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THE PROFIT IMPACT OF A STRATEGIC APPROACH TO WEB ENHANCED SERVICES (WES)—A STUDY OF THE MOTOR CARRIER INDUSTRY

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ABSTRACT

An increasing number of motor carriers offer web-enhanced services (WES) such as real-time-tracking-and-tracing, on-line ordering, and conflict resolution. However, the burst of the Internet bubble raised questions as to whether investments in such Internet-related services increase corporate profitability (e.g., Nagarajan et al., 2000). This article studies financial and operational values that web-enhanced services add to publicly traded interstate trucking companies. Large companies offering WES were found to be more profitable than smaller companies in general, and they were more profitable than other large carriers not offering WES. Investments in WES appear to provide a strategic advantage specifically for large companies.

INTRODUCTION

From 1995 to the present, the interstate motor carrier industry in the United States has seen growth in the number of companies offering web-enhanced services (WES). These services range from limited tracking and tracing to transactions that are completely Internet-based. New technologies such as automatic vehicle location systems (AVLS), automatic vehicle identification (AVI), and satellite and radio based communication (SRC), make value added real-time service to shippers possible. Several publications have highlighted this growth. Lancioni et al. (2000) noted that throughout the supply chain, the sector that most widely uses the Internet is the transportation sector. Hickey (2001) reported that most trucking companies are involved in one or more Internet projects aimed at improving customer service. The *Inbound Logistics'* 2000 Annual Top 100 Trucking issue identified specific web-enhanced technologies commonly found in the motor carrier industry—real time tracking and tracing (RTT), electronically available bills of lading, POD's, etc.—and ranked the breadth of each of

"the Top 100 Company's" web-enhanced capabilities.

While success stories abound (e.g., Shulman, 1999) and lead to the assumption that WES capabilities add financial value to a motor carrier, motor carriers are hesitant to embark on a full-scale adoption of WES. According to a study by Nagarajan et al. (2000), motor carrier spending on Internet development has been small, accounting for only 12 percent of their investment in new technology. Implementation is still in its infancy with respect to both breadth and depth (Ellinger et al., 2001). With the recent difficulties that many Internet companies have experienced, some are questioning the cost advantages of WES for motor carriers (Chakraborty and Kazarosian, 2000; Graham, 2001; Nagarajan et al., 1999; Nagarajan et al., 2000).

These concerns reflect the lack of actual knowledge and the scarcity of research regarding relationships between WES and their impact on profitability. Some authors have theorized that companies offering WES would be able to advantage themselves competitively (Chan and Artmangkorn, 2002; Kleindl 2000; Watson et al., 2000), that effective implementation would separate the successful trucking companies from the struggling ones (Panza, 2000), and that web-enhanced capabilities would even the playing field between large establishments and smaller startups (Rodriguez, 2001). However, others have noted that there are no well-established ways to estimate or measure the value of a website (King, 1999), or to accurately account for development costs (Stout and Marden, 2001). Still others have suggested that investment in WES may not be as profitable as other investment opportunities (e.g., Chakraborty and Kazarosian, 2000; Graham, 2001; Nagarajan et al., 2000).

This study clarifies some of these issues by investigating relationships between adoption of WES and a motor carrier's financial performance. In particular, this study measures the financial results that firms should expect from offering WES in the motor carrier industry. This study also identifies distinguishing characteristics of companies that offer WES and addresses the issue of whether recent technological advancements have allowed smaller companies to compete more effectively with larger companies in service levels.

Due to significant website development and maintenance costs and the lack of ability to clearly measure the financial value of WES, motor carriers are incurring substantial risks in committing resources for implementing and maintaining WES. This research provides empirical evidence that establishes a clear relationship between the offering of various web-enhanced services and their impact on profitability. This increased understanding offers great value and allows firms to allocate resources to WES with greater understanding of the likely effect of these investments.

BACKGROUND AND HYPOTHESIS DEVELOPMENT

Historical Background

The motor carrier industry in the U.S. was economically deregulated in 1980, resulting in increased competition and substantial reductions in shipping rates. As a result, motor carriers have been experiencing profit deterioration and financial difficulties. In fact, marginal costs often dropped below average costs. At the same time, there have been many new entrants into the industry despite reduced profitability. This ultimately led to high bankruptcy rates (Belzer, 1995a). Adding to these pressures, shippers continued to demand better and faster services from carriers.

Pressures from customers for lower rates and greater reliability of on-time delivery have forced carriers to seek new ways of developing profits while maintaining or improving service levels (McMullen and Lee, 1999; Voos, 2001). Recent developments in information technologies have opened much-needed new avenues for motor carriers to both improve efficiencies and to differentiate themselves from their competitors.

