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ABSTRACT

This article reports the findings of a mobile communications survey mailed out to over 2,000 trucking firms. The findings indicate that 68% of respondents use some form of mobile communication system in their firm. Various types of mobile communication systems were reported, including two-way pagers, one-way pagers, cell phones, two-way radio, and satellite communications. Additionally, implementation decision factors for mobile communication systems were evaluated for both users and non-users of mobile communication systems.

INTRODUCTION

Just-In-Time (JIT), Quick Response (QR), and Efficient Customer Response (ECR) are a few of the logistics strategies that manufacturers and retailers have embraced that frequently require tracking a shipment to determine its location on a moment's notice. Traditionally, complete, timely, and accurate tracking information simply have not been available for shipments as they flow through the supply chain. Common transportation-related events such as departed-from-shipper, en-route status, and arrival-at-consignee have relied upon a phone call from a truck driver to their dispatcher as the trigger for valuable shipment information to be captured and entered into the information flow required by the supply-chain. The result has been waits of two or more days for matches to be made between the trucker and the required paper work, resulting in a $5 billion drain in business (Spencer, 2000). However, electronic data interchange (EDI) plays a critical role in supply chain management by improving vendor responsiveness and flexibility, thereby improving relationships and improving carrier operational planning and performance (Crum, 1998). Dadzie, et. al (1999) suggest that the integration of new technologies (EDI) into the logistics supply chain allows for higher levels of customer service, as

well as giving management a new method for reducing overall costs.

Kavalaris and Sinha (1995) report that, as recently as 1993, most trucking companies were not using advanced mobile communications technology and the majority of firms were not aware of advances in toll collection, weigh station bypass, and vehicle identification devices. Indeed, as recently as 1999, Regan and Golob reported that, while many vehicles are equipped with two-way communication devices, they are not typically equipped with vehicle location or identification devices. However, a technological revolution within the truck-load (TL) segment of the transportation industry has been evolving over the past decade which has extended the real-time information gathering and communication capabilities directly into the cabs of many over-the-road trucks in America. This assertion is supported by Crum, Johnson, and Allen (1998) who report that the use of EDI technologies increased significantly between 1990 and 1996. This technology, frequently referred to as mobile, wireless, or satellite communications, provides bi-directional data and, in some cases, voice communications capabilities between the truck and their dispatch office computer systems. Interestingly, this same technology may serve the less-than-truckload (LTL) segment of the motor carrier industry equally as well. The LTL segment tends to experience even greater operating problems, which may be even more complex than the TL segments of the industry (Crum, Johnson, and Allen 1998).

The three primary vendor-based justifications for the implementation of mobile communications technology have been: 1) improved customer service, 2) improved operational efficiencies, and 3) improved driver quality of work life. Not a week goes by without several articles or advertisements in the major trucking publications referring to mobile communications in the form of pagers, cellular phones, and satellite global positioning systems (GPS). However, even though these justifications are intuitively valid and important, little academic research has yet been conducted that fully explores the relationship between them and the actual implementation of mobile communications within a fleet operations.

The primary purpose of this research was to understand the level of implementation of mobile communications within the trucking industry. Additionally, decision factors in the buying process for both users and non-users of mobile communication systems were investigated.

LITERATURE REVIEW

There is no doubt that there has been an ongoing communication revolution in the trucking industry which has included technical advances in two-way radios, pagers, cellular phones, wireless data communications, and vehicle tracking systems (Bald, 1995). In fact, by 1995, advancements in these areas had made the transportation industry the single largest user of wireless data services in the United States with a 34 percent share of the wireless market resulting in increases in customer satisfaction, improved delivery, improved information systems and more accurate vehicle tracking (Dollar, 1995).

Communication in the trucking industry is continuing to evolve as improved technology has become available. Johnson (1999) observes that the 1950's saw the introduction of the CB radio. While popular with ham radio operators, the CB did not become popular with truckers until 1974, and then primarily as an aid to find fuel during the oil embargo. However, twenty years later CB radios were being used by approximately 99 percent of all heavy trucks on the highway as a common form of communication between drivers (Bald, 1995). Communication from truck-to-truck is one thing but, communication from a company's dispatcher to the truck operator is quite another problem which was yet to be completely solved.

Pagers provided dispatchers with a relatively low cost method of reaching drivers. As a result, the growth rate of pager usage was about 5 million

per year in 1995 (Bald, 1995). However, while pagers provided an improved method of communicating with drivers from much longer distances than CB radios, the communication was one-way (dispatcher to operator) and drivers were forced to stop and find a phone if they wished to communicate directly with their dispatchers. Johnson (1999) reports that the solution to the short range problems associated with CB's and the one-way communication problem associated with pagers came in 1969 with the introduction of cell phone service in the form of Improved Mobile Telephone Service. This product was replaced in 1979 with Bells' Advanced Mobile Phone Service.

