure. This provides a strategic opportunity for transportation providers to acquire new business.

One of the recurring calls in academic research is the need to understand how the phenomena changes over time through the use of longitudinal research. Our goal is to expand this effort into an annual study that can be useful in understanding the role of R-SCM,

stay in touch with current trends and shifting challenges, and routinely update the best practices being used by retailers to manage their supply chain related issues. We believe understanding how capabilities evolve over time is an area of interest to the discipline.

The purpose of this research was to gain greater understanding of the issues and competitive strengths of retailers and while more remains to be learned, we believe the findings do shed light onto those areas. Our interviews and survey results confirm the importance of SCM to long-term retail success. This research begins to address the knowledge gap identified by the relative lack of research in the area. We have provided initial insight into the challenges of R-SCM, and described a number of the capabilities that characterize best-in-class R-SCM. This research lays a foundation for a more expansive agenda oriented toward uncovering the role of supply chain management in the retail industry.

All research has limitations and this effort is no different in that respect. While we firmly believe the findings are informative and robustly developed, the qualitative techniques used do not lend themselves to broad generalization of findings. The goal of the study was to explore and provide greater understanding of R-SCM, and establish a path for future research to follow.

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THE IMPACT OF HOURS-OF-SERVICE REGULATIONS ON TRANSPORTATION PRODUCTIVITY AND SAFETY: A SUMMARY OF FINDINGS FROM THE LITERATURE

Hokey Min

ABSTRACT

Since driver fatigue has known to be the primary cause of serious truck crashes, the Federal Motor Carrier Safety Administration (FMCSA) has attempted to implement new hours-of-service (HOS) regulations that aimed to promote safer driving environments. The new HOS regulations effective on October 1st of 2005, however, may lead to substantial cost increases for the trucking industry which will in turn hurt shippers and ultimately customers. For instance, motor carriers may need to hire additional drivers to comply with new HOS regulations requiring that drivers be placed out-of-service until they accumulated enough off-duty time. In particular, off-duty breaks required to refresh driving hours were increased to 10 consecutive hours from the old rule of eight cumulative hours. A chronic shortage of truck drivers coupled with new HOS regulations could further aggravate the driver recruitment and retention problems. In addition, due to potential loading/unloading delays and stiffer fines/penalties resulting from new HOS regulations, trucking productivity may decline. To help trucking firms cope with various challenges of new HOS regulations, this paper provides a systematic overview of prior literature that examines the impact of HOS on transportation productivity and safety in the U.S. It also discusses managerial implications of new HOS regulations.

INTRODUCTION

The hours of service (HOS) regulations were first introduced by the now-abolished Interstate Commerce Commission (ICC) in 1937 as a way to protect the safety of long-haul truckers. The HOS's main purpose is to prevent truck accidents caused by driver fatigue. This is accomplished by limiting the number of driver working hours per day and week. Driver working hours include the time spent on loading, unloading, driving, handling freight, preparing reports, preparing vehicles for service, or performing any other duty pertaining to the transportation of passengers or property. The main reason for limiting driver working hours is to prevent fatigue by keeping drivers on a 21- to 24-hour schedule, maintaining a human body's

natural sleep and wake cycle (so-called circadian rhythm). Drivers are required to take a daily minimum period of rest and are allowed longer weekend rest periods to combat sleep deprivation, cumulative fatigue, and time-on-task fatigue effects that accrue on a weekly basis (Federal Motor Carrier Safety Administration, 2006). Despite their intent to enhance traffic safety, HOS regulations have become sources of controversy because it is hard for the policy maker to determine exactly how long drivers should work and sleep for their safety. As such, there were numerous proposals to amend HOS regulations between 1962 and 2009, but none were ever finalized due to contentious debates over their effectiveness in enhancing traffic safety.

One of the most notable proposals of those includes the highway reauthorization bill recently passed by the U.S. House of Representatives, which contained several important amendments for HOS regulations that aimed to balance the requirement for highway safety and the need for effective trucking services in the United States. Amended HOS regulations introduced by the U.S. Federal Motor Carrier Safety Administration (FMCSA) in 2003 and 2005 were generally well received by drivers, carriers, and shippers, although carriers seek more flexible sleeper berth rules. The main theme of the 2003 HOS rules is to increase an opportunity for restorative sleep by increasing the amount of off-duty time by two hours. To elaborate, these rules allowed truck drivers to drive a maximum of 11 hours after 10 consecutive hours off duty. However, truck drivers are prohibited to drive beyond the 14th hour after coming off duty, following 10 consecutive hours of duty. The 2003 HOS rules were further refined in 2005 which remained virtually unchanged as of 2008, because of a decision by the United States Court of Appeals for the District of Columbia Circuit in *Public Citizen et al. versus Federal Motor Carrier Safety Administration* (374 F.3d 1209) on July 16, 2005, which stated the 2003 HOS rules did not consider the impact of rules on driver health (Blanchard, 2004). As summarized in Table 1, the 2008 HOS rules intended to increase potential for quality sleep by mandating commercial motor vehicle (CMV) drivers to take at least 8 consecutive hours in the sleeper berth plus two consecutive hours either in the sleeper berth, off duty, or any combination of the two.

Unfortunately, these amended regulations were still attacked by the International Brotherhood of Teamsters and public safety advocacy groups such as *Public Citizen*, *Parents against Tired Truckers (PATT)*, and *Citizens for Reliable and Safe Highways (CRASH)* despite the fact that truck crashes and driver fatalities have fallen in the recent years even as more freight has been moved since their enactment (Cutler and Regan, 2007). To elaborate, the 2006 fatal crash rate for large trucks stood at 1.93 fatal crashes per 100 million vehicle-miles-traveled. This rate broke the previous low of 1.97 fatal crashes per 100 million vehicle-miles-traveled in 2002. The large truck-involvement rate fell to 2.12 per 100 million vehicle miles traveled, down from 2.21 a year earlier. The fatality rate declined to 2.24 per 100 million vehicle-miles-traveled, down from 2.34 in 2005 (Business Wire, 2008).

So, the fundamental questions still remain to be answered:

- (1) Do these amended HOS rules save lives, or do they put more lives at risk?
- (2) Do these amended HOS rules improve carrier operations and subsequently enhance trucking productivity or do they put the trucking industry in jeopardy and thus increase trucking business failures?

Since the major goals of various interest groups are varied and often conflicting, the implications of HOS regulations have become one of the most controversial topics in the United States. Those groups, such as shippers, who are in favor of 2008 HOS rules have advocated maintaining status quo or getting the 2008 HOS rules legislated into law, without FMCSA ever addressing the above questions. On the other hand, those groups, such as public safety advocacy groups, who are opposed to the 2008 HOS rules have supported enacting stricter controls over the trucking industry on the premise that drivers who are allowed more than 10 hours a day behind a wheel will get fatigued and threaten the safety of the general public on the road. Recognizing these contrasting views and interpretations of the HOS rules, this paper intends to gather factual evidence from the past scientific studies regarding the HOS rules and their related issues such as human fatigue, circadian rhythms, accident rates, fatalities, potential carrier costs, and trucking productivity and then validate some of the rationale behind arguments made by various interest groups. Specifically, the main objectives of this paper are to

1. Synthesize the existing literature dealing with the pros and cons of HOS rules with respect to their safety and productivity implications;
2. Identify key factors influencing driver fatigue, reduced alertness, and driving task performance based on the findings of the past studies;
3. Clarify the myth surrounding the correlation between HOS rules and transportation safety and trucking business failures based on secondary data analyses;
4. Recommend best-practices and more productive transportation strategies that can minimize driver fatigue and improve driver productivity under new HOS rules;
5. Discuss the future outlook for extensions of existing HOS literature and untapped research topics relevant to HOS rules.

TABLE 1
RECENT CHANGES IN HOURS-OF-SERVICE RULES

2003 HOS Rule Property Carrying CMV Drivers- Compliance Through 09/2005	2008 HOS Rule Property Carrying CMV Drivers- Compliance On & After 01/19/2009
May drive a maximum of 11 hours after 10 consecutive hours off duty.	No Change
May not drive beyond the 14 th hour after coming off duty, following 10 consecutive hours off duty.	No Change
May not drive after 60 hours of duty in 7 consecutive days if the employing motor carrier does not operate commercial motor vehicles every day of the week.	No Change
• A driver may restart a 7 consecutive day period after taking 34 or more consecutive hours off duty.	
May not drive after 70 hours of duty in 8 consecutive days if the employing motor carrier operates commercial motor vehicles every day of the week.	No Change
• A driver may restart a 8 consecutive day period after taking 34 or more consecutive hours off duty.	
May not drive after the 14 th hour after coming on duty 5 days a week or after the 16 th hour after coming on duty 2 days a week for those drivers who operate within a 150-mile radius of their normal work reporting location.	No Change
Commercial motor vehicle (CMV) drivers using a sleeper berth must take 10 hours off duty, but may split sleeper berth time into two periods provided neither is less than 2 hours.	CMV drivers using the sleeper berth provision must take at least 8 consecutive hours in the sleeper berth, plus 2 consecutive hours either in the sleeper berth, off duty, or any combination of the two.

Note: Passenger-carrying carrier/drivers are not subject to the above rules. These operations must comply with the hours-of-service limitations in 49 CFR 395.5.

KEY HOS PREMISES AND THEIR RATIONALE

The human body typically functions on a 24-hour cycle. To elaborate, most people's biological clocks work on a 25-hour cycle rather than a 24-hour cycle. However, the human body's biological cycle normally follows the 24-hour cycle of the sun rather than the human body's innate cycle, because sunlight or other bright lights can reset a pair of pinhead-sized brain structures called suprachiasmatic nucleus (SCN) that contain about 20,000 neurons (Koukkari and Sothorn, 2006). This biological clock is set based on circadian

rhythms which dictate changes in the human's mental and physical characteristics in the course of a day. These changes include: fluctuations in blood pressure, heart rate, body temperature, hormones, memory, reaction time, and attention span. Thus, circadian rhythms influence total sleep hours, rest hours, and subsequent restoration power of the human body (Liskowsky, 1992).

In particular, the disruption of circadian rhythms caused by irregular work patterns and sleep deprivation that are common in long-haul truck

driving can lead to serious driver fatigue and performance decrement (Ogilvie and Wilkinson, 1984). The cumulative driver fatigue would increase the likelihood of the driver's slow reaction, slow driving, disorientation, poor gear change, poor steering, and lane deviation and thus increase the risk of truck crashes (Office of Technology Assessment, 1991). As a matter of fact, a number of studies linked driver fatigue to safety. For example, Van Cauter and Turek (1990) observed that driver fatigue tended to deteriorate driving performance and subsequently increased accident rates. Similar conclusions were drawn by Sweedler et al. (1990) and Mitler et al. (1997) whose studies indicated that fatigue was one of the most probable causes of many truck crashes in the United States. Indeed, the U.S. National Transportation Safety Board (2008) blamed driver fatigue as a probable factor in 20-40% of truck crashes. That is to say, when truck drivers become fatigued from excessive driving/working hours and continuous sleep deprivation (e.g., sleep apnoea, insomnia, narcolepsy), they significantly increase the risk of truck crashes that result in fatalities and serious injuries. Considering this serious risk to public safety, HOS's main intent is to provide an increased opportunity for truck drivers to obtain necessary rest and restorative sleep. This intent of HOS, however, is in conflict with the goal of many truck drivers whose earnings depend heavily on the number of their driving hours. The U.S. National Transportation Safety Board (2008) estimated that the average trucker drove 125,000 miles a year, and that was on the low end of an average. The question remains how one can compromise the number of driving hours sufficient enough for truckers to make their ends meet, while not too long for them to lose their circadian rhythms and necessary daily sleeps.