The Internet, particularly WES, provides a new avenue to link shippers and carriers. According to a 1999 survey of shippers (Purchasing, 1999), 62 percent said their use of the Internet had increased in the previous year and 76 percent said they expected to use it more in the coming years. Carriers and shippers both recognize that the key to greater operational efficiencies is improved integration of processes, including the use of mechanisms that bring shippers and carriers together in the transport process (Dornier et al., 1998; Onliner and Sichel, 2000). Increasingly, shippers, transport carriers, and logistics intermediaries such as international freight forwarders are turning to the Internet for effective information management (Litan and Rivlin, 2001).

As customers are expecting carriers to be Internet savvy, motor carriers have no choice but to adapt themselves by installing some form of web-enhanced systems. This transition is being facilitated by an increase in Internet usage among drivers. According to Machalaba (2000), at least 40 percent of truck drivers are computer literate and 25 percent have routine access to the Internet. One example of how Internet usage is affecting the motor carrier industry is Landstar, which allows its connected drivers to link to the web via cell phones, scan available freight shipments posted at landstar.com by Landstar's network of independent agents, and select the most lucrative loads. This has produced considerable financial and operational advantage for Landstar (Machalaba, 2000). A study by Bradley et al. (2000) suggests that Landstar's practices may be representative of what motor carriers will experience in the future. To put this forecast into perspective, according to the American Trucking Association's Year 2000 estimate, almost 60 percent of motor carrier companies have websites, providing services ranging from simple company information to more and increasingly enhanced, even interactive, Web-based services for shippers.

Potential Influence of Web-Enhanced Services

Some studies revealed positive effects of Internet usage by companies, including increased efficiencies in a wide range of functions (e.g., Onliner and Sichel, 2000), such as enhanced purchasing functions in the petroleum refinery industry with measurable financial benefits (Lyle, 2000), and a wide range of old economy arenas (Litan and Rivlin, 2001). Implementation of web-enhanced services also leads to improved and expanded customer service levels and coordination (Litan and Rivilin, 2001), and reduced coordination costs (Garicano and Kaplan, 2000), making the supply chain more reliable for a large variety of companies in both traditional and services fields (Walker et al., 2000). Garicano and Kaplan (2000) classified these positives into three broad categories: (1) process improvements, (2) marketplace benefits, and (3) indirect improvements, and further suggested that process improvement and marketplace benefits could potentially be large. As Brynjolfsson and Hitt (2000, pg. 23) stated,

> rather than being paradoxically unproductive, computers have had an impact on economic growth that is disproportionately large compared to their share of capital stock or investment, and this impact is likely to grow in the future.

Benefits of WES in the Motor Carrier Industry

In spite of the interest in the value that the Internet provides to companies in general, studies about the specific impact of web-enhanced services on profitability in the motor carrier industry are scanty. Some scholars have argued that WES would potentially benefit the motor carrier industry (e.g., Walker et al., 2000) because the trucking industry's future success

will rely heavily on its ability to anticipate changes and to innovate to meet market demands (Panza, 2000). A recent KPMG survey confirmed that web-enhanced services allow motor carrier companies to provide better shipment tracking, on-line ordering, invoicing/payment, etc. (Rosencrance, 2000). Murphy and Daley (2000) found that these opportunities extend to freight forwarder operations where they are taking advantage of the Internet to offer the benefits of quick access to information with improved tracing and expediting of services to customers. A related study indicated that such web-enhanced activities could result in a reduction of 50 percent to 70 percent in transaction costs in some instances, and have the potential of providing additional benefits from disintermediation (Carr, 2000). This demonstrates the view that the strategic use of information in the motor carrier industry will become a principal facilitator in the integration of processes because "operations and logistics have evolved from simply moving products through the supply chain to being information providers" (Dornier et al., 1998).

Another potential benefit of WES is the influence on potential economies of scale in the motor carrier industry. Previous research has shown that motor carriers apparently do not enjoy economies of scale (e.g., Adrangi et al., 1995; Belzer, 1995a, 1995b). However, there is some evidence that, independent of WES, large firms can achieve competitive advantages through increasing long haul shipment distance and number of loads per shipment (Xu et al., 1994). One inference from Xu et al. (1994) is that in the pre-Internet era, large firms could leverage their operations, thus achieving some economy of scale over smaller trucking companies. In fact, in the past, large firms have maintained a measurable advantage in attracting these preferred shipments (Xu et al., 1994). However, long-haul shipments have longer and more variable transit times than do short-haul shipments. Reduction in this variability through the use of Internet-based RTT might encourage participating companies to pursue more long haul shipments. Thus, one possible value of WES in the motor carrier industry is the potential it offers to develop economies of scale. On the other hand, WES might offer smaller firms an opportunity to compete more effectively with larger firms for these preferred shipments. It has been argued that the ability to compete for standardized EDI transactions through use of the Internet might advantage small firms (Nagarajan et al., 2000). It is therefore unclear who will ultimately benefit the most from use of WES. This study investigates these issues.

