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**THE USE OF
NEW INFORMATION TECHNOLOGIES
IN THE MOTOR CARRIER INDUSTRY**

*Yvon Bigras
Universite du Quebec a Trois-Rivieres
Teodor Crainic
Jacques Roy
Universite a Quebec a Montreal*

ABSTRACT

For the last ten years or so, the freight transportation industry has been facing new challenges such as "Quick Response", "Just-in-Time" and "Efficient Consumer Response" industrial practices as well as the globalization of markets which led to free trade agreements between countries. As a result, the demand for electronic trade and specialized logistical services has significantly increased.

These changes have highlighted the importance of information in freight transportation. In response to these needs, new information-related technologies have developed rapidly: Electronic Data Interchange (EDI), Global Positioning Systems via satellites (GPS) and Decision Support Systems (DSS). These new technologies can greatly enhance the operations planning capability of freight carriers.

This paper provides a review of the utilization of new information technologies in the trucking industry. It also presents the results of a recent survey of trucking companies operating in the Province of Quebec. The impact of new information technologies and decision support systems on motor carrier operations is analysed and future directions are discussed.

1. Introduction

During the last decade, the freight transportation industry had to face new challenges as a result of important changes affecting supply chains and logistical processes. The first change may be attributed to the impetus toward inventory reduction which led to "Just-in-Time" procurement practices and, more recently, to "Quick Response" or the just-in-time replenishment of goods in the retail industry. While aiming for the goal of reducing both inventories and reorder cycle time, today's practices call for enhanced consumer value by reducing distribution costs while responding to customer needs. "Efficient Consumer Response" and "Flow-through-Logistics" are two examples of such information-based and time sensitive practices currently implemented in the grocery industry.

The procurement and distribution of goods has also been significantly influenced by the recent trend toward the globalization and liberalization of markets. This has led to free trade agreements between countries over wide geographical regions such as the European Union and the North American Free Trade Agreement (NAFTA), which resulted in the creation of regional or continental free trade zones, such as the territory composed of Canada, USA and Mexico, for example. The liberalization of markets has been accompanied by a restructuring of manufacturing and distribution channels worldwide. Centralized warehousing facilities and value added distribution centers are changing the flow of goods on the American and European continents. These changes have resulted in increased demands for electronic trade and specialized logistical services such as "Third Party Providers".

As a result of these changes, the freight transportation industry has had to recognize the importance of information technologies in order to enhance its capability to respond to the needs and requirements of its customers. This paper reviews the utilization of some of the more relevant information technologies in the trucking industry. It also analyses the impact of such technologies on motor carriers by discussing the results of a recent survey of trucking companies operating in the Province of Quebec.

The remainder of the paper is divided into four sections, dedicated to a brief review of relevant information technologies, the Quebec trucking industry's competitive environment, the survey methodology and results, as well as to conclusions.

2. New Information Technologies and Freight Transportation

2.1 Electronic Commerce

Electronic commerce is defined as conducting or enabling the buying and selling of goods or services through electronic networks, including the internet (Gopal and Fox, 1996). Electronic commerce makes use of a wide array of information technologies such as fax, E-mail, voice mail, electronic funds transfer (EFT), internet, image processing and electronic data interchange (EDI). According to Emmelhainz (1990), the latter, EDI, can be defined as the inter-organization, computer-to-computer exchange of business documentation in a standard, machine processable format. Its popularity has grown rapidly over the recent years due to several benefits associated with its use: minimization of manual data entry, increased transaction speed and accuracy, lower communication costs and promotion of simplification of procedures.

The number of motor carriers offering EDI services in USA has increased significantly in recent years as shown in Figure 1 (Sunstrum and Howard, 1996). However, Canadian motor carriers have been slower to adopt EDI as indicated in a recent survey of motor carriers using best practices conducted by KPMG in 1995 (Figure 2).