An answer to the above question hinges on the threshold of sleep deprivation that can adversely affect driving performance and begin to pose a serious danger to both truck drivers and others on the road. One of the clues can be found in several recent studies that examined the impact of partial and full sleep deprivation on driving impairment such as lane keeping performances. These studies include Fairclough and Graham (1999) who discovered that the effect of one night sleep deprivation was equivalent to that of 0.07% blood alcohol content (BAC). Similarly, Arnedt et al. (2001) found that the impact of 21 hours of driving without any sleep on driving performance was equivalent to that of 0.08% of BAC. Driving with such a level of BAC is illegal in most of the U.S. since that level of BAC would increase the risk of fatal vehicle crashes by three to 17

times more (Heng et al., 2006). Amundsen and Sagberg (2003) also discovered that even a small reduction in sleep (e.g., restricting sleep less than seven hours) could triple the accident risk. Considering such risk, 2003 HOS aimed to move towards a 24-hour work-rest cycle, enhance the opportunity for restorative sleep by increasing the amount of off-duty time by two hours, and strike a balance between uniform, consistent enforcement, and operational flexibility. As shown in Table 2, Federal Motor Carrier Safety Administration (FMCSA) under the U.S. Department of Transportation (2003) estimated that 2003 HOS would save up to 75 lives and prevent as many as 1,326 fatigue-related crashes annually (<http://www.fmcsa.dot.gov/about/news/news-releases/2003/052703.asp>).

Taking a step further, new 2008 HOS rules effective on January 19th of 2009 require 10 consecutive hours of off-duty time to increase the potential for quality sleep. However, the new HOS rules may lead to substantial cost increases for the trucking industry which will in turn hurt shippers and ultimately customers. For instance, the trucking industry may need to hire additional 84,000 drivers to comply with the new HOS rules requiring that drivers be placed out-of-service until they accumulated enough off-duty time. In particular, off-duty breaks required to refresh driving hours were increased to 10 consecutive hours from the old rule of eight consecutive hours. A chronic shortage of truck drivers coupled with the new HOS rules could further aggravate the driver recruitment and retention problem. In addition, due to potential loading/unloading delays and stiffer fines/penalties (between \$550 and \$11,000 per violation depending on the severity) imposed by the new HOS rules, motor carriers such as Schneider National estimated that trucking productivity would decline by 4-19% (WERC, 2004). Similarly, the new HOS rules stipulated that drivers would be considered on duty when loading and unloading or waiting to clear customary paperwork. For this reason, most observers anticipate significant productivity losses--in some cases approaching 20%--particularly for truckload carriers. As such, Wal-Mart expected the new HOS rules to add \$25 million to the cost of new drivers and tractors alone (Clair and Fox, 2004). Furthermore, a HOS compliance cost can add a significant burden to the trucking industry. For example, the purchase and installation of an electronic on-board recorder (EOBR) could cost the trucker more than \$2,000. Its annual operating and maintenance cost of \$200 should be factored into the cost estimate as well. Also, drivers averaged 20 minutes of time to write logs for each trip and fleet managers typically spent 20 minutes a month to review and monitor

TABLE 2
TRAFFIC SAFETY RECORD AND HOS EFFECTS FOR LARGE TRUCKS (GROSS VEHICLE WEIGHT RATING EXCEEDING 10,000 POUNDS)

2001-2003 total number of large truck involved in crashes	141,000 crashes
2001-2003 total number of large truck involved in fatigue-related crashes	18,000 crashes
1997-2000 average fatalities in fatigue-related crashes	375 people
1997-2000 average injuries in fatigue-related crashes	7,500 people
1997-1999 average cost per truck crash	\$62,613
2002 total cost of fatigue-related crashes	\$2.3 billion
Lives that could have been saved in 2002 by 100% HOS compliance	75 to 120 people
Estimated annual cost savings to motor carriers by 100% HOS compliance	\$900 million to \$1.3 billion
Net benefits of HOS rules	\$600 million to \$1.1 billion per year

Source: FMCSA (2005), Commercial Motor Vehicle Facts, <http://www.truckbrakesafety.com/pdf/articles/fmcsa-facts-figures.pdf>; FMCSA (2008), *The Large Truck Crash Causation Study*, <http://www.fmcsa.dot.gov/facts-research/research-technology/analysis/FMCSA-RRA-07-017.htm>.

driver compliances; thus, HOS compliance efforts would be detrimental to trucking productivity (Barnes, 2000). Complicating the HOS compliance efforts, new HOS rules can be interpreted in many different ways since FMCSA officials have no plans to issue a clarification to the rules (Adams, 2005). For example, the rules do not regulate how off duty hours must be used, how a mandatory two rest-break should be utilized, and what the parameters of a continuous 14 shift should be. Thus, many drivers may end up taking odd nap times, trying to travel hundreds of miles without a proper rest-break, and feeling the increased pressure of meeting delivery times.

THE DRIVER FATIGUE MODEL

As discussed earlier, the leading cause of truck accidents is driver fatigue. In fact, driver fatigue was the primary cause of 2% to 23% of all truck crashes (O'Hanlon 1978, Horne and Reyner, 1995). Reissmann (1997) also discovered that drowsy drivers were responsible for 50% of the fatal vehicle crashes on the Pennsylvania Turnpike and New York Thruway. In particular, driver fatigue is overrepresented in

accidents during nighttime, single-vehicle accidents, high-speed (especially more than 90 miles) accidents, and accidents on monotonous roads (Sagberg, 1999; Amundsen and Sagberg, 2003). A recent study conducted by the Adelaide Centre for Sleep Research showed that drivers who have been awake for 24 hours have an equivalent driving performance to a person who has a BAC (blood alcohol content) of 0.1 g/100ml are seven times more likely to have an accident (<http://www.smartmotorist.com/traffic-and-safety-guideline/driver-fatigue-is-an-important-cause-of-road-crashes.html>, 2008).

The typical symptoms of driver fatigue include groggy and exhaustive feeling, frequent yawning, strained eyes, daydreaming while on the road, driving right of center, driving with varying speed, and experiencing short bursts of microsleep (i.e., a lapse from wake to sleep that lasts only a few seconds). One of the ironies of driver fatigue is that the driver may be too tired to determine his/her own level of fatigue (<http://www.sleep-deprivation.com/articles/causes-of-sleep-deprivation/driver-fatigue.php>, 2008). Since driver fatigue reduces driver alertness and adversely

affects driver performance, it has been the central theme of the various HOS rules. Thus, it is important for us to understand what causes driver fatigue and how significantly driver fatigue influences truck safety. To increase such understanding, we developed a driver fatigue model based on the findings of prior studies and theory postulated by human biology and behavioral science.

Factors Influencing Driver Fatigue

Driver fatigue is affected by a multitude of factors encompassing human biology (e.g., circadian rhythms), working environments (e.g., time on the road), working schedules (e.g., trip schedules), and work demand (e.g., breaks). Among those factors, a circadian rhythm is generally known to be one of the most important factors contributing to driver fatigue since it directly affects a driver's psychological processes and mental functions such as memory, reaction time, manual dexterity, and feel of alertness that, in turn, influence driver performance (Office of Technology Assessment, 1991; Dawson et al., 2001; Fletcher and Dawson, 2001). Figure 1 shows how driver fatigue can increase the risk of truck crashes. To complicate the driver fatigue model, the circadian rhythm is intertwined with a driver's individual characteristics (e.g., age, fitness, driving experience, sleep disorders, medical conditions), monotonous working environments creating boredom (e.g., straight driving with a lack of stimulation), and work schedules (e.g., nighttime driving, long working hours, cumulative sleep debt, irregular rest periods) (Brown, 1993; Crum et al., 2001; Eskandarian, 2007). Figure 2 displays the correlation between these attributes and driver fatigue. In the next sub-sections, we will elaborate on the effect of some of these factors on driver performance and subsequent truck safety.

Driver age. It is a common perception that younger drivers are likely to get involved in accidents due to their lack of driving experience and recklessness. Thus, a combination of driver fatigue and youth can be a deadly mix for potential vehicle crashes. Regardless, the findings of prior studies examining the link between driver age and fatigue are not conclusive. For example, although there were large differences among drivers in levels of alertness and performance, a driver fatigue and alertness study conducted by FMCSA (1997) showed no significant relationships between driver age and fatigue. On the other hand, Horne et al. (2002) indicated that younger drivers had a somewhat higher risk of being involved in fatigue-related accidents than older drivers. This finding is somewhat contrary to an observation made by Reissman (1997)

that younger drivers often have greater flexibility adjusting to new sleep patterns than older drivers do. Also, Campagne et al. (2004) compared the performance of three age groups in a driving simulator study and found that deterioration of vigilance was correlated with driving errors for drivers aged 60 and above.

Another study conducted by Summala and Mikkola (1994) showed that record road accidents among 18-20 old drivers peaked during midnight to 6 a.m., whereas the accidents caused by drivers over 50 years old peaked during the late afternoon hours. More recently, Australian Transport Safety Bureau (2008) discovered that fatigued drivers under 29 years of age had a higher risk of vehicle crashes than those over 50 years old. It also showed a significant relationship between the age of the fatigued driver and the type of fatigue-related crash (single vehicle or head-on). Single vehicle crashes involved a higher proportion of fatigued drivers under 29 years of age compared with head-on crashes. However, fatigued drivers over 50 years of age were involved in more head-on crashes. This relationship might be linked to the time of crash. That is to say, single vehicle crashes are more likely to occur in the early morning and early morning crashes are more likely to involve fatigued drivers under 29 years of age. A similar logic could explain the relationship between older fatigued drivers and head-on crashes. Therefore, age can be a mediating factor for accidental risk. However, its importance to driver fatigue is unclear.

Obesity. Stoohs et al. (1994) found that obese truck drivers had a two-fold higher accident rate per mile than non-obese drivers. Similarly, a recent 15-month empirical study conducted by Park et al. (2009) subjected 456 commercial truck drivers to screenings for an obstructive sleep apnea (OSA) which disrupts sleep and results in daytime sleepiness, sleep attacks or "nodding off", impaired psychomotor ability, and poor decision-making ability. The study reported that approximately 2.4 – 3.9 million licensed commercial drivers in the U.S. might suffer from OSA due to their obesity, which would likely cause them to fall asleep at the wheel more frequently than physically-fitting drivers and thus increase accident risks.