Financial Performance

In spite of predictions of the potential value being offered by implementing WES, there has been no clear-cut evidence that trucking companies have gained significant advantages by providing an Internet presence, either financially or competitively (e.g., Nagarajan et al., 2000). In fact, a study by Chakraborty and Kazarosian (2000) found that productivity increases were not significant for companies that pursued Internet strategies. The authors reasoned that this was due to the difficulty of correctly identifying outputs, particularly in a service sector such as the motor carrier industry where WES offerings are often differentiated by quality attributes of the services provided rather than merely the physical content of the goods delivered. Furthermore, many of the previous measurements of the profitability of Internet implementation have centered on increasing sales through the addition of another channel, i.e., the Internet or e-commerce, which did not capture the operational improvement WES may bring.

Perhaps a better measurement would focus on the influence of comprehensive web-enhanced services on a motor carrier's performance. In another study, Nagarajan et al. (2000) failed to find a relationship between the use of information technology and economic performance. According to that article, 75 percent of the trucking companies have set up websites, but by 1999 only about 5 percent of the shipments by firms offering Internet activity were produced via the Internet. They argued that the motor carriers that implemented Internet technologies

were simply adding tasks, and that these tasks might become inefficient as the new Internet becomes more complex. They concluded that adoption of new information technology would not necessarily lead to greater profitability for most firms.

The unproven effects of various WES on profitability has certainly reduced the number of motor carriers pursuing WEB based initiatives and impeded efforts to implement WES projects. In order to clarify the issues involved, this study examines the relationship between trucking companies' web-based technologies and their performance. It should be noted that while this research has been limited to publicly traded companies with revenues greater than $25 million, it is reasonable to expect that these findings can be generalized across all large and medium-sized motor carriers. The study first identifies the most widely adopted WES, then explores the role of company size in their implementation. Finally, the impact of WES on motor carriers' profitability is investigated.

Hypotheses

Consistent with the objectives stated above, the following hypotheses were developed and examined by this research:

H1. Given the overall push to meet customer demands, it is hypothesized that among the various web-enhanced services being offered by motor carriers, real time tracking and tracing (RTT) is proving to be one of the more important "first step" technologies for motor carriers interested in utilizing web-enhanced technologies.

H2. In spite of conflicting evidence in the literature, due to the potential advantages and the rapid development of Web technologies, it is hypothesized that company size will not influence the implementation of WES. In particular, successful implementation of WES by both medium and large, publicly traded, interstate motor carriers will be independent of firm size.

H3. It is hypothesized that the implementation of WES by publicly traded interstate motor carriers will lead to improved financial performance.

METHODOLOGY

Data Collection and Sample

Information is widely available on publicly traded companies, facilitating research regarding profitability of these companies. Since the literature suggests that large motor carriers are much more likely to utilize the Internet than their smaller counterparts (Nagarajan et al., 2000), a sample consisting of larger, publicly traded motor carriers should be representative of all companies with sufficient resources and impetus to implement WES. The *Inbound Logistics* 2000 Top 100 list provided the initial list of companies in the study. This list was expanded by searching Standard and Poor's COMPUSTAT database for similar companies. The representative sample companies from the search had annual revenues greater than $25 million and cumulative annual revenues of about $33 billion. This represents almost 10 percent of annual revenues for the industry, and, as previously mentioned, represents the companies most likely to implement and benefit from the use of WES.

Once the representative sample of motor carriers was obtained, extensive efforts and processes were utilized to exclude any company whose primary focus might be in peripheral or related businesses such as freight forwarding, logistics services, or transportation consulting rather than trucking. Sources for this determination included: *Moody's (or more recently Murgent's) Transportation Manual* (1997-2001), *Wall Street Journal Index* (1997-2001), *Dun and Bradstreet's Million Dollar Directory* (1997-2001) and the existing web sites of the companies in the sample.

The screening and validation processes identified the companies that 1) had trucking as a main offering/ focus, 2) had annual net sales of over 25 million dollars, and 3) were publicly traded. These were then classified as medium or large companies, using the cutoff of 100 million dollars in annual net sales to distinguish between the two groups. Since web-enhanced services were not widely available before this time, the starting point was 1997. Full content data were available and collected for dates through the end of 1999. This date was chosen since, according to the survey mentioned earlier by Nagarajan et al. (2000), 75 percent of trucking companies reported having at least minimal Internet activity by early 2000. Their finding makes it reasonable to expect that the impact of WES should be demonstrable by data from this time period. Interestingly, our sample displayed a level of Internet activity that exceeded the reported 75 percent, supporting the methodology employed.