Figure 1
Number of trucking companies offering EDI services in the US

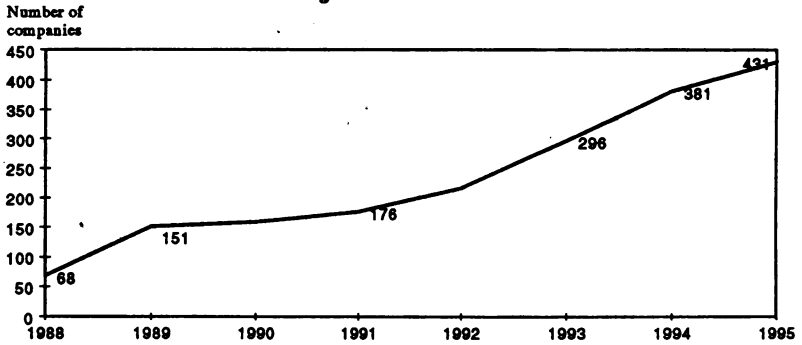
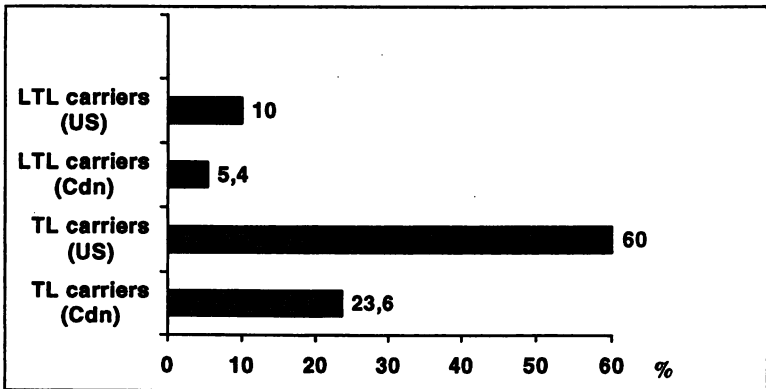
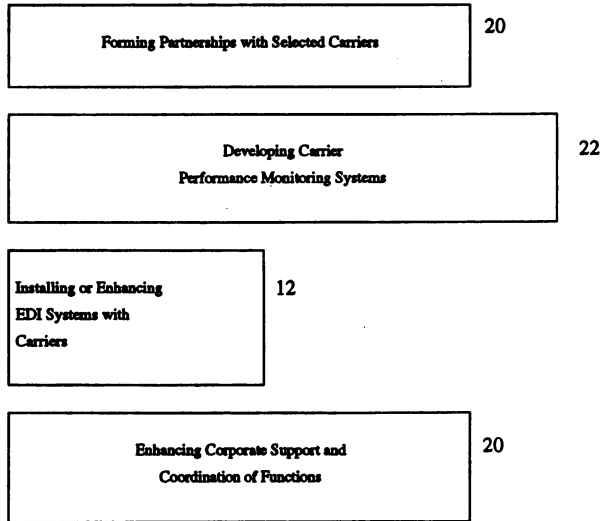


Figure 2
Use of EDI by carriers in Canada (CDN) and the US



Freight motor carriers are therefore under strong incentive to join the movement and integrate these technologies into their day-to-day operations. At the same time, a large number of shippers are forming partnerships with freight carriers as illustrated in Figure 3 (source: *Traffic Management*, October 1992). As a result, the average number of carriers used by shippers in the USA has been reduced significantly over the last 10 years (Anderson et al., 1994). In a recent survey, Walton (1994) has found that carriers adopt EDI mainly to satisfy customer requirements, increase customer service and remain competitive. Similar results were found earlier by Allen, Crum and Brauschweig (1992) and Johnson, Allen and Crum (1992). By adopting EDI, some carriers are pursuing a differentiation strategy based on technology and customer focus. Finally, a small number of carriers have adopted EDI in order to reduce costs.