Long driving hours. Long-haul drivers represent about half of the registered truck fleet in the U.S., but were involved in more than 90% of fatal truck crashes (FMCSA, 2003). This may be due to the fact that long haul (i.e., trips of 100 miles or more from the driver's home base) requires longer driving hours and thus increases the risk of vehicle crashes. Indeed, the relative risk of truck drivers who have driven more than eight hours was almost twice as high as those who drove lesser hours (Kaneko and Jovanis, 1990;

FIGURE 1
THE DRIVER FATIGUE INFLUENCE DIAGRAM

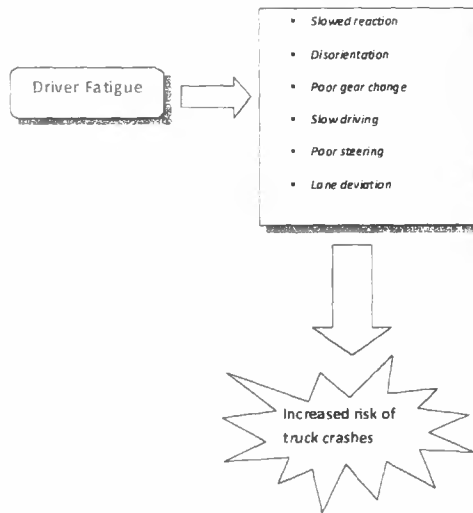
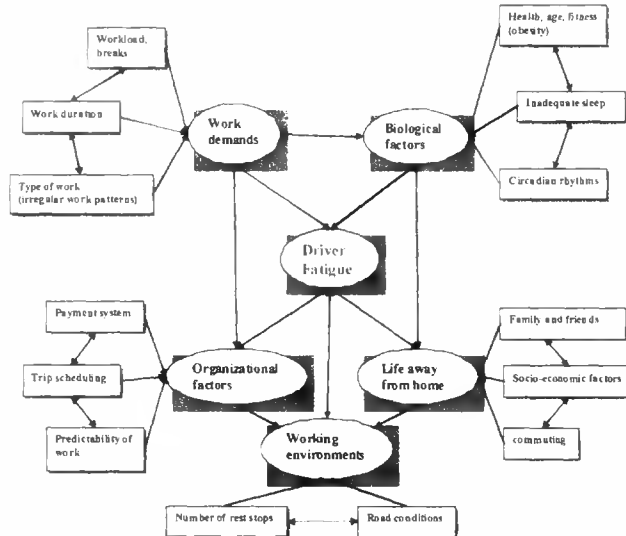


FIGURE 2
FACTORS INFLUENCING DRIVER FATIGUE



Source: Adapted and modified from Dawson, D., Feyer, A.M., Grander, P., Hartley, L., Haworth, N., and Williamson, A. (2001), *Fatigue Expert Group: Options for Regulatory Approach to Fatigue in Drivers of Heavy Vehicles in Australia and New Zealand*, Unpublished Discussion Paper, Melbourne, Australia: Australian Transportation Safety Board.

Braver et al., 1999; Heaton, 2005). Similarly, Mukherjee et al. (2006) discovered that a restriction on trips of no more than eight hours would reduce truck fatalities by 3-5% as compared to no such restriction.

Flexible driver schedules. Mackie and Miller (1978) observed that driving performance among truck drivers started declining after 5 hours of driving for drivers with irregular schedules as compared to 8 hours for drivers with regular schedules. As such, driver schedules can influence driver performance and the subsequent risk of truck crashes. Considering the impact of driver schedules on driver safety, a growing number of trucking firms have considered driver-friendly schedules, such as flexible schedules. For instance, flexible driver schedules resulting from the 24-hour restart provision often allow drivers to maintain a more routine (so-called rhythmic) driving schedule because they prevent the drivers from driving at odd hours and decrease off-duty time driving. As a result, a majority of drivers believed that such schedules would help them spend more time at home, increase their income, and thus improve their safety (Griffin et al., 1992).

Driver income. Truck drivers earn relatively low hourly wages as compared to most other comparable jobs (Belzer et al., 2002). To make matters worse, many drivers (especially non-union drivers) typically get paid only by the mile with no separate pay for non-driving work, such as their waiting and loading/unloading time at the dock. Under the current HOS rules, the opportunity cost of non-driving work can be too high for many drivers. This peculiar situation will force some drivers to violate the HOS rules and drive longer hours without sufficient breaks to make their ends meet and increase the risk of truck crashes. Indeed, the violations of HOS rules are on the steady rise. For example, 3.8% of the road-check inspection of motor carriers resulted in out-of-service conditions for HOS violations in 2005 that was slightly up from 3.44% in 2004 (Logistics Today, 2005). Braver et al. (1992) found that truck drivers who violated the HOS rules are more likely to fall asleep at the wheel and thus increase the risk of truck crashes. Thus, inadequate driver compensation may have a harmful effect on driver safety. Some studies such as Griffin et al. (1992) suggested that for every one cent increase in driver pay, there would be an 11.1% decrease in truck crash probability.

Monotonous driving. Due to a lack of stimuli, the monotony of road conditions can increase driver boredom and decrease driver performance. For

example, driving performance degrades at a faster rate on straight road sections than on curves (Desmond and Mathews, 1998). In particular, sleep related accidents may be more common on long stretches of interstate highways and may account for 40% of fatal accidents (Shafer, 1993; McCartt et al., 1996). Likewise, driver fatigue is likely to occur much earlier when driving on straight, rural roads (Fell, 1994; Thiffault and Bergeron, 2003).

Vehicle speed. Since vehicle speed can either shorten or lengthen the truck driver's driving hours, potential traffic congestion and road construction along the driver's designated route can influence driver fatigue and the subsequent driver safety. Considering the potential link between vehicle speed and driver safety, both Malandraki and Daskin (1992) and Donati et al. (2006) developed a step function with consecutive time intervals that took into account changes in vehicle speed due to traffic congestions and unexpected delays on the road. Their studies revealed interdependence between vehicle speed and driver schedules/truck routes that, in turn, influence driver fatigue.

Preventive Measures for Driver Fatigue and Truck Crashes

As summarized in Table 2, driver fatigue can result in truck crashes and the subsequent fatalities, injuries, and property damages, and thereby burden motor carriers with a substantial amount of financial losses and decreased productivity. In the era of intensified competition in the trucking industry, motor carriers should develop viable guidelines to alleviate driver fatigue and then prevent the potential truck accidents/crashes, while complying with the HOS rules. With that in mind, we propose the following "best-practice" guidelines:

- Crum and Morrow (2002) found that starting the work week tired was the single most important factor influencing truck driver fatigue. To ensure adequate rest before the beginning of the work week, trucking firms should discourage long-haul drivers to follow disjoint sleep patterns and encourages them to have at least five hours of uninterrupted sleep by developing driver routes/schedules (especially post-trip) that allow frequent stops at home;
- To make the effective use of a driver's time to get adequate rest, trucking firms should minimize or eliminate the time a driver spends to count, load, and complete the paperwork, while minimizing the assistance of unnecessary lumpers who may prolong

the unloading time. Also, it is known that drivers tended to be more awake after lumping in the morning, but grew tired after lumping in the afternoon (Barnes, 2000). In other words, trucking firms need to find "driver-friendly" freight (e.g., automotive parts, grocery/food items, paper delivery) whenever possible;

- To minimize waiting/idle time at the unloading dock that takes away a driver's rest time and earning opportunities, trucking firms should consider using "drop-and-hook" options more frequently. In a typical drop-and-hook operation, the driver drops off a fully loaded trailer in the warehouse/distribution center yard and then hauls away an empty one without waiting for unloading. Thus, it saves the driver's waiting time. Also, this practice reduces fuel costs and carbon footprints since it eliminates the need for the truck to sit in the warehouse yard with its engine idling;
- To prolong the quality rest break, trucking firms should direct and encourage truck drivers to full-service rest stops where they can combine non-driving activities such as meal stops, stretches, refueling, shower, laundry, and social hours with the other drivers. Given the nationwide shortages of rest areas, the use of global positioning systems (GPS) along with satellite communication systems to locate nearest rest areas may be essential. Also, truck routes/delivery schedules should be restructured in such a way that drivers can have a greater access to these rest areas;
- According to Braver et al. (1992), the main reason why drivers violated the HOS rules are irregular route driving, penalty for late arrivals, carrying perishable goods, and being assigned unrealistic delivery deadlines. To minimize instances of HOS violations by truck drivers, trucking firms should negotiate with their shippers to allow the drivers to arrive at any time up to a certain time and day with open (soft) time windows as opposed to strict (fixed-schedule) delivery deadlines (Nixon, 2005). Also, the increased use of relay and team driving may help reduce the adverse impact of irregular route driving on the drivers;
- If the truck breaks down in the middle of the road, its driver would waste his/her valuable time for adequate rest and force the driver to catch up with his/her lost time by driving faster. Thus, thorough

pre-trip inspection and preventive maintenance of the truck will help drivers make better use of their on-the-road off-duty time and subsequently reduce the potential risk of fatigue-related truck crashes.

The recent study conducted by NAVTEQ indicated that the use of a real-time navigation system which could alert drivers about unexpected traffic delays and ongoing road construction activities would help drivers save 18% of driving time on an average trip and increase fuel efficiency (Industry News, 2009). Considering this benefit, long-haul drivers may take advantage of this kind of device to better utilize their driving hours and thus increase non-driving restorative periods.

MYTHS ABOUT HOS IMPACTS USING SECONDARY DATA ANALYSIS

As discussed earlier, there were conflicting reports regarding the impact of HOS amendments on traffic safety in terms of reduced truck crashes. To further investigate the validity of this impact, we summarized the secondary data available from the U.S. Department of Transportation. As shown in Table 3, truck crashes declined a year after 2000, 2003 and 2005 HOS amendments despite steady increases in the number of vehicle miles, whereas those figures increased a year after 1996 HOS amendment. However, truck crashes seem to climb back gradually two year after each HOS amendment. As a matter of fact, the Wilcoxon signed rank test revealed that there was no statistically significant difference (p -value = 0.144) in truck crash statistics between four years before and after 2003 HOS amendment. Thus, it is difficult to make any concrete conclusions about the impact of HOS on traffic safety. To settle controversies surrounding the impact of HOS on the trucking industry, we looked at trucking business failures as a surrogate measure of the financial health of the trucking industry. As displayed in Figure 3, although there is a surge in trucking business failures in the third quarter of 2000 and the first quarter of 2001, past patterns of the trucking business failures tend to be cyclical and thus have little to do with any particular government mandates or rules. Instead, increases in trucking business failures seemed to be more correlated with economic downturns than any particular government policies or rules such as HOS amendments. For example, dramatic increases in trucking business failures in 2001 and 2007 coincided with recessionary economies during those years.

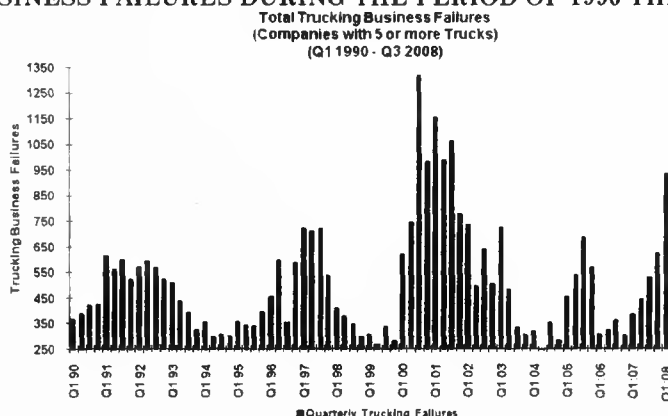
TABLE 3
CRASH RECORD FOR LARGE TRUCKS (GROSS VEHICLE WEIGHT RATING EXCEEDING
10,000 POUNDS) DURING THE PERIOD OF 1990 THROUGH 2007

Year	Recession year?	Trucks involved in crashes in total	Vehicle miles in millions
1990	Yes	384,776	146,242
1991	No	330,347	149,543
1992	No	376,035	153,384
1993	No	397,328	159,888
1994	No	460,644	170,216
1995	No	377,472	178,156
1996	No	393,755	182,971
1997	No		
1998	No	411,955	196,380
1999	No	474,920	202,688
2000	No	456,955	205,520
2001	Yes	429,823	209,032
2002	No	434,587	214,603
2003	No	456,721	217,917
2004	No	415,902	220,792
2005	No	440,951	222,523
2006	No	384,766	222,513
2007	Yes	413,584	226,963
Aver		411.459 (39.461)	172.711 (84.076)

Note: Numbers in parentheses represent standard deviations.

Source: U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, *Traffic Safety Facts 2007, Final Edition* (Washington, DC), available at <http://www-nrd.nhtsa.dot.gov/> as of March 2009.