Web-Enhanced Services

Inbound Logistics 2000 identified the following as web-enhanced Services (WES): 1) Real Time Tracking and Tracing, 2) POD, BOL in Image Format, 3) Creating BOL, 4) Transit Times by Origins/Destination, 5) Individual Rates, 6) Standard Rates, 7) Individual Account Information, 9) Activity Management Report, 10) Claims Ratio Statistics, 11) On-time Statistics, 12) Location Directory, and 13) Filing Claims. These WES enable shippers to timely and accurately track and trace shipments and streamline other existing processes. Information on the existence of company Internet sites as well as which of the WES technologies were offered was determined on a company-by-company and service category by service category basis. These determinations were made by collecting data included in the *Inbound Logistics* 2000 Top 100 list, on corporate web sites, and information gathered from direct telephone contacts with information service departments. Only companies that offered at least one of the above services were classified as WES companies (WESC). All other companies were classified as non-WES companies (NWESC). Table 1 lists the WES offered and the corresponding number of companies offering the services for all years of the study period. A breakdown of these numbers into their WESC and NWESC categories is also included.

Size and Financial Performance

Size and financial performance of each company in the study were established. Company size is traditionally determined based upon revenues, assets, number of employees, or some combination of these three items. A preliminary size analysis was employed comparing number of employees with net sales revenues, and these two factors correlated highly in the motor carrier industry (0.98, n = 121).

Net-sales was chosen as the measure of company size for this study. Corporate financial performance for each firm was determined based upon return on assets (ROA), return on equity (ROE), and return on investment (ROI).

Statistical Procedures and Analysis

In order to reveal differences between the WESC and NWESC companies, several tests were conducted. Figure 1 illustrates the flow of the analyses conducted throughout this research. Notice that the map shows how the results of a particular analysis naturally led to the analyses that followed.

Testing of Normality

First, the data were analyzed to determine if they were distributed normally. Several analyses and tests were used for this purpose. Graphical tests were used (histograms and normal probability plots) as well as analytical tests: Shapiro-Wilk's W-test, Kolmogorov-Smirnoff and Chi-Square tests of normality. Figure 2 is a representative graph used to investigate the normality of the data. In every case, normal plots suggested that the normality assumption was not appropriate. This result, coupled with the size of our data set (less than 100 observations in

TABLE 1
WEB-ENHANCED SERVICES

Services Offered	Number of Companies		
	WESC	NWESC	TOTAL
RTT	75	0	75
POD, BOL in Image Format	63	36	6
Request for Shipment P/U	42	3	45
Creating BOL	33	0	33
Transit Times by Origins/Destination	44	1	45
Individual Rates	51	4	55
Standard Rates	62	4	66
Individual Account Information	35	0	35
Activity Management Report	33	0	33
Claims Ratio Statistics	21	3	24
On-time Statistics	19	2	21
Location Directory	75	82	157
Filing Claims	23	1	24

each group), dictated the use of non-parametric statistics throughout the remainder of the analyses. The Mann-Whitney U-test was employed for this purpose (Statsoft, 2002—see, in particular, discussion of sample size requirements for utilization of parametric statistics with non-normal data).

RESULTS

RTT (Real Time Tracking and Tracing)

Confirming our first hypothesis, RTT did, in fact, emerge as the "first step" technology for the companies in this study. In fact, every company that offered any value added WES service via the Internet also offered RTT. Previously, RTT has received attention due to its successful implementation by Federal Express, UPS and the USPS. Many trucking firms are offering RTT and customers are increasingly demanding it. A case study by Shulman (1999) offered some pictures of the benefits of successful implementation of RTT at Giant Foods, which has used WES effectively to improve its trucking fleet operations. Through development of RTT, digitized driver reporting systems, etc., the company has substantially improved timely delivery. Moreover, RTT via the Internet is developing as a common way to help improve transit time problems. At a time when congestion on US roadways is increasing transit time and variability of transit time (Regan and Golob, 1999), WES and developing information technologies are seen as ways to combat this. As attempts are made to utilize WES to its full advantage, help with on-time delivery appears to be extremely relevant (Hickey, 2001). This suggests that companies are implementing this technology early in the process of developing WES. In fact, many companies offered only RTT in their attempts to establish online services. RTT has been used as an important "first step" technology for motor carriers interested in utilizing web-enhanced technologies. One implication from this is, accordingly, that RTT can be used as a cutoff mark to easily distinguish WESC (companies offering WES) from NWESC (companies not offering WES) in future studies.

Size

The second hypothesis (that WES implementation would be independent of company size) was tested by comparing measurements of the size of interstate motor carriers that do not offer web-based services and those that do offer web-based services. The Mann-Whitney U-test rejected the null hypothesis with a p-value of 0.0036. This allowed us to conclude that a relationship did, in fact, exist between corporate size and the implementation of WES. It was found that companies

that have implemented WES are larger (on average) than their counterparts that have not implemented WES, suggesting that although barriers to entry in offering WES can be low, smaller companies have not been able to, or have not chosen to add these capabilities.