Figure 3
Initiatives Taken by Shippers
According to a Survey of 52 of the Largest Companies in the USA



FREQUENCY OF RESPONSES

But, in any case, there has to be a critical mass of EDI users in the market before it is financially justifiable (Giannopoulos, 1996). This is a particularly sensitive issue for small carriers (Udo and Pickett, 1994). Moreover, investing in information technologies such as EDI may only be profitable when these technologies are fully integrated with other internal systems within the organization (Ratliff, 1995).

In short, a growing number of carriers are concluding partnerships or alliances with shippers and other carriers as well. These alliances are facilitated by the use of new information technologies that are part of the electronic commerce arsenal. This pattern may lead to virtual (or electronic) integration between carriers and shippers. However, carriers that elect not to invest in these new technologies will not be able to provide value added services to their customers and will therefore have to be satisfied with low yield traffic only.

2.2 Vehicle Tracking and Dispatch

If electronic commerce has been instrumental in improving the efficiency of the supply chain, the same can be said about the combination of wireless communications and computers in the trucking industry. Motor carriers are facing increased demands from their customers for on-time pick-up and delivery, not only on a given day but within a specific time window of a few minutes. At the same time, the economic deregulation movement initiated in the US in 1980, has resulted in increased competition and price wars. Therefore, new information technologies must not only assist motor carriers in providing high quality services to their customers but also enable them to reduce operating costs and thus maintain a competitive edge.

Vehicle tracking and dispatch technologies may assist in reaching this goal. For example, one of the major truckload companies in the USA, Schneider National, equipped its fleet with on-board computers and satellite communication devices. Its use of technology has reportedly resulted in cost reductions in the order of 24% and increased on-time performance from below 90% to about 99% (Cohen, 1995). Using satellite communication, Schneider can track the location of each vehicle anywhere in the United States and dispatch it on a real time basis to satisfy customer needs and adapt to unforeseen changes. This tracking ability has enabled the company to reduce empty mileage by 25% last year. The use of on-board computers also enables Schneider

to monitor vehicle speed and drivers' working hours in order to comply with laws and regulations. As a result, technology has helped reduce the company's accident rate by 35% since 1987 (Cohen, 1995).

In California, a recent study (Hall, 1996) suggests that vehicle tracking was used by 29% of the large companies, 25% of the medium size companies and none of the small companies. In Canada, the number of trucking companies using satellite positioning and two-way communication has doubled between 1994 and 1995, going from 42 to 90. It is interesting to note that even small Canadian companies with fleets of less than 50 units, are using satellite positioning. These are long distance truckload companies and several of them carry refrigerated goods on a contractual basis. The satellite positioning capability is sometimes a customer requirement.

In the less-than-truckload (LTL) industry, highway vehicles are moving freight on a schedule basis between terminals that are located within a few hours of each other. Hence, vehicle tracking is less required. However, bar coding is increasingly used to track the shipment's progress as it moves from terminal to terminal, from pick-up to final delivery. In some cases, customers are provided with the capability of checking on line the status of their shipments using computers or by phone.

Some of the larger courier services like Federal Express and UPS make extensive use of information technologies. Both can track shipments using bar codes and offer their customers a software for tracing shipments. At UPS, pick-up and delivery drivers carry mobile data terminals called "DIAD" (Delivery Information Acquisition Device). This device is used to electronically record deliveries. It contains a keyboard, a bar-code scanner and an interface to electronically record signatures. Once the DIAD is placed in a base set in the truck, the delivery transaction data is transmitted electronically to the terminal, (Hall, 1996).

3. The Survey

3.1 The Quebec Trucking Industry

The Quebec trucking industry is evolving in a very competitive environment. Since 1988, the Motor Vehicle Transport Act allows companies to operate freely and access to the industry is given to anyone asking for a permit. There is an exception with tip-lorry trucks for wood, sand, gravel and other aggregates which are still regulated. The industry is then characterized by fierce competition and slim margins. Some carriers, especially the more important ones, are complaining about some smaller carriers not respecting safety rules and other regulations (for instance, the amount of time drivers may work, weight and dimension rules, and equipment maintenance standards) and thus accuse them of unfair competition. Government is therefore pressured to more severely enforce those standards and rules.