FIGURE 3
TRUCKING BUSINESS FAILURES DURING THE PERIOD OF 1990 THROUGH 2008



Source: Avondale Partners, LLC, American Trucking Association (2008)

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Since the inception of HOS regulations in 1939, these regulations have been controversial. Even the series of their amendments in 1962, 1996, 2000, 2003, and 2005 have failed to stop controversies and silence critics. The center of the controversies often lies in the misinterpretation and misunderstanding of their impact on reduction in driver fatigue and increase in driver safety/productivity. To compound the moot point surrounding HOS regulations, some study findings regarding the impact of HOS rules on driver safety are incongruent and inconsistent with each other. Thus, there is a great need for us to synthesize these study findings and discern real facts from misconceptions. With that in mind, this paper thoroughly reviewed various forms of prior studies including empirical, exploratory, case, and analytical studies that investigated the various effects of HOS rules on driver fatigue and safety, while analyzing secondary data sources available from the public domain. Based on the review of prior literature and secondary data sources, we can draw the following conclusions:

- The disruption of a truck driver's circadian rhythms resulting from irregular work or rest patterns is one of the most important reasons for driver fatigue. As driver fatigue increases, driver safety decreases due to a lack of reaction time, dexterity, memory, cognition, and feeling of alertness associated with driver fatigue. Thus, a series of HOS rules introduced in the past aimed to reduce driver fatigue by not only limiting the truck driver's duty hours, but also increasing off-duty rest periods. Despite this intention, HOS rules have become a constant source of controversies due to their oversight of long haul trucking practices. By nature, long haul trucking is characterized by extended and irregular duty hours that are often affected by many interwoven factors such as delivery schedules (including restricted time windows, nighttime driving), geographical customer bases, truck routes, driver shifts, driver earning opportunities, driver idle/waiting time at the loading/unloading docks, and number of different time zones that drivers need to pass. Thus, the effectiveness of HOS rules should be assessed holistically rather than being judged by their influence on each factor.
- For a variety of reasons including the carrier's delivery service commitments and the driver's concerns over his/her income, many drivers across the U.S. and Canada seemed to knowingly violate

the HOS rules. Although electronic monitoring (through on-board recorders) of driver logs is available, its reliability is still questionable and the strict enforcement of the HOS rules on violators would significantly increase compliance costs for both carriers and federal agencies such as FMCSA. Thus, the FMCSA may need to ease the driver's burden of writing logs and reduce the dispatch manager's time to review and administer driver compliance regulations by reducing the frequency of writing logs and reviewing records.

- In addition to driver fatigue, truck driving environments such as the number of rest stops, dedicated parking areas, and road conditions (e.g., straight rural roads) are attributed to driver safety. Since the improvements of these environments require the state/federal governments' extensive time and monetary investments in transportation infrastructure, these environments are considered "given." Thus, dispatchers should be aware of these environments and restructure truck routes that can be adapted to these environments.
- It is inconclusive that HOS amendments drastically reduced traffic safety. Likewise, it is difficult for us to pinpoint the adverse economic impact of HOS amendments on the trucking industry from the macro-economic standpoint, although HOS compliances and enforcements will be costly.

As summarized above, various studies have been conducted to identify the sources of driver fatigues and their impact on trucking safety. However, there is still void left to fill in the literature to assess the effectiveness of HOS rules holistically. To point the right direction for future research endeavors, we suggest the following selected line of research topic areas that can help trucking firms improve transportation strategies in accordance with new HOS rules.

- Develop the best combination of duty and off-duty periods that add up to normal 24-hour circadian rhythms by simulating various combinations of duty and off-duty periods;
- Estimate the minimum recuperation time needed to compensate for interrupted sleep time by comparing various combinations of flexible driving schedules (e.g., shorter away from home versus longer at-home periods, Monday driving after home rests versus Friday driving after long driving on the road);

- Examine the effects of nighttime driving between midnight and 6:00 a.m. on driver safety with required off-duty periods that enable restorative sleep for drivers involving such nighttime driving versus without those required off-duty periods;
- Assess the impact of lumper hiring on the driver's productivity and fatigue;
- Determine the adequacy of sleep obtained in cab sleep-berth in comparison to sleep at the full service rest areas;
- Identify warning signals for potential truck accidents such as the driver's eye movement, eye-lid droop, and lane violations and then develop strategies/devices to monitor such signals;
- Develop profiles (e.g., age, gender, experience, physical fit) of truck drivers who are more prone to

cause accidents as a result of fatigue by using data-mining techniques;

- Assess the economic impact of mandated electronic on-board recorders on long-haul operations and team/relay driving;
- Evaluate the impact of monetary incentives for drivers complying with the HOS rules on their productivity and safety records.

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AVOIDING SHIPPER/CONSIGNEE DOUBLE PAYMENT LIABILITY

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“Double, double, toil and trouble, fire burn and cauldron bubble”
—from the three witches’ chorus, Wm. Shakespeare’s *Macbeth*.

It is now beyond question that shippers and consignees face potential double payment liability to motor carriers for freight transportation charges. Three federal court cases, two of them being 2008 “cases of first impression” in the 9th and 11th Federal Judicial Circuits, have recently imposed “double payment liability” upon an innocent shipper or consignee. Double payment liability for non-brokered shipments was imposed upon consignee *Kawasaki Motors* in the 8th Circuit case of *Harms Farms Trucking v. Woodland Container and Kawasaki Motors Manufacturing Corp. U.S.A.*, 2006 WL 3483920 (D. Neb. 2006); double payment liability for brokered shipments was imposed upon shipper and consignee *Sears Roebuck* in the 9th Circuit (*Oak Harbor Freight Lines v. Sears, Roebuck & Co. et al.*, 513 F.3d 949 (9th Cir., 2008)); and consignees *Peters Hospitality* and *Polaroid Electronics* were found doubly liable for loads passing through a freight forwarder in the 11th Circuit (*Spedag Americas, Inc. v. Peters Hospitality and Entertainment Group LLC et al.*, 2008 WL 3889551 (S.D. Fla. 2008)).

These cases illustrate the breadth of potential double payment liability which may arise any time a load moves – regardless of whether or not a transportation intermediary such as a freight broker or freight forwarder is involved. The cases also underscore the importance of shipper/consignee preventative up-front due diligence. As a practicing attorney, your author is reluctant to exercise the literary license of simile by comparing the decisions in *Harms Farms*, *Oak Harbor*, and *Spedag* to Shakespeare’s three witches’

chorus; nonetheless, a legal cauldron of “double, double, toil and trouble” awaits an unwary shipper or consignee.

The purpose of this article is neither to engage in an overly technical legal analysis nor to disparage motor carriers who bring “double liability” claims against financially viable shippers/consignees; after all the trucking company has performed a valuable service and is simply trying to be paid “once” for that service – even though the financially viable shipper or consignee may have to pay twice with the bankrupt/insolvent third party absconding. The purpose of this article is generally to provide some “front-end” practical suggestions to shippers/consignees in how to avoid being in court on one of these claims in the first place and more specifically how to do so by exercising due diligence in selecting a freight broker for transportation needs.

In the *Harms Farms* case no broker or freight forwarder was involved, rather consignee *Kawasaki Motors* directly contracted with shipper *Woodland* for delivery of 90 shipments of pallets to *Kawasaki*. Shipper *Woodland* verbally contracted with motor carrier *Harms Farms* to deliver the pallets and the motor carrier did so. Shipper *Woodland* billed consignee *Kawasaki* for *Harms’* freight charges. *Kawasaki* paid *Woodland* some \$27,000 of those charges with *Woodland* agreeing to forward payment to the motor carrier. *Woodland* sent a check for partial payment to the motor carrier but the check was returned for insufficient funds and *Woodland* never

made good on the check nor otherwise paid any of the freight charges. Motor carrier Harms Farms then sued consignee Kawasaki in a U.S. District Court in the 8th Judicial Circuit (which encompasses the 7 states of ND, SD, MN, IA, MO, AR, & NE). The District Court held consignee Kawasaki liable to the plaintiff motor carrier for the entire remaining balance of the motor carrier's freight charges notwithstanding that Kawasaki had already paid some \$27,000 of those freight charges to the shipper, Woodland (which ultimately was insolvent and statutorily dissolved). In *Oak Harbor*, a "case of first impression" from the 9th Circuit (the 7 states of WA, OR, CA, MT, ID, NV, & AZ), Sears Roebuck Co. contracted with broker National Logistics to secure motor carriage of Sears' product. The broker in turn contracted with motor carrier Oak Harbor to move the freight. Sears was the shipper on some of the loads and the consignee on others. Before suit was filed Sears had paid the broker in excess of \$225,000 from which the broker was to pay Oak Harbor. The broker did not pay Oak Harbor and Oak Harbor sued both the broker and Sears. Sears asserted that its \$225,000 in payments to the broker should be credited as an off-set against Oak Harbor's \$425,000 claim. The Court rejected Sears' arguments and held Sears jointly liable with the broker for Oak Harbor's entire claim.

In *Spedag*, a "case of first impression" from the 11th Circuit (the 3 states of GA, FL, & AL), air freight carrier Spedag entered into a contract with freight forwarder Transworld Freight Systems whereby Transworld agreed to pay carrier Spedag for transporting electronic equipment from shippers in Asia to US consignees Peters Hospitality Group LLC and Polaroid Consumer Electronics LLC. Freight forwarder Transworld agreed to bill and collect freight charges from Peters and Polaroid and to forward such payments to Spedag. Spedag transported the equipment on straight bills of lading identifying Peters and Polaroid as consignees. Consignees Peters and Polaroid promptly paid the freight charges to freight forwarder Transworld, however, after a time the freight forwarder stopped remitting payment to Spedag. Eventually Transworld filed for bankruptcy having collected some \$850,000 from consignees Peters and Polaroid which Transworld had not remitted to freight carrier Spedag.

Spedag then sued consignees Peters and Polaroid contending that they remained liable to Spedag for its entire outstanding freight bills of \$850,000 notwithstanding that the consignees had already paid that amount to the now bankrupt freight forwarder Transworld. Peters and Polaroid raised numerous

defenses to Spedag's claims. Although the District Court found that there were questions of fact as to Peters' and Polaroid's mitigation of damages defenses the District Court granted summary judgment in favor of Spedag on the issue of "double liability", holding both consignees liable to the carrier for freight charges and leaving only the question of the amount of damages which Peters and Polaroid must pay to a jury.

Double liability claims can be defeated. Clear contractual specifications of liability for freight charges will be upheld as between the contracting parties and proper marking of bills of lading can be a determinative factor ("freight pre-paid" typically imposes primary liability on the shipper while "freight collect" places primary liability on the consignee; but see the 11th Circuit's modified rule adopted in *Nat. Shipping Co. of Saudi Arabia v. Omni Lines, Inc.* 106 F.3d 1544 (11th Cir. 1997). Different facts, different contracts, and different entries on bills of lading may mean different results. However, given the high cost of litigation, even a successful defense of a "you must pay twice" claim hardly feels like a victory — you have simply lost less than you would have otherwise.

What you really want to accomplish is avoiding any such suit in the first place. The U.S. District Court in *Spedag* and the 11th Circuit Court of Appeals in *Omni Lines, Inc.* have recommended selection of a reputable third-party intermediary as one significant, practical means by which shippers/consignees may avoid double liability suits. The *Spedag* Court observed that "consignees . . . can avoid the loss and risk of liability for double payments . . . (by) choosing to deal only with reputable forwarders", and the Court in *Omni Lines* noted that a shipper wishing to avoid liability for double payment "must take precaution to deal with a reputable freight forwarder." The Courts' admonitions regarding forwarders apply equally as well to freight brokers.