Financial Performance

The third hypothesis (that use of WES would lead to improved financial performance) was tested using the Mann-Whitney U-test. The results of these tests are captured in Table 3. The statistical tests show that, when the financial performance of both WESC and NWESC are compared, ROA, ROE and ROI are all significantly higher for WESC with p-values of 0.0115, 0.0046, and 0.0031 respectively. This indicates that a relationship exists between implementation of WES and the financial measures tested. In other words, companies that have implemented WES enjoy higher profitability than their counterparts that have not implemented WES (see Figures 3, 4, and 5). These findings support arguments made in the literature that WES could lead to improved financial performance (e.g., Garicano and Kaplan, 2000; Nagarajan et al., 2000).

A question was raised as to whether the enhanced profitability could be attributed to company size. That is, did the findings merely imply that larger motor carriers were more profitable in general than smaller motor carriers? To answer this question, corporate size was controlled for and profitability ratios of large and medium-sized firms were compared. The results from the Mann-Whitney U-test failed to suggest a significant difference in financial performance (ROA, ROE, ROI, p-values 0.29, 0.33, 0.36 respectively) between the large and medium sized firms in the sample, with $100 million as the cutoff point. This clearly indicates that WES, instead of size, is the distinguishing factor in the sample that contributed to the difference in performance between WESC and NWESC motor carriers.

In order to further isolate the size effect, company size was controlled and two comparisons were made: large WESC vs. large NWESC; and medium WESC vs. medium NWESC. For the large motor carriers, WESC have greater ROE and ROI than their similarly sized NWESC counterparts. ROA was not found to be different at a statistically significant level (p value = 0.11). However, the average ROA of large WESC were greater than their large NWESC counterparts and tended towards significance. For the medium motor carriers (those with revenues in the range of $25 million to $100 million), results were not as clear. Although medium WESC were generally more profitable than medium NWESC, the Mann-Whitney U-test did not reveal a statistically significant difference in ROA, ROE, or ROI between these two groups of companies. These results indicate that while WES does provide certain financial advantages for large companies when WESC and NWESC of equivalent size are compared, this does not appear to hold true for medium-sized companies.

Discussion

Until recently, the issue of determining whether WES provides increased profitability has been complicated by the diversity of companies developing these services, by company size, and by the lack of understanding of what value these services offer to motor carriers. This study is the first that empirically clarifies relationships between investment in WES and financial returns. It identifies certain practices that enhance the operational and financial performance of interstate motor carriers. Results from this study indicate that companies adopting WES are usually large companies and exhibiting better financial performance, and that large companies that offer WES are statistically more profitable than their large counterparts that do not offer such services. This financial performance difference was confirmed across ROE and ROI, and tended towards significance with ROA. It confirms the belief that current technologies