There is no doubt that cellular usage is still popular. In fact, United Parcel Service is reported to make about 1 million calls and uploads data on 6 million packages per day (Dollar, 1995). However, even with the popularity of cellular usage, the 1980s and 1990s have witnessed the introduction of widespread computer usage and satellite tracking systems which have dramatically changed communication in the trucking industry. Internet systems now exist that allow truckers web access at truck stops where they can log on to web cites to obtain information from their dispatchers. To date, PNV (formerly Park-in-View) has introduced services to over two-thirds of all full-service truck stops which allows the driver to hook up to phone lines, the internet or even cable TV (Spencer, 2000). Spencer further notes, however, that only four percent of drivers and trucking companies are taking advantage of these services. The companies must also educate truckers, of which only 20 percent own a PC, of the advantages of these services.

Qualcomm, Incorporated was the first company to successfully introduce this type of technology in 1988. Since that time, Qualcomm systems have been adopted by more than 1,000 trucking fleets in North America, including 37 of the top 40 trucking companies (Marchetti, 2000). In fact, by 1995 they had equipped 106,000 trucks with new satellite tracking technology (Bald, 1995) and the number of units in use continued to increase to 250,000 by 1999 (Allen, 1999). Also in 1999, the Federal Communications Commission approved increasing the number of units from 250,000 to 400,600 (Whitten, 1999). This type of continued increase in satellite tracking tends to support Munson's (1999) assertion that satellite tracking of fleets is rapidly becoming a standard practice in the trucking industry.

Munson further notes that this technology has been expanded into other areas and is now being used not only as a method to communicate with drivers and track their positions, but also to perform engine diagnosis while the truck is on the road, receive real-time data on the truck's engine, schedule preventive maintenance, and track parts and labor costs per vehicle. Even though this technology has dramatically improved the ability to track positions of a fleet, some problems do still exist. Milligan (1999) reports that the typical tracking systems are generally attached to the tractor, as it has a source of power to run the unit, and when the tractor is separated from the trailer the system will lose track of the trailer resulting in a wide variety of inventory control and handling problems.

Presently, a wide variety of satellite tracking systems are available to the trucking industry including systems from @Track Communications (formerly HighwayMaster), Rockwell Highway Transport Electronics, Cadec Systems, Airtouch Teletrac (Bald, 1995), Arinc, Orbcomm, PeopleNet, and Vantage (Fleet Equipment, 1999). While each of these systems tend to differ slightly, they are all designed to help pinpoint the location of a particular tractor or trailer.

METHODOLOGY

The research methodology incorporated a self-response survey instrument that was developed in coordination with Qualcomm, Incorporated, a leading mobile communications provider for the trucking industry. The questionnaire was designed to investigate both current users and non-users of mobile communication technology.

The survey was pre-tested for content and readability based on feedback from a small sample of trucking companies and Qualcomm. An introductory letter, the survey, and a postage paid return envelope were then mailed to a sample of 2,736 trucking companies asking for their participation in this study. In an effort to avoid the possibility of bias, the research sponsor was not identified in either the cover letter or questionnaire.

Non-respondents to the initial survey mailing were sent a follow-up postcard approximately ten days later. At the end of the collection period, twenty-four (24) surveys were returned undeliverable along with 565 completed surveys thus providing a response rate of 21 percent (565/2,736-24). Non-response bias was evaluated by comparing earlier responses to later responses for nine of the Likert scaled questions (Armstrong, 1977). No statistically significant differences were found from the comparisons. Therefore, non-response bias was not considered to be a problem.

FINDINGS

The first section of the questionnaire examined if the responding company used some form of mobile communications and, if so, what types of systems were presently being used in their fleets. Of the 563 companies responding to the question, "Does your company currently use mobile communications," 384 (approximately 68 percent) indicated that their company does use some form of mobile communication, while 179 (approximately 32 percent) of the companies responded that they did not presently use mobile communications systems within their fleet. Two respondents did not answer this question. Table 1 shows the type of mobile communication systems currently being used by the respondent companies. Note that some companies indicated the use of more than one type of mobile communication system in their fleet.

Table 1 clearly shows that, while a variety of systems are being used, two-way pagers receive the least usage. The most popular forms of communication, in descending order are cell phones, satellite systems, one-way pagers, and two-way radios.

TABLE 1
TYPE OF COMMUNICATION SYSTEM

System Type	Number/Percent Using	
Two-Way Pagers	37	9.6%
One-Way Pagers	165	43.0%
Cell Phones	226	58.8%
Two-Way Radio	121	31.5%
Satellite	183	47.7%

Note that respondents were asked to check all that applied. Therefore, some companies indicated the use of more than one type of mobile communication system in their fleets.

During the development stage of the questionnaire several decision factors were identified that could be used in deciding whether or not to purchase a mobile communications system. Table 2 shows those decision factors and the level of importance that companies reported for each factor regarding their implementation of mobile communication in the fleet.