Shipper/Consignee out-sourcing of motor carrier transportation needs to freight brokers is prevalent because it simply makes bottom line economic sense. Federal Motor Carrier Safety Administration (FMCSA) findings have empirically documented shipper savings through utilization of brokers. "General commodities brokers and freight forwarders offer valuable services to the business community. They work with motor carriers to find less expensive transportation alternatives for commercial shippers and provide additional services to assist shippers . . . (the "additional services" alluded to in the FMCSA findings include quickly securing vetted motor carrier, confirmation of motor carrier compliance with

insurance requirements, administrative/tracking support, and competitive price points) . . . Without these transportation intermediaries, shippers would have to devote additional resources to locating and negotiating with motor carriers and would likely have to pay higher transportation costs. Smaller businesses in particular would be disadvantaged by not being able to rely on the services provided by brokers and freight forwarders. Available statistics also indicate a growing reliance on these entities in the shipment of goods." Registration of Brokers and Freight Forwarders of Non-Household Goods" (Federal Register Vol. 71, No. 164).

FMCSA April 2006 findings also note that as of April 2006, 16,930 active general commodities brokers were registered with FMCSA and annual applications for broker's licensure had increased by 30% since 2003. Freight brokers come in all sizes; TransCore's™ "2008 Broker Benchmark Survey" (© 2008 TC IP, Ltd) reflects that 47% of all freight broker companies have 5 or fewer employees; 34% have 6-25 employees; 11% have 26-100 employees and the remaining companies have 100+ employees.

As documented by FMCSA's findings, the transportation industry's increased utilization of brokers and a cost-benefit analysis both attest to the bottom-line economic benefit of utilizing broker services as opposed to incurring the cost of establishing an internal "do-it-yourself" transportation division to promptly secure vetted motor carriers at competitive price points. Moreover, the Courts have recommended that shippers/consignees utilize the services of "reputable" forwarders/brokers as a means of avoiding double liability lawsuits (see *Spedag & Omni Lines*, supra). So, what are the markers of a "reputable broker" and how does one exercise due diligence in making that determination? Given the growth in the freight brokerage industry, the disparate sizes of brokerage companies, and the relative ease in qualifying for FMCSA broker certification, one would correctly assume that there are the good, the bad and the ugly.

There are three outstanding markers of a reputable freight broker. A reputable freight broker: (1) has financial stability; (2) carries (a) a higher limit insurance policy/bond which supplements its minimally required \$10,000 broker's bond/trust fund, (b) adequate contingent cargo insurance, (c) general liability insurance; and (3) enjoys a long-standing good reputation for service to its customers (shippers/consignees) and prompt payment to motor carriers.

1. **Financial Stability** - Independent companies such as Dun & Bradstreet, commonly "D&B" (www.dnb.com), Experian (www.Experian.com), and Cortera (www.cortera.com) provide wide-ranging business reports including business credit history, liens and lawsuits, UCC filings and summaries of a company's timeliness in debt payments. Although each of these companies can provide good baseline information, this author's preference is D&B. Pursuant to the Federal Acquisition Regulation ("FAR"), D&B's D-U-N-S Number® was adopted as the U.S. Government's contactor ID code for U.S. Government procurement activities and was also adopted as the standard business identifier for federal electronic commerce. You should require a prospective broker to provide you with its D&B "D-U-N-S Number®" (which D&B assigns to each physical location for companies which choose to participate with D&B). Use it as a due diligence tool. Of particular interest in evaluating a freight broker is the broker's D&B "PAYDEX® Score" which evaluates a company's timeliness in debt payments - scores range 1-100 with higher scores generated by a company's payment of debts prior to due date terms, e.g. if a company, on average, pays its debts on the dates such become due per its terms with vendors (typically 30 days) then a PAYDEX® Score of 80 is assigned and if it pays 30 days sooner than due date terms then a PAYDEX® Score of 100 is assigned. Brokers who offer "quick pay" to motor carriers receive higher PAYDEX® Scores and are in a position to negotiate motor carrier freight rate discounts which can be passed on in whole or part to its customers. Quick pay to carriers also solidifies the broker's on-going relationships with the motor carriers. On the downside, a low PAYDEX® Score (less than 80) is a red flag. Caveat: Database info on any company can be stale. Inquire with any third-party information provider regarding last updates and time periods tracked.

Does the broker factor accounts receivable ("A/R")? The freight brokerage business is highly competitive. A competitive freight broker operates on a thin profit margin. If the broker is factoring its A/R then two bad things are happening: (1) the broker, by discounting its A/R to the factor, is now most likely operating at break-even or worse, and (2) there is now a perfected

secured creditor (the factor) with priority rights in the A/R who will not hesitate to exercise its security rights in the A/R should it deem itself insecure. Factoring of A/R by a broker is a definite red flag.

Request that third party reports include UCC filings on the broker. If A/R is being factored the UCC financing statement will clearly state that the secured creditor holds a security interest in "accounts receivable". It is true that lenders other than factors will sometimes secure equipment or mortgage loans with A/R. "Google©" the name of the secured creditor listed on the UCC and check its website – this will typically reflect if the creditor is a factor. If there is any doubt or question of whether a secured creditor is factoring the broker's accounts you can secure the prospective broker's written consent to the creditor's disclosure of any factoring or other security agreements with the broker.

2. (a) **Carries Insurance Supplementing the Broker's Bond/Trust Fund** – The FMCSA requires that any registered freight broker post a minimum broker's bond (a "BMC-84" filing) or establish a trust fund (a "BMC-85" filing) of \$10,000.00. As stated at 49 CFR §387.307(b), "The surety bond or the trust fund shall ensure the financial responsibility of the broker by providing for payments to shippers or motor carriers if the broker fails to carry out its contracts, agreements, or arrangements for the supplying of transportation by authorized motor carriers".

Most brokers simply comply with the \$10,000 minimum. However, a broker may elect to purchase supplemental insurance/bond coverage for higher limits. The supplemental limits provide a layer of insurance protection in the event that a broker defaults on its obligations (see 49 CFR §387.307(b) above) and the \$10,000 bond/trust fund is exhausted. Supplemental coverage is typically offered in increments up to \$100,000 (\$10,000 bond plus \$90,000 supplemental policy). While larger supplemental limits may be offered, premiums for such are correspondingly higher and must be passed on to a customer. A broker that carries a higher limit supplemental policy and remains competitive with its price points is the broker of choice. This is true for several reasons. First, obtaining supplemental coverage demonstrates the broker's commitment to fulfill its obligations; second, both the bond and supplemental policy/bond proceeds are available should the broker fail in that commitment; and third, insurers offering such coverage require the broker to meet more stringent underwriting requirements than are required of a broker who simply posts a minimum (\$10,000) surety bond or trust fund. If the broker cannot meet those underwriting requirements then that is a sign that perhaps you too should not do

business with that broker. Go to the FMCSA's "SAFER" website (www.safer.fmcsa.dot.gov) and follow the links to track a broker's filings with the FMCSA. Caveat: note that the "SAFER" website will only reflect whether a broker has met its minimally required \$10,000 bond/trust fund requirement - "SAFER" does not show voluntary higher limits coverage data. Voluntary higher limits coverage should be documented via an ACCORD™ certificate of coverage.

2. (b) **Contingent Cargo Insurance** – As a protection for itself and its customers a freight broker will (or should) secure ACCORD™ certificates of coverage of a motor carrier's primary cargo and motor vehicle liability insurance. Additionally, a broker should carry its own contingent cargo insurance and you should require the broker to provide you with an ACCORD™ certificate of coverage for such. Contingent cargo insurance is "contingent"; it provides cargo coverage upon the contingency that the motor carrier's primary cargo insurance denies coverage or is insolvent (note that additional contingent cargo coverage "triggers" may apply). Levels of coverage should be adequate to cover the value of the cargo on any one shipment. While \$200,000 in contingent cargo coverage is typically adequate, a shipper whose cargo will exceed such should require a higher level; which can be accomplished by a special endorsement to the policy or via "spot coverage".
2. (c) **General Liability Insurance** – Although you will not qualify (in all likelihood) as an "insured" under a broker's general commercial liability policy, the fact that the broker carries such is nonetheless significant in evaluating a broker. A broker with "nothing to lose" may skimp on this coverage. A broker operating without a general commercial liability policy of at least \$1,000,000 is a red flag. Get an ACCORD™ certificate of coverage for such.
3. **Reputation** – A broker's length of time in business should be given due consideration. Longevity bears on a broker's experience and establishes a longer track-record for evaluation. Longevity is not the sole criterion by which to judge a broker – every long-standing business began as a new-start and even General Motors went bankrupt. However, experience and a track record are as significant in the freight brokerage business as they are in any other business.

When choosing a broker think of it similarly to interviewing a job applicant. Like a prospective employee, a broker will not provide you with a poor reference source, but recognizable (to you) long-standing customers of the broker who vouch for the broker's service record is a positive sign; a broker's reluctance or inability to provide those references is a red flag. As previously discussed a broker's D&B PAYDEX® Score will provide "prompt pay"

information which directly correlates with the broker's relationship and reputation with motor carriers.

Due diligence in freight broker selection can greatly reduce the potential for a shipper or consignee being exposed to a double payment liability claim. Exercise that due diligence lest ye find yourself boiling in a cauldron of "double, double, toil and trouble."

AUTHOR BIOGRAPHY

Mr. Huff is a practicing attorney in Duluth, Georgia. He was lead counsel for the prevailing plaintiff in *Miller v. Harco National Insurance Co. et al.*, 241 F.3d 1331 (11th Cir. 2001), 274 Ga. 387 (2001), 280 F.3d 1353 (11th Cir. 2002) a "case of first impression" expanding the scope of FMCSA motor carrier liability coverage following certified questions by the 11th Circuit Court of Appeals to the Georgia Supreme Court.

A LONGITUDIAL STUDY OF PRIVATE WAREHOUSE INVESTMENT STRATEGIES

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ABSTRACT

This article revisits private warehouse investment decision making, a topic previously examined in 1989 by McGinnis, Kohn, and Myers (1990). Since then there has been a substantial amount of discussion regarding the scope and nature of logistics/supply chain management. In particular the roles of private, contract, and public warehousing has been discussed, increased emphasis on financial performance and strategic decision making may have altered the criteria for investment decisions in private warehousing, increased coordination of supply chains may have altered the relative importance of private, contract, and public warehousing, and increasing emphasis on controlling inventory investment may have shifted inventory responsibilities onto suppliers and customers. Empirical data was collected in 1999 and 2008 regarding warehouse investment decisions in large United State manufacturing firms. This research focused on private warehouse investment decisions, topics that might affect those decisions, and the mix of private, contract, public, and other warehouse options. The results of the 1999 and 2008 data were compared to the earlier findings reported by McGinnis, Kohn, and Myers. Changes in private warehouse investment strategies, the roles of market/product mix uncertainties and availability of for-hire warehouse providers, and changes in warehouse mix were examined. Implications for practitioners, teachers, and researchers of transportation, supply chain management, logistics, and warehousing are discussed.

INTRODUCTION

During the last decade of the 20th century, conventional purchasing and logistics functions expanded into a broader strategic approach to include materials and distribution management known as supply chain management (Tan, 2001). Warehousing, as part of this larger system, enables companies to store purchases,

work-in-progress, and finished goods while simultaneously performing break bulk and assembly activities. The ability to complete these functions rapidly results in providing faster delivery and better customer service (Wisner, et al 2009). The consequence of this capability is the establishment of a competitive edge in the marketplace.