FIGURE 1
FLOW CHART FOR ANALYSIS

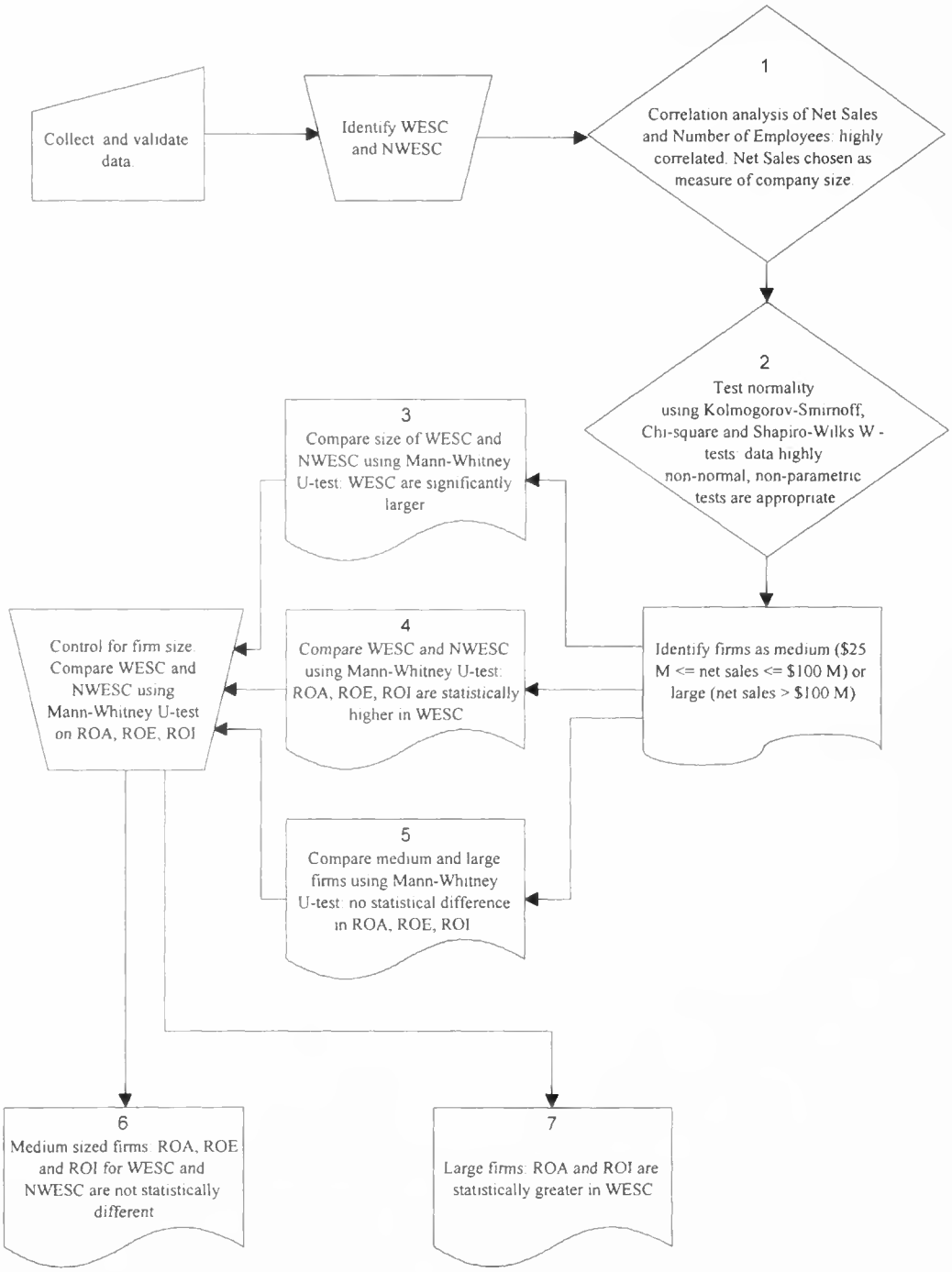
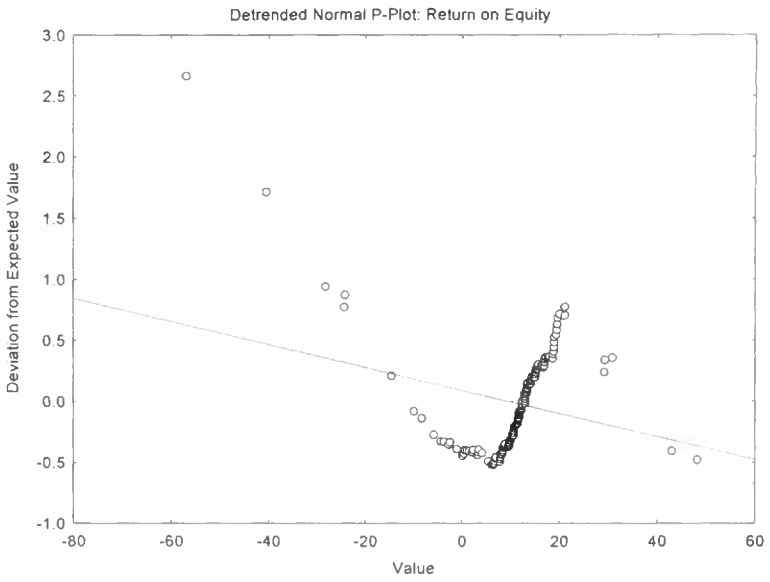