Table 2 shows the mean level of importance that the respondents reported for each decision factor with 1 representing "not very important" and 7 representing "very important." The least important decision factor as reported by the respondents was the use of a mobile communications system by a competitor with a mean response of 3.87. Another relatively unimportant decision factor was the anticipation that, by using some form of mobile communication system they might increase their own customer base, with a mean response of 4.35. However, the level of importance associated with each of the remaining decision factors appears to be relatively high. The highest level of

TABLE 2
DECISION FACTOR IMPORTANCE

Decision Factors	Mean Importance Level
Ability to contact driver immediately	6.25
Ability to track shipments	5.66
Operating Efficiency	5.62
Enhance Customer Service	5.52
Driver Quality of Life	5.07
Customer requires mobile communication	4.96
Increase customer base	4.35
Competitors use mobile communication	3.87

1 = "Not Very Important" – 7 = "Very Important"

importance (6.25) clearly rests in the ability of the dispatcher to be in immediate contact with the driver. Other factors scoring relatively high were the ability to track shipments (5.66), operating efficiency (5.62), and enhancing customer service (5.52).

As noted earlier, non-mobile communication users were asked a series of questions to determine why they have chosen not to invest in this type of technology. The responses to these questions are shown in Table 3.

Responses were based upon whether the respondents found the criteria to be of low importance, medium importance, or high importance in their decision **not** to purchase mobile communication equipment. The factor rated as highest in importance for **not** purchasing a mobile communication system was "routes don't need mobile communication" (rated high importance by 23.9 percent and medium importance by 14.8 percent of respondents). The second highest rated factor for **not** purchasing a mobile communication system was "cost of hardware and implementation" (rated as high importance by 12.8 percent and medium importance by 29.1 percent of respondents). Additionally, the "cost of monthly service" also received medium importance ratings from 23.0 percent of respondents which shows some concern for cost.

TABLE 3
FACTORS AFFECTING NON-USE OF MOBILE COMMUNICATIONS

Factor	Low Impt (%)	Med Impt (%)	High Impt (%)
Other Critical IT initiatives underway	93.3	3.3	3.3
Customers don't require mobile communication	78.3	16.9	4.8
Fleet size is too small	73.2	19.6	7.1
Cost of monthly service	77.0	23.0	0.0
Routes don't need mobile communication	61.9	14.8	23.9
Cost of hardware and implementation	58.2	29.1	12.8

However, the wide range of responses indicates that no single factor was found to be rated of particularly high importance in the decision **not** to purchase a mobile communication system. These findings appear to be similar to those of Hall and Intihar (1997) who reported that trucking companies are willing to invest in new technologies as long as the costs are low and there are no new taxes or user fees involved. Scapinakis and Garrison (1991) reported that short distance operators are heavy users of communication technologies but it is long distance carriers that are most likely to require both communication and vehicle location systems. Regan and Golob (1999) also reported that large fleets are more likely to use technologies than small fleets. As might be expected from the literature, the results of this study demonstrate that companies running regular short routes see little need for the implementation of any type of sophisticated vehicle location systems.

DISCUSSION

The results of this study rather clearly support the assertion that mobile communications systems are becoming more commonly used in the trucking industry. Indeed, these systems appear to be more sophisticated than the simple one-way pagers of the past. The use of cell phones and satellite systems were the most commonly mentioned types of systems being used. The primary reasons for continued growth in the use of mobile communication systems appear to be based on both the effectiveness and efficiency provided to the fleets implementing these systems. On the effectiveness side of the value equation, the ability of a trucking firm to be in immediate contact with a driver and track shipments clearly allows the company flexibility that was not available when the dispatcher was forced to wait for a driver to find a truck stop and check in by phone. On the efficiency side of the value equation, operational efficiencies like the ability of a trucking firm to better manage out-of-route miles and manage more drivers per driver manager are important cost benefits of a mobile communication system.

As noted earlier, the ability of a transportation firm to be able to immediately tell a shipper where their shipment is at any given time provides that firm with a competitive advantage over trucking firms who have chosen not to invest in mobile communication systems. There can also be little doubt that the operational efficiencies provided by this type system will help keep inflation down in transportation prices, providing an additional competitive weapon for the fleets implementing the systems.

The ability for a maintenance manager to be in constant contact with a driver is an obvious advantage in terms of vehicle maintenance and providing immediate help in case of a breakdown or other emergencies. The ability of dispatchers to both know exactly where a shipment is and be able to talk directly with a driver about present and expected conditions will undoubtedly serve as a tool for increasing customer satisfaction and profits.

While there appeared to be no one specific reason for companies not to invest in mobile communications systems, cost of the hardware and implementation of the system along with the monthly service fees did appear as significant contributing factors for non-users of these types of systems. If these systems prove to be as effective as they appear to be, the fear of investment cost may put the non-using company at a true competitive disadvantage. Those respondents indicating that mobile communications were not a necessity for their fleets, as a result of routes being relatively short, may find that these shipments are every bit as important to buyers as those loads traveling long distances and the ability to be able to locate the shipment and advise the buyer as to arrival time may be the characteristic that sets them apart from their competitors.

Further research in this area is clearly needed. For example, a comparison of perceptions that fleet managers held prior to the implementation of a mobile communications system to perceptions after the implementation of the system could be of significant value to those companies using the systems, those considering implementation of a system, and to those companies providing the systems to the industry.

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