Traditionally, manufacturers fabricated products for storage in warehouses and then sold from inventory. Several warehouses were required to maintain inventory levels of 60 to 90 days supply in order to meet production needs, customer needs, and avert stock outs. Warehousing of the past appeared to be an inescapable cost center that functioned like a large stock-keeping unit (Coyle et al, 2003).

According to De Koster (1998) strong global competition that has emerged caused warehousing to assume a considerably more important competitive role in delivering high quality customer service, in a timely fashion, and within budget allocations. Warehouses have been redesigned and automated for high speed, high throughput rate, and high productivity in order to shrink processing and inventory carrying costs. With the arrival of innovative management ideas such as just-in-time inventory control, strategic alliances, and integrated logistical supply chain thinking in the 1990s, the function of warehousing changed to facilitate the goals of a shorter cycle times, lower inventories, lower costs, and better customer service. At present, warehouses are less likely to be long-term storage facilities. They are more than likely to be high-speed technologically equipped facilities with greater attention focused on high levels of stock turnover and meeting customer service objectives. The contemporary approach to the movement of goods allows product to remain in a warehouse for only a few hours or days, at most (Nynke et al, 2002). Extra emphasis is now directed towards flow-through warehouses where products stay in the warehouse for a short period of time and then move on to their destination (Nynke et al, 2002).

Another area of warehouse management that has become an important focus of supply chain management is financial performance. Stock and Lambert (2001) use a Strategic Profit Model, which highlights the importance of logistics/supply chain management as an important part of organizational financial performance. They show the impact of investments in inventory, warehouse assets, fixed and variable costs, and cost of goods sold on return on net worth.

In this context, one of the management decision's that can affect a firm's financial performance is whether to use private or for-hire (public or contract) warehousing. Stock and Lambert's (2001) discussion of the advantages and disadvantages of these two warehousing strategies can be summarized as follows: private warehouses provide a.) higher levels of control, b.) flexibility of design, c.) opportunity to operate the

facility to meet specific product and customer needs, d.) lower costs if utilization is high, e.) greater use of specialized human resources, and f.) tax benefits. However, private warehouses offer less flexibility to respond to fluctuations in demand and require substantial investment.

Conversely, public (for-hire) warehousing can: a.) conserve capital, b.) provide flexibility in responding to changes in market demand, c.) avoid the risk of obsolescence of private facilities, d.) offer a wide range of specialized services, e.) provide tax advantages, and f.) enable a manufacturer to better manage its storage and handling costs. Disadvantages of public (for-hire) warehousing include communication problems, uneven availability of specialized services, and space availability problems during peak demand. A combination of the public and private choices is contract warehousing. With this approach, the firm and provider enter into a long-term agreement to outsource some, or all, of the manufacturer's warehousing requirements. When contract warehousing operates well the advantages of both private and public warehousing can be realized. When it does not work well the disadvantages of both may dominate.

McGinnis, Kohn, and Myers (1990) investigated a wide range of topics related to private warehouse investment decisions in large United States manufacturing firms. Based on empirical data gathered in 1989, they identified two factors (constructs) that explained private warehouse investment decisions, developed two private warehouse investment strategies based on these factors, and then assessed the impact of three variables (product mix uncertainty, availability of contract warehouse providers, and post-audit private warehouse investment decisions) on the choice of strategy. Finally, McGinnis, Kohn and Myers gathered data on the current, past, and expected future mixes of private, contract, public, and other (usually supplier or customer storage) warehousing. A review of this research presents two challenges and an opportunity. The first challenge is that the study has not been replicated. This means that one is not able to ascertain whether the strategies and conclusions developed can be generalized. The second challenge is that this topic has not been studied over time to assess whether private warehouse investment strategies have changed since 1989. The opportunity is that this study is reported in sufficient detail to enable replication. This opportunity makes it possible to revisit the topic of private warehouse investment decisions with a reasonable level of confidence that subsequent results would be able to assess the validity of the strategies identified earlier,

and report on changes in private warehouse investment decision constructs and strategies, variables that may impact private warehouse investment strategy, and the blend of (private, for-hire, and other) warehousing used.

The balance of the manuscript is composed of five sections. The first section presents an overview of the literature associated with private warehouse investment. Next the methodology, survey used, and data collection process are discussed. The third section presents the data analysis. Findings based on the analysis section are discussed in the fourth section. The final section discussed the authors' conclusions and the implications of this research for practitioners, educators and researchers.

LITERATURE REVIEW

McGinnis, Kohn, and Myers' (1990) work on private warehouse investment decisions in large United States manufacturing firms provides some major conclusions about their decision-making processes. They discovered that 59.1% of the firms surveyed selected an Analytic-Intuitive approach to warehouse investment strategy that blended formal capital budgeting techniques with strategic considerations, subjective issues, and decisions in other logistics activities. Forty point nine percent followed an Intuitive Private warehousing Investment strategy that focused on subjective, strategic considerations, subjective issues, and decisions in other logistics activities with only modest consideration of capital budgeting techniques.

From another perspective, Thai and Grewal (2005), focused on the location selection process for distribution centers. They documented the importance of investment in warehouse logistical operations and argue for its inclusion in the firm's strategic planning. Thai and Grewal also argued that investment in warehousing is not a simple exercise. Rather, it requires the selection of the right location with careful consideration to the firm's special needs. Undoubtedly mathematical models can do a comprehensive analysis of the financial alternatives and location schemas, but good investment decisions must include a variety of factors such as customer access, manufacturing facility nearness/farness and the availability of transportation facilities (Anonymous, 2004). These arguments are supported by Sanchez (2005) who indicated that location tops the list of considerations in buying or leasing a warehouse. Nearness to major transportation routes-highways, arterial roads, airports, rail yards, ports and labor pools are critical. However, these issues

raise the investment cost and complicate the decision making process.

An investment in warehousing requires analysis of a variety of options because paying too much can create a competitive disadvantage. Warehouse building budgets, as with all capital expenditures budgets, are always tight and consequently there is little flexibility to cover overruns. When the warehouse logistics market is tight and costs are increasing, the firm will not be able to compete (Sanchez, 2005). An alternate approach is to use quantitative finance models to analyze the return on invest (ROI) or return on asset (ROA) from warehouse investment (McLemore, 2004).

Based on the previous paragraphs, it would be reasonable to expect that warehouse or distribution center investment decisions would be thoroughly evaluated to insure that decisions to invest in private warehousing would result in a strategy which was an efficient component of a firm's supply chain. The path to successfully achieving this objective will depend upon how managers evaluate the qualitative and the quantitative aspects of the investment decision. The purpose of the research reported in this manuscript is to revisit the decision making process of private warehouse investment decisions in United States manufacturing firms and ascertain whether the process has evolved during last decade of the 20th century and first decade of the 21st century.

After reviewing the literature the authors developed a series of research questions. They are listed as follows:

- a. Have private warehouse investment decisions in United States manufacturing firms changed substantially between 1989 and 2008?
- b. If they have changed, how have they changed?
- c. Do market/product mix uncertainties affect private warehouse investment decision strategies?
- d. Does the availability of good contract warehousing providers affect private warehouse investment decision strategies?
- e. Has the mix of warehousing types changed during the period studied? If so, how?
- f. Does the mix of warehousing types vary with private warehouse investment decision strategy?

METHODOLOGY

Before gathering data, the McGinnis, Kohn, Myers (1990) article was examined. Data for this article, collected in 1989, was based on a subset of questionnaire items in a seven-page questionnaire that was an extensive survey of logistics managers in United States manufacturing firms. The precise wording of these questionnaire items, the method of data collection, and methods of analysis were adequately described in the article for future replication. Additional data for this manuscript was collected 1999, and 2008 using the methodology described in the referenced article. Because the raw data on which the McGinnis, Kohn, and Myers (1990) article was based was not available the authors were not able to conduct any statistical analyses beyond that which appeared in the article. However, the table in that article was adequate for visual comparison with the results from the 1999 and 2008 data.

In 1999 the authors sent a four-page, 36-item questionnaire to 732 randomly selected managers working in United States manufacturing firms who were members of the Council of Logistics Management. A pre-notification letter was sent one week before the questionnaire and cover letter, and a follow-up letter was sent one week after the questionnaire. This criteria and methodology was similar to that of the earlier cited 1990 study. Eighteen questionnaires were returned for a net mailing of 714. A total of 172 questionnaires, 24.1% of the net mailing, were returned by the response cut-off date. Contingency table analysis and Chi-square analysis of respondent ZIP codes indicated that the respondents were geographically representative of the sample.

In 2008 a four-page, 46-item questionnaire was electronically sent to 905 Council of Supply Chain Management Professionals members who worked for United States manufacturing firms and had job titles of manager or higher in logistics, distribution, or supply chain management. One hundred and twenty-three were undeliverable for a net sample of 782 subjects. After two follow-ups a total of fifty (6.4%) usable responses were returned. Forty-seven (47) responses were usable for the subject of the research reported in this manuscript. While the response rate was lower

than the previous surveys, it is understandable given the results of similar recent studies reported in the logistics/supply chain management literature (Flint, Larsson, and Gammelgaard, 2008). After examining the means, standard deviations, and reliability coefficients for the six variables the authors concluded that the 2008 results were adequate for inclusion in the longitudinal analysis. The eight questionnaire items that are the basis for the research reported in this manuscript are shown as Table 1.

ANALYSIS

The analysis was conducted in three stages as described by McGinnis, Kohn, and Myers (1990). In the first stage five questionnaire items that addressed the private warehouse investment decision process were factor analyzed. Factor analysis is useful for identifying any underlying constructs that explain the variance in a set of questions. The factor analysis method was principle components. Factors with eigenvalues of one or greater than one were rotated orthogonally. These results are presented as Table 2.

In the second stage of the analysis scores were calculated for each factor for each respondent. The values for all questionnaire items loading on a factor at 0.5 or greater were added and the sum divided by the number of items loading on the factor. Based on the factor scores of each respondent, cluster analysis was used to classify the subjects into mutually exclusive groupings. Each grouping was then examined and then named based on its factor score average values. Each name reflects the "Private Warehouse Investment Strategy" based on its average factor scores. Table 3 presents the results of this stage of analysis.

The third stage of analysis was comprised of two evaluations using the identified warehouse strategies as independent variables. The first evaluation assessed mean differences of three questionnaire items concerned with market/product mix uncertainties, perceived availability of warehouse providers, and auditing of warehouse decisions. Next, perceived warehouse mixes were identified and evaluated relative to warehouse strategies. These results are shown as Tables 4 and 5.

TABLE 1
QUESTIONNAIRE ITEMS*

Private Warehouse Investment Decision Process Questions

- WH-1 Formal capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity.
- WH-2 Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.
- WH-3 My company/division explicitly considers subjective, hard to measure, service issues when considering whether to invest in private warehousing.
- WH-4 Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division.
- WH-5 Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities.

Other Questions Related to Private Warehouse Investment

- WH-6 Market and/or product mix uncertainties make it difficult to plan for future private warehouse needs.
- WH-7 The use of contract warehousing by my company/division is limited by the number of good providers that are available.
- WH-8 In my company/division private warehouse investment decision are audited after the project is in place.