After the 1988 industry economic deregulation, another shock came with the 1991-1992 recession hurting the Quebec and Canadian economies. Since then the industry has not recovered as it usually does after an economic slow down. In fact, the Free Trade Agreement with the United States has boosted transborder operations at a rate of about 10 percent yearly, while the other markets are showing very small growth if any.

Motor carriers from other Canadian provinces and American carriers are active in Quebec but they are respectively concentrated in interprovincial and transborder operations. The local and intra-Quebec markets are dominated by Quebec carriers. Quebec's geography is providing some level of protection to local carriers, the territory being characterized by a large area with low population density and some remote regions. Moreover, the flow of goods is unbalanced with finished goods being shipped by LTL (less-than-truckloads) from Montreal to the other regions, while unfinished goods are forwarded to Montreal in TL (full truckloads) shipments. This raises the possibility for regional general carriers to conduct both TL and LTL operations.

3.2 The Methodology

The survey on the use of new information technologies and decision support systems was conducted among the 270 for-hire carriers who are members of the Quebec Trucking Association (QTA). Some members of the QTA are private carriers, but they were not considered in the survey in order to keep the sample more homogeneous. This association comprises most of the major motor carriers in Quebec and a good percentage of the smaller ones. The different segments of the industry are represented, from general carriers to bulk liquids carriers, from TL to LTL specialists and from local to transborder carriers. Most are specialized in a given segment but there are some general carriers performing a combination of different types of transportation. The owner-operators and carriers of bulk products with tip-lorry trucks have their own respective associations and were left out of the survey.

Of the 270 questionnaires mailed out in February 1996, 48 were completed and returned, giving a response rate of 17.8%. The eight-page questionnaire was divided into four sections: company data, company specific activities, current and foreseen use of information and communication technologies, and current and foreseen use of decision support software and systems. It was sent to the executive listed in the QTA directory, who is, in most cases, the president. Approximately three weeks after the mailing, a follow up letter was faxed to each of the QTA members who had not responded yet.

3.3 Characteristics of Companies Surveyed

The survey sample obtained seems to reflect the variety of Quebec motor carriers. Of the 47 respondents to question 1, 34 (72.3%) had less than 100 employees and 13 had more than 100 employees, with an average of 117 and a median of 42. In terms of their 1996 operating revenues, 42.9% were under the \$5 million mark, 28.5% fell in the \$5-10 million range, 21.5% generated revenues of between \$10 and \$50 million, and only 7.1% exceeded \$50 million in revenues. The average annual revenue is \$12.4 million with a median at \$5.3 million.

The respondents included carriers with different specialization. Using a cluster analysis, we obtain the following five categories of carriers: 1) those that are primarily TL carriers ($n = 16$ or 34%), 2) those that are mainly LTL operators ($n = 6$ or 12.5%), the bulk carriers ($n = 12$ or 25%), general

carriers conducting both TL and LTL operations ($n = 11$ or 22%), and finally 3 carriers (6.3%) in the category listed as other activities (in fact these were movers).

Another differentiating characteristic is the geographical market in which motor carriers are involved. Again, using a cluster analysis, we get: 9 firms (19.1%) indicating that their primary geographical coverage is local, 17 (35.4%) that it is provincial, 6 carriers reporting that their primary geographical coverage is international (or transborder) and 7 (14.6%) covering both the Province of Quebec and other Canadian provinces. It leaves 9 non-specialized carriers (19.1%) covering all geographical markets!

These results indicate that a wide range of carriers replied to the survey although very small companies and owner-operators truckers are absent. Therefore, for the purpose of this study, it is reasonable to consider that this sample gives a good idea of the use of new information technologies and decision support systems by Quebec motor carriers.