FIGURE 2
NON-NORMALITY CHART



FIGURES 3, 4, AND 5
DIFFERENCES IN PERFORMANCE BETWEEN WESC AND NWESC

FIGURE 3

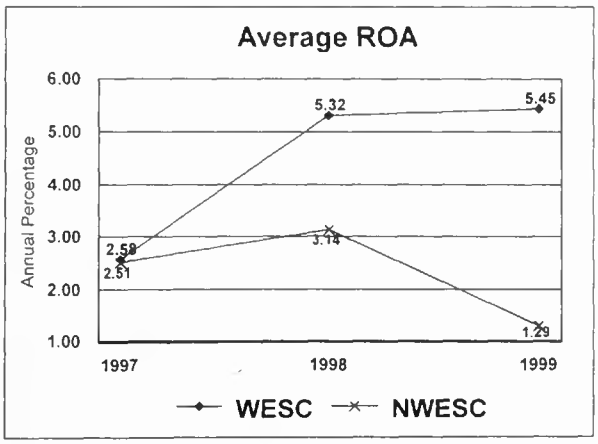


FIGURE 4

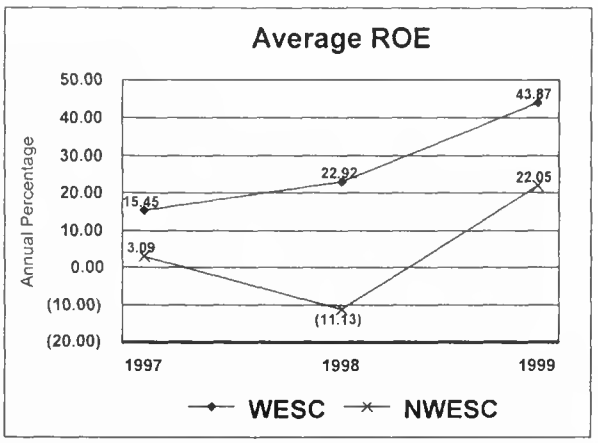


FIGURE 5

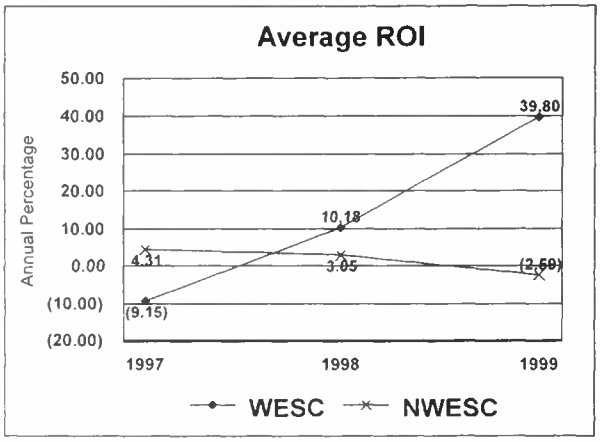


TABLE 2
STATISTICAL RESULTS

Task	Statistical Test(s)	Hypotheses Tested	Statistical Results	Conclusions	p-value*	Sample Size
1. Correlation Test	Correlation Matrix	Ho: Employee number and Net sales is not correlated	Reject hypothesis	Select Net sales as measurement for size	< .05	
2. Normality Test	Kolmogorov-Smirnoff, Chi-Square and Shapiro-Wilk's W - tests	H0: # Employees data is normally distributed	Reject hypothesis	Non- parametric tests should be used	< .01	WESC n = 75 NWESC n = 74
		H0: Net sales data is normally distributed	Reject hypothesis	Non- parametric tests should be used	< .01	WESC n = 75 NWESC n = 82
		H0: ROA data is normally distributed	Reject hypothesis	Non- parametric tests should be used	< .10	WESC n = 75 NWSC n = 82
		H0: ROE data is normally distributed	Reject hypothesis	Non- parametric tests should be used	< .01	WESC n = 75 NWESC n = 82
		H0: ROI data is normally distributed	Reject hypothesis	Non- parametric tests be used	< .01	WESC n = 75 NWESC n = 82
3. Test on Size	Mann-Whitney U-test	H0: Mean number of employees is the same for WESC and NWESC	Reject hypothesis	Mean number of employees is greater for WESC than NWESC	0.0036	WESC n = 75 NWESC n = 74
		H0: Mean net sales is the same for WESC and NWESC	Reject hypothesis	H0: Mean net sales is greater for WESC than NWESC	0.0036	WESC n = 75 NWESC n = 82
4. Test on Profit between WESC and NWESC	Mann-Whitney U-test	H0: Mean ROA is the same for WESC and NWESC	Reject hypothesis	Mean ROA is greater for WESC than NWESC	0.0115	WESC n = 75 NWESC n = 82
		H0: Mean ROE is the same for WESC and NWESC	Reject hypothesis	Mean ROE is greater for WESC than NWESC	0.0046	WESC n = 75 NWESC n = 82
		H0: Mean ROI is the same for WESC and NWESC	Reject hypothesis	Mean ROI is greater for WESC than NWESC	0.0031	WESC n = 75 NWESC n = 82

Table 2
(continued)

Task	Statistical Test(s)	Hypotheses Tested	Statistical Results	Conclusions	p-value*	Sample Size
5. Test on Profit between Large and Medium firms	Mann-Whitney U-test	H0: Mean ROA is the same for large as for medium firms	Fail to reject hypothesis	Statistically indeterminate.	0.29	Large firms n = 83 Medium firms n = 74
		H0: Mean ROE is the same for large as for medium firms	Fail to reject hypothesis	Statistically indeterminate.	0.33	Large firms n = 83 Medium firms n = 74
		H0: Mean ROI is the same for large as for medium firms	Fail to reject hypothesis	Statistically indeterminate.	0.36	Large firms n = 83 Medium firms n = 74
6. Test on Profit between medium WESC and medium NWESC	Mann-Whitney U-test	H0: Mean ROA is the same for Medium WESC as for Medium NWESC	Fail to reject hypothesis	Statistically indeterminate.	0.31	Medium WESC n = 24 Medium NWESC n = 50
		H0: Mean ROE is the same for Medium WESC as for Medium NWESC	Fail to reject hypothesis	Statistically indeterminate.	0.24	Medium WESC n = 24 Medium NWESC n = 50
		H0: Mean ROI is the same for Medium WESC as for Medium NWESC	Fail to reject hypothesis	Statistically indeterminate.	0.23	Medium WESC n = 24 Medium NWESC n = 50
7. Test on profit between large WESC and large NWESC	Mann-Whitney U-test	H0: Mean ROA is the same for large WESC and large NWESC	Fail to reject hypothesis	Statistically indeterminate.	0.11	Large WESC n = 51 Large NWESC n = 32
		H0: Mean ROE is the same for large WESC and large NWESC	Reject hypothesis	Mean ROE is greater for large WESC than large NWESC	0.004	Large WESC n = 51 Large NWESC n = 32
		H0: Mean ROI is the same for large WESC and large NWESC	Reject hypothesis	Mean ROI is greater for large WESC than large NWESC	0.003	Large WESC n = 51 Large NWESC n = 32