*Scale: 1 = Strongly Agree, 2 = Agree 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree

Table 2
FACTOR ANALYSES

1989 N = 220

Factor 1: Intuitive Decisions

Questions	Factor Loading
WH-2 Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.	0.640
WH-3 My company/division explicitly considers subjective, hard to measure service issues when considering whether to invest in private warehousing.	0.713
WH-4 Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division.	0.730

Table 2
(continued)

Questions	Factor Loading
WH-5 Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities.	0.651
(Reliability Coefficient = 0.621)	
Factor 2: Analytical Decisions	
WH-1 Formal, capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity.	0.912
Amount of total variance explained by both factors = 60.1%	
Source: Adapted from McGinnis, Kohn, & Myers (1990)	
1999 N = 170	
Factor 1: Analytical/Strategic Decision	
WH-1 Formal, capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity.	0.825
WH-2 Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.	0.754
WH-5 Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities.	0.700
(41.3% of variance, reliability coefficient = 0.904)	
Factor 2: Subjective Decisions	
WH-3 My company/division explicitly considers subjective, hard to measure service issues when considering whether to invest in private warehousing.	0.806
WH-4 Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division.	0.808
(23.5% of variance, reliability coefficient = 0.893)	
Amount of total variance explained by both factors = 64.8%	
2008 N = 47	
Factor 1: Strategic/Subjective	
WH-2 Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division.	0.755
WH-3 My company/division explicitly considers subjective, hard to measure service issues when considering whether to invest in private warehousing.	0.689

Table 2
(continued)

Questions	Factor Loading
WH-4 Formal cost analysis is tempered by other subjective factors before final decisions are made in my company/division.	0.801
(37.5% of variance, reliability coefficient = 0.633)	
Factor 2: Analytical/Integrative	
WH-1 Formal, capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity.	0.857
WH-5 Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities.	0.856
(29.9% of variance, reliability coefficient = 0.651)	
Amount of variance explained by both factors = 67.4%	

TABLE 3
PRIVATE WAREHOUSE INVESTMENT STRATEGIES

1989					
Factor Scores*					
		Factor 1	Factor 2	Number of Respondents	Percentage of Respondents
Private Warehouse Investment Strategies		Intuitive Decisions	Analytical Decisions		
1. Analytical-Intuitive		2.38**	1.73***	130	59.1
2. Intuitive		2.43	3.59	90	40.9
				220	100.0
Source: Adapted from McGinnis, Kohn, and Myers (1990)					
**Differences between Factor 1 means not significant, alpha = 0.05					
***Difference between Factor 2 means significant, alpha = 0.05					
1989					
1. Unfocused		2.46**	3.35**	46	29.3
2. Subjective		3.14	2.31	36	22.9
3. Intense		1.94	2.08	81	47.8
				157	100.0
**Differences among factor means significant, alpha = 0.05					

Table 3
(continued)

Factor Scores*				
	Factor 1	Factor 2		
Private Warehouse Investment Strategies	Intuitive Decisions	Analytical Decisions	Number of Respondents	Percentage of Respondents
2008				
1.	3.18**	1.81**	11	23.4
2.	2.18	2.71	36	76.6
			47	100.0

*Factor scores are the value (means) of the questionnaire item(s) loading on the factor
Scale: 1 = Strongly Agree; 2 = Agree; 3 = Neither Agree nor Disagree; 4 = Disagree; 5 = Strongly Disagree
**Differences between factor means significant, alpha = 0.05

TABLE 4
COMPARISON OF MEANS (OF SELECTED ITEMS)
AMONG WAREHOUSE INVESTMENT STRATEGIES

1989		Mean Responses*		
		Strategy 1: Analytical- Intuitive Decisions	Strategy 2: Intuitive Decisions	
Questions		N = 130	N = 90	Significance
WH-6	Market and/or product mix uncertainties make it difficult to plan for future private warehousing needs.	2.86	3.01	Not Significant
WH-7	The use of contract warehousing by my company/division is limited by the number of good providers that are available.	3.48	3.36	Not Significant
WH-8	In my company/division, private warehouse investment decisions are audited after the project is in place.	2.50	2.93	< 0.01

Source: Adapted from McGinnis, Kohn, and Myers (1990)

*Scale: 1 = Strongly Agree; 2 = Agree; 3 = Neither Agree nor Disagree; 4 = Disagree; 5 = Strongly Disagree

Table 4
(continued)

1999		Mean Responses*			Significance
		Strategy 1: Unfocused	Strategy 2: Subjective	Strategy 3: Intense	
Questions		N = 46	N = 36	N = 75	
WH-6	Market and/or product mix uncertainties make it difficult to plan for future private warehousing needs.	2.98	2.69	2.61	0.172
WH-7	The use of contract warehousing by my company/division is limited by the number of good providers that are available.	3.54	3.28	3.22	0.236
WH-8	In my company/division, private warehouse investment decisions are audited after the project is in place.	2.87	3.22	2.57	0.003**

*Scale: 1 = Strongly Agree; 2 = Agree; 3 = Neither Agree nor Disagree; 4 = Disagree; 5 = Strongly Disagree
 **WH-8 Strategy 1 mean not significant, alpha < 0.05, from Strategy 2 and Strategy 3 means

2008		Mean Responses*		Significance
		Strategy 1: Analytical	Strategy 2: Intuitive	
Questions		N = 11	N = 36	
WH-6	Market and/or product mix uncertainties make it difficult to plan for future private warehousing needs.	3.27	2.89	0.322
WH-7	The use of contract warehousing by my company/division is limited by the number of good providers that are available.	3.45	3.47	0.963
WH-8	In my company/division, private warehouse investment decisions are audited after the project is in place.	2.45	2.78	0.373

*Scale: 1 = Strongly Agree; 2 = Agree; 3 = Neither Agree nor Disagree; 4 = Disagree; 5 = Strongly Disagree

TABLE 5
WAREHOUSE MIX 1989 THROUGH 2008

1989						
Warehouse Mix Percentages						
	N	Private	Contract	Public	Other	Total
	208	68.5	10.8	13.7	6.9	99.9*

*Totals vary from 100% due to individual respondent totals not equaling 100%.

Source: Adapted from McGinnis, Kohn, and Myers (1990)

1999						
Strategy	N	Private	Contract*	Public	Other**	Total
1. Unfocused	46	50.7	34.8	9.0	5.5	100.0
2. Subjective	36	27.7	13.0	9.4	19.9	100.0
3. Intense	75	52.0	23.7	13.7	10.6	100.0
Overall	157	53.0	24.5	11.3	11.3	100.1***

*Means for contract warehousing significantly different at alpha < 0.05. Mean of Strategy 3 not significant, alpha < 0.05 from Strategy 1 and Strategy 2 means based on post hoc analysis.

**Means of other warehousing not significant, alpha < 0.05. Mean of Strategy 3 not significant, alpha < 0.05, from Strategy 1 and Strategy 2 means based on post hoc analysis.

***Total varies from 100% due to rounding.

2008						
Strategy	N	Private	Contract	Public*	Other	Total
1. Analytical	11	51.4	31.4	15.9	1.4	100.1**
2. Intuitive	34	54.2	37.1	3.0	5.7	100.0
Overall	46***	53.2	35.7	6.2	4.7	100.1**

*Means for public warehousing significantly different at alpha = 0.05

**Total varies from 100% due to rounding.

***On respondent whose totals did not equal 100% was not included.

FINDINGS AND DISCUSSION

Examination of Table 2 reveals some similarities and differences among the three replications (1989, 1999, & 2008). First, two factors were identified in each replication. In each replication one of the factors is

relatively "analytical" and the other is relatively "subjective". For example "subjective" variables WH-3 (My company/division explicitly considers subjective, hard to measure, service issues when considering whether to invest in private warehousing) and WH-4 (Formal cost analysis is tempered by other subjective

factors before final decisions are made in my company/division) loaded on the same factor in all three replications but never loaded on the "analytical" variable WH-1 (Formal capital budgeting techniques, such as discounted cash flow, net present value, and/or payback period dominate the decision whether to invest in private warehousing capacity). Variable WH-2 (Strategic considerations dominate the decision whether to invest in private warehouse capacity in my company/division) loaded on the same factor as "subjective" variables, WH-3 and WH-4, twice and the "analytical" variable, WH-1, once. WH-5 (Decisions whether to invest in private warehousing are increasingly intermingled with decisions in other logistics activities) loaded on the "subjective" variables only once but loaded on the "analytical" variable twice.

Based on the previous paragraph it appears that the factor analyses in each replication identified one factor that was primarily "analytical" and one that was primarily "subjective". The "analytical" factors in 1989, 1999, and 2008 were "Analytical Decisions", "Analytical/Strategic Decisions", and "Analytical/Integrative" respectively. The "subjective" factors were "Intuitive Decisions", "Subjective Decisions", and "Strategic/Subjective Decisions" respectively. Two variables, WH-2 (strategic considerations) and WH-5 (private warehouse decisions intermingled with other logistics decisions) appear to be less fundamental to either of the two factors.

The major difference in the factors presented in Table 2 are that one variable, WH-2, did not consistently load on either the "analytical" or the "subjective" factor. In the three replications, no clear pattern was observed that would lead to a conclusion that strategic considerations are inherently "analytical" or "subjective". However, an argument could be made that variable WH-5, private warehouse investment decisions being intermingled with decisions in other logistics activities, which loaded on the same factor as WH-1 in 1999 and 2008 may have become integrated into the analysis. In summary the results, shown as Table 2, indicate that there are two constructs that affect decisions to invest in private warehousing. They are "analytical" and "subjective". The private warehouse investment strategies based on the factor analysis are

shown as Table 3 and are discussed in the following paragraphs.

Examination of Table 3 reveals that two warehouse investment strategies were identified in 1989 and 2008 and three distinct strategies were identified in 1999. While the strategies in the data sets are not identical, some generalizations can be made for purposes of discussion. First, there are strategies in all three replications that emphasize an "analytical" factor. They are "Analytical-Intuitive" in 1989, "Intense" in 1999, and "Analytical" in 2008. If 1999 strategies 1 (Unfocused) and 2 (Subjective) are combined and described as "non-analytical" then some observations can be made regarding relative to trends that have occurred during the time period studied. First, the percentage of "analytical" focused (Analytical-Intuitive in 1989, Intense in 1999, and Analytical in 2008) strategy respondents declined steadily (59.1% to 52.2% to 23.3% in 1989, 1999, and 2009 respectively) during the period studied. However, the focus of "analytical" focused strategies evolved from capital budgeting (WH-1) in 1989 to capital budgeting (WH-1) + strategic considerations (WH-2) + warehouse investment decisions intermingled with other logistics decisions (WH-5) in 1999 to capital budgeting (WH-1) and warehouse investment decisions intermingled with other logistics decisions (WH-5) in 2008. These results suggest that "analytical" approaches to private warehouse investment decisions evolved from a quantitative focus to include a combination of quantitative and qualitative issues. In the process "analytical" approaches became more inclusive (or comprehensive).

Second, while the percentage of "non-analytical" strategies increased (from 40.9%, to 52.2%, to 76.6% in 1989, 1999, and 2008 respectively) steadily during the period studied, the nature of "non-analytical strategies" evolved. In 1989 the strategy "Intuitive Decisions" included all questionnaire items that were not capital budgeting focused. They were WH-2 (strategic considerations), WH-3 (subjective issues), WH-4 (formal cost analysis tempered by subjective factors), and WH-5 (warehouse investment decisions intermingled with other logistics decisions). In 1999 the strategy "Subjective Decisions" included only two items (WH-3 and WH-4) which focused on subjective issues. By 2008

"Strategic/Subjective" was comprised of three items, strategic considerations (WH-2) and the two subjective items (WH-3 and WH-4). Finally, an examination of Table 2 reveals that, although the percent contribution of each cluster to total variance in 1989 was not available, the percent variance of strategy clusters explained by "analytical" and "subjective" changed from 41.3%/23.5% in 1999 to 29.9%/37.5% in 2008. While difficult to conclude with finality, these results suggest that

- a. "quantitative" and "strategic" techniques in private warehouse investment decisions appear to remain two distinct approaches,
- b. strategic approaches to private warehouse investment decisions increased in importance relative to formal capital budgeting techniques between 1999 and 2008, and
- c. "subjective" considerations remain a significant component of private warehouse investment decisions.