4. Survey Results

4.1 Information Technologies

The present use of information technologies in the Quebec trucking industry varies considerably according to the type of technology as shown in Table 1. Communication technologies such as CB radios, cellular phones and tele pagers are widely used in the industry. However, these technologies are not expected to be utilized as intensively in the next 3 years as shown also in Table 1. On-board computers, and, to a lesser degree, tachymeters are also utilized by a fair percentage of respondents. But the more conventional tachymeter technology is expected to decline over the next 3 years. The use of internet and electronic mail is also significant and it is expected to grow considerably over the next 3 years. EDI is currently used by some 23% of respondents and its use is also expected to grow quite significantly in the near future. Finally, although satellite positioning is only currently used by roughly 9% of respondents, its use should also increase intensively by the year 2000.

Table 1 Present and Expected Use of Information Technologies

TECHNOLOGY	PRESENT USE (%)	EXPECTED USE WITHIN 3 YEARS¹			
Tachymeter	31.9	2.13			
Cellular Phone	57.4	2.90			
Tele Pager	31.9	2.59			
CB Radios	63.8	2.45			
Satellite Positioning	8.5	3.78			
On-board Computers	42.6	N/A			
EDI	22.9	3.69			
Bar Coding	6.3	3.53			
Internet	37.5	3.91			
Intranet	2.1	3.56			
Electronic Mail	22.9	3.58			
Electronic Imaging	2.1	3.54			
1	1 = Much less usage	2 = Less Usage	3 = Same Usage	4 = More Usage	5 = Much More Usage

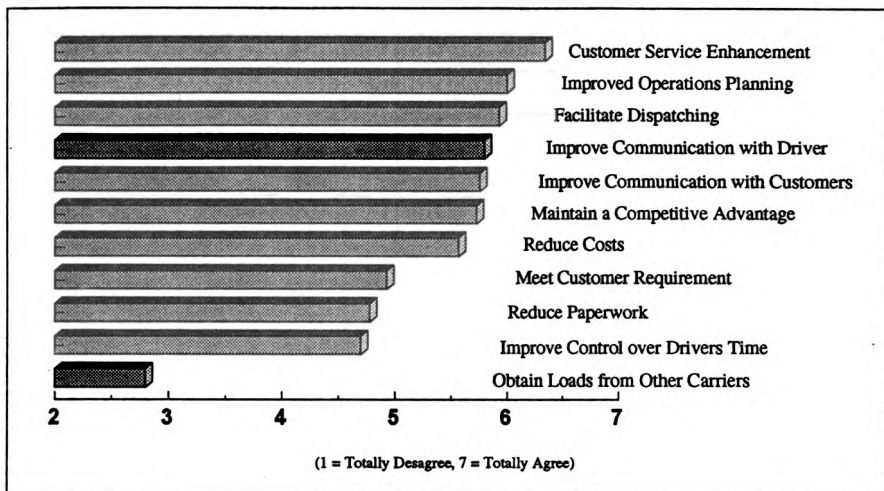
According to Table 2, information technologies are currently having a greater impact on the following motor carrier activities: billing, costing, dispatching and fleet management. However, during the next 3 years, the following functions will also be affected by the use of these technologies: vehicle routing and tracing, shipment tracing, and customer call answering services. As a result, the vast majority of respondents feel that information technologies will have an impact on such critical activities as dispatching, billing, costing and fleet management by the year 2000.

Table 2 Motor Carrier Activities Being Affected by Information Technologies

ACTIVITIES	AFFECTED NOW (%)	AFFECTED WITHIN 3 YEARS (%)	NOT AFFECTED (%)
Billing	57.8	33.3	8.9
Costing	46.5	37.2	16.3
Dispatching	43.5	47.8	8.7
Fleet Management	39.5	44.2	16.3
Shipment Tracing	33.3	41.0	25.6
Vehicle Tracing	28.9	42.1	28.9
Loading/Unloading	26.3	28.9	44.7
Vehicle Routing	25.6	48.8	25.6
Load Preparation	25.6	35.9	38.5
Answering Customer Calls	23.8	45.2	31.0

When asked for the reason why these information technologies were implemented, respondents insist on customer service enhancement, improved operations planning and communications with both drivers and customers. Cost reductions motives are only ranked seventh according to Figure 4. These results are not surprising when compared to the benefits obtained as a result of using these technologies. Indeed, on average, respondents report significant improvements in service quality and only small reductions in cost as a result of using information technologies.

Figure 4
Reasons Why Information Technologies Were Implemented



4.2 Planning Software and Decision Support Systems

As indicated in Figure 5 a majority of carriers is currently using some kind of computer software to assist them in making decisions regarding costing and pricing, equipment maintenance and dispatching. On average, they have been using these software since 1992-1993. The vast majority of these software systems were developed internally, often with outside assistance. Very few were purchased off the shelf. As far as the future is concerned, 55% of respondents claim that a higher percentage of revenues will be spent on software over the next three years while 43% believe that this percentage will remain the same.

Figure 5
Present Use of Software to Assist in Various Activities

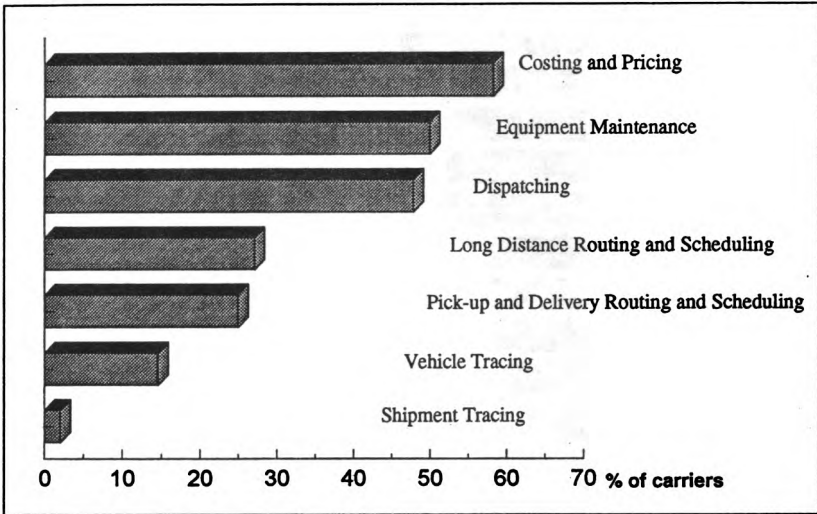
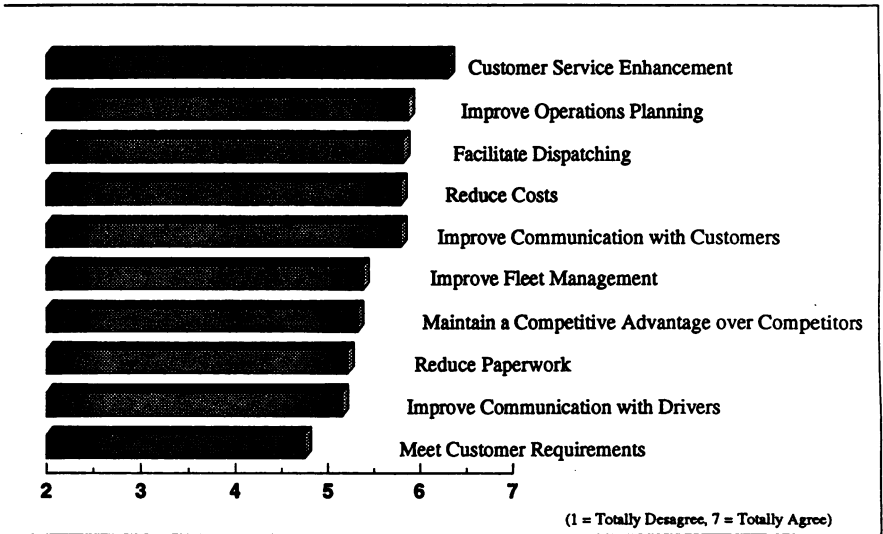