* reported p-values for Shapiro-Wilk's W-test, Kolmogorov-Smiroff and Chi-Square tests (testing hypothesis of the underlying distribution being normal) is the higher of the three values. In all cases, this was the value calculated for the Kolmogorov-Smirnoff test.

have begun changing operational efficiencies with improved financial performances. Since a very strong positive relationship was found between company size and the existence of web-enhanced capabilities, our results contradict the conventional thought that the Internet would be employed equally, regardless of company size. Explanation of this finding is not difficult. It is relatively easy for a company with a very limited budget to create and maintain small, non-interactive websites that only present company information. However, development of advanced WES (particularly interactive WES) requires greater commitments of development funds. As

such, it is possible that medium-sized companies will carry a larger burden as a percentage of development funds than their large counterparts in offering the same level of WES. Therefore, there is a smaller percentage of medium size firms that adopted WES, and the financial returns of WES may not be as great for medium-sized firms. It is very possible that, because of the high costs associated with developing and maintaining WES, the added benefits to medium-sized firms are actually offset by the disproportionately large costs, minimizing the financial benefits for the medium-sized WESC. Thus, barriers to entry for adopting Web technologies may exist which prevent smaller companies from offering comprehensive WES, or may actually cause them to not realize financial benefits from offering WES. In general, web-enhanced services do not appear to offer competitive disadvantage to companies, although the financial implications are not clear at this point.

Managerial Implications

The significance of the findings is threefold. First, since WES implementation provides financial advantages to certain companies, those firms that have developed WES may enjoy a first mover advantage in the field. This advantage may serve as a threat to those companies that are slow to implement WES in their businesses. As such, motor carriers may need to implement WES as a competitive weapon. Second, company size appears to be related to propensity to adopt WES. The association between company size and the implementation of WES is quite strong. The Internet has not facilitated the creation of a level playing field for large and small trucking companies. Rather, it has further polarized companies with size as the factor of differentiation. The study results indicate the Internet has actually widened the gap between small and large companies. Third, if financial barriers to adoption of WES restrict smaller companies from participating in these services, then perhaps an opportunity exists for third party providers to bridge the gap. Clearly, these points have profound significance for the motor carrier industry.

Limitations and Future Research Opportunities

At present, these findings are interesting and raise questions for future research. The findings tend to point out that corporate size may be a reliable predictor of which companies have implemented web-based technologies, and which might benefit from the new technologies. Large companies are more prone to develop web-enhanced capabilities and offer such services to their customers, making a difference on corporate profitability. However, causal relationships could not be established, thus limiting the generalizability of these results across the industry. Future research needs to investigate the relationships found in this study. Moreover, research is needed to further identify which WES provide the greatest value to companies, thus providing practical guidelines to companies that engage in phased decisions for adopting WES. A second limitation is that, since the study has been restricted in scope to publicly traded companies, the impact of WES implementation on private trucking companies is still unknown. However, it is reasonable to expect that these private motor carriers follow patterns similar to those demonstrated among publicly traded companies due to the similarity of their operational environment. Future research should include these companies.

CONCLUSION

The motor carrier industry finds itself in a difficult economic situation. Pursuit of adequate profit-ability is of the greatest importance. One option available to motor carriers in attempting to increase efficiencies and improve customer service is the adoption of web-enhanced services. This study has addressed the question of whether WES is implemented uniformly across all motor carriers and whether such services provide any financial value. The study found that companies that adopt WES tend to be large. It also showed that large companies that utilize WES tend to be more profitable than their similarly

sized counterparts that do not. It also found that every company that offers any WES offers RTT.

Several implications can be drawn from these findings. Since size is positively related to a trucking company's propensity to adopt WES, use of the Internet further polarizes companies based upon size, rather than leveling the playing field for both large and small trucking companies. Further, since the use of WES gives trucking companies financial advantages, those companies that have begun to utilize WES may enjoy a first mover advantage, while for those firms that have not incorporated the use of WES, the Internet may represent a significant threat.

In conclusion, motor carriers pursuing the elusive objective of increased profitability and greater customer satisfaction should consider offering WES. The key to success is to reshape for the Internet and devise an evolving business plan that responds to changes in the market as they occur.

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