Further examination of the results shown in Table 3 together with the interpretations discussed in the previous paragraph indicate that emphasis on "analytical" strategies declined from 59.1% of respondents in 1989 to 47.8% in 1999 and 23.4% in 2008. By comparison the percentage of respondents selecting a "subjective" strategy increased from 40.9% in 1989 to 76.6% in 2008. Further, the combination of Strategies 1 and 2 in the 1999 data suggests 52.2% "non-analytical" strategies. These findings suggest that, during the period from 1989 to 2008, the analysis of analyzing private warehouse investment strategies became less "analytical" and more "subjective". The implications of these findings will be discussed later.

Inspection of the results shown as Table 4 revealed that market/product mix uncertainties (WH-6) and the availability of good contract warehouse providers (WH-7) were not concerns in the selection of a private warehouse investment strategy in any of the three studies. The 1989 and 1999 results reveal that post-audit private warehouse investment decisions were more likely to occur in "analytical" strategies. However, in the 1999 study the "Intense" strategy was not

significantly different, $\alpha < 0.05$, from the "Unfocused" strategy. Further examination of these two strategies in Table 3 revealed that the "Unfocused" strategy's mean score on Factor 1 was between "Intense" and "Subjective" strategies but closer to that of the "Intense" strategy (0.52) than to the "Subjective" strategy (0.68). Apparently, post-audits of private warehouse investment decisions were significantly more prevalent in "analytical" strategies, but are used equally in both "analytical" and "subjective" strategies by the time of the 2008's replication of the study. Again, the implications of these findings will be discussed later. Finally, responses to the questions WH-6, WH-7, and WH-8 suggest that the external issues, market and product mix uncertainties and the availability of good contract warehousing providers, and the internal issue, whether private warehouse investment decisions are post audited, do not appear to vary systematically among the private warehouse investment strategies.

In each study respondents were asked to estimate the percentage of inventory stored in four warehouse options. These options were Private (company owned), Contract (long-term for-hire), Public (short-term as needed), and Other (usually supplier or customer storage). Examination of the warehouse mixes of the respondents to the three studies suggests three trends. First, the use of private warehousing declined from 68.5% in 1989 to 53.0% in 1999 then remained steady. Second, the usage of contract warehousing increased over the period studied, from 10.8% in 1989 to 24.5% in 1999 to 35.7% in 2008. Finally, the usage of public warehousing declined over the period studied from 13.7% in 1989 to 11.3% in 1999 to 6.2% in 2008. These findings provide a basis for the following two observations. First, United States manufacturing firms may have completed the process of assessing the appropriate mix of private warehousing overall. However, when the percentages of inventory stored in the combination of private and contract (we will call this "controlled" warehousing) warehousing is examined the percentages are 79.3% in 1989, 77.5% in 1999, and 88.9% in 2008. Second, these figures suggest that while the emphasis on private warehousing has declined over the period studied, the need to control warehousing through a combination of private ownership and contractual arrangements increased between 1999 and

2008. Perhaps the issue that is more relevant is not “ownership” but “control” of warehouse operations. This second observation is further supported by the decline in public (inventory is stored in a for-hire basis on an as needed basis) warehouse usage from 13.7% to 11.3% to 6.2% during the period studied. Finally, the “Other” (usually supplier or customer storage) increased from 6.9% in 1989 to 11.3% in 1999 and then declined to 4.7% in 2008. This combined with the decline in public warehousing reinforces the second observation that United States manufacturing firms have increased their emphasis on the control of warehousing through a combination of private and contract operations.

CONCLUSIONS AND IMPLICATIONS

The results of three studies of private warehouse investment decisions suggest that emphasis of decision-making processes in United States manufacturing firms has evolved from a heavy emphasis on quantitative capital budgeting techniques to a heavy emphasis on strategic/subjective processes that blends strategic and subjective (qualitative) issues. On reflection, this change in processes over a two decade period is not totally surprising since the maturity of strategic planning during that period tempered earlier emphases on quantification of decision making. In addition, the results of these studies suggest United States manufacturing firms placed increased emphasis on control of warehousing through a combination of private ownership and contractual arrangements with third-party providers. This increasing emphasis on control of warehousing may be due to the increasing need to manage the supply chain including warehousing.

While the results of the three studies reported in the research suggest that there has been a trend in private warehouse investment decisions away from an emphasis on capital budgeting focused processes towards emphasis on strategic focused processes, several issues are likely to affect the process in specific firms, or in specific situations within a firm. They include

- The availability of reliable data regarding alternatives, costs, forecasts regarding markets and

product mixes, industry stability, and market stability.

- The role of warehousing in the achievement of the firm’s objectives.
- The role of warehousing in the overall management of the supply chain.
- The extent that the firm’s strategies are proactive or reactive.
- The firm’s overall financial strategy.
- The extent to which warehousing is seen as important to the firm’s core competencies.
- The firm’s culture regarding the importance of quantitative versus qualitative decision making.

A summary of responses to the research questions is as follows:

- a. Private warehouse investment decisions in United States manufacturing firms have evolved.
- b. They have changed from an emphasis on quantitative capital budgeting techniques in 1989 to a process that blends strategic and subjective (qualitative) issues in 2008.
- c. Market/product mix uncertainties did not appear to have affected private warehouse investment decision strategies during the period studied.
- d. The availability of good contract warehousing providers did not appear to affect private warehouse investment decision strategies during the period studied.
- e. The warehouse mix evolved during the period studied. During the period studied (1989 – 2008) the percentage of inventory stored in private warehousing United States manufacturing firms declined from 68.5% to 53.0%, contract warehousing increased from 10.8% to 24.5%, and private warehousing declined from 13.7% to 6.2%. “Other” (usually supplier or customer storage) increased from 6.9% in 1989, increased to 11.3% in 1999, and then declined to 4.7% in 2008. The percentage of inventory stored in a combination of private and contract warehousing (considered by

the authors to be "controlled warehousing") increased from 79.3% in 1989 to 88.9% in 2008. In summary, the warehouse mix evolved during the period studied to reflect an overall higher percentage of inventory stored in "controlled" warehousing and a smaller percentage stored in "owned" warehousing.

- f. It was not possible to determine whether the warehouse mix of warehouse types varied with the private warehouse investment strategy from the 1989, McGinnis, Kohn, Myers (1990), study. In the 1999 study contract and "other" percentages varied among strategies and in 2008 the percentage of private warehousing varied between strategies. Overall, these variations did not appear to be systematic in the two (1999 and 2008) studies where comparisons could be made.

Applied Implications

This research provides implications for practitioners, teachers, and researchers of transportation, supply chain management, logistics, and warehousing. For practitioners it appears that, while strategic considerations have increased in importance in private warehouse investment decisions, there is no one process that is ideal for all private warehouse investment decisions. Rather, a blend of analytical, strategic, and subjective considerations should be selected in a proportion appropriate for the organization and situation. However, the private warehouse investment decision is much less likely to be made independently of other organizational considerations than it would have been in 1989. Second, it appears that the dominant concern may not be whether warehouse capacity is owned or outsourced. Rather the dominant concern may be how warehousing will be controlled through a combination of private and contract warehousing. Future decisions regarding private warehouse investment decisions are likely to include wider participation from internal and external stakeholders including non-supply management professionals in the firm, key suppliers, and key customers.

While subtle, the implications of this research are relevant to the transportation industry, and its strategies. First, the decline in percentages of private warehousing (68.5% to 53.2%) and public warehousing (13.7% to 6.2%) indicates that approximately 22.8% of warehouse capacity moved from direct control of the manufacturer. As a result, depending on the agreement between the firm and its contract warehouse operator, responsibility for as much as 1/5 of inbound and outbound transportation decisions may have shifted

from the manufacturer to a third-party provider. This means that transportation provider strategies that emphasize manufacturers may face declines in business if the contract warehouse operator also provides (or arranges for) inbound and outbound transportation services.

However, the trend toward contract warehousing may benefit transportation providers if their strategies (a) include providing transportation services to contract warehouse and other third-party logistics providers and/or (b) expansion into value-added services. The potential of former strategy is that many contract warehouses/third-party providers serve multiple manufacturers. This means that increased focus on contract warehouse firms and other third-party providers may provide traffic increases that offset declines due to manufacturers outsourcing warehousing. The promise of the latter strategy is that the revenues and profits of non-transportation value-added services may more than offset decreases in transportation revenues that may occur if warehouse outsourcing reduces the potential of a transportation only focus.

For teachers of supply chain management, this research provides a glimpse of the dynamic nature of decision-making in one sector of logistics management. Presenting alternate perspectives on the topic of this research, as well as other decision areas (such as customer service, inventory management, supplier selection and evaluation, and transportation management) could help better prepare students for a real world where strategies and analysis models vary with situations.

For researchers of supply chain management and logistics this research provides one perspective on the changing nature of one decision-making process. The value of examining a process over a two decade period has increase the authors' understanding of the changing nature, and continuity, of private warehouse investment decisions. Perhaps researchers will revisit topics that have been previously examined with the goal of conducting additional longitudinal research in a greater array of supply chain management and logistics topics.

Logistics/supply management research would gain from a broader array of longitudinal research in a larger array of manufacturing and nonmanufacturing logistics/supply chain management topics. Such topics as transportation alternatives, customer service measures, standards of performance, the effectiveness of multinational supply chains, the importance of

financial performance versus logistics/supply chain performance, and integration of supply chains versus independent supply chains are important allied topics that would benefit from longitudinal research. Finally,

continuing longitudinal research of private warehouse investment decisions in United States manufacturing firms provide useful insights over time.

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MANUSCRIPT SAMPLE

A FRAMEWORK FOR EVALUATING SUPPLY CHAIN PERFORMANCE

Terrance L. Pohlen, University of North Texas

ABSTRACT

Managers require measures spanning multiple enterprises to increase supply chain competitiveness and to increase the value delivered to the end-customer. Despite the need for supply chain metrics, there is little evidence that any firms are successfully measuring and evaluating interfirm performance. Existing measures continue to capture intrafirm performance and focus on traditional measures. The lack of a framework to simultaneously measure and translate interfirm performance into value creation has largely contributed to this situation. This article presents a framework that overcomes these shortcomings by measuring performance across multiple firms and translating supply chain performance into shareholder value.

INTRODUCTION

The ability to measure supply chain performance remains an elusive goal for managers in most companies. Few have implemented supply chain management or have visibility of performance across multiple companies (Supply Chain Solutions, 1998; Keeler et al., 1999; Simatupang and Sridharan, 2002). Supply chain management itself lacks a widely accepted definition (Akkermans, 1999), and many managers substitute the term for logistics or supplier management (Lambert and Pohlen, 2001). As a result, performance measurement tends to be functionally or internally focused and does not capture supply chain performance (Gilmour, 1999; *Supply Chain Management*, 2001). At best, existing measures only capture how immediate upstream suppliers and downstream customers drive performance within a single firm.

Table 1 about here

Developing and Costing Performance Measures

ABC is a technique for assigning the direct and indirect resources of a firm to the activities consuming the resources and subsequently tracing the cost of performing these activities to the products, customers, or supply chains consuming the activities (La Londe and Pohlen, 1996). An activity-based approach increases costing accuracy by using multiple drivers to assign costs whereas traditional cost accounting frequently relies on a very limited number of allocation bases.

$$y = a^2 - 2ax + x^2 \quad (1)$$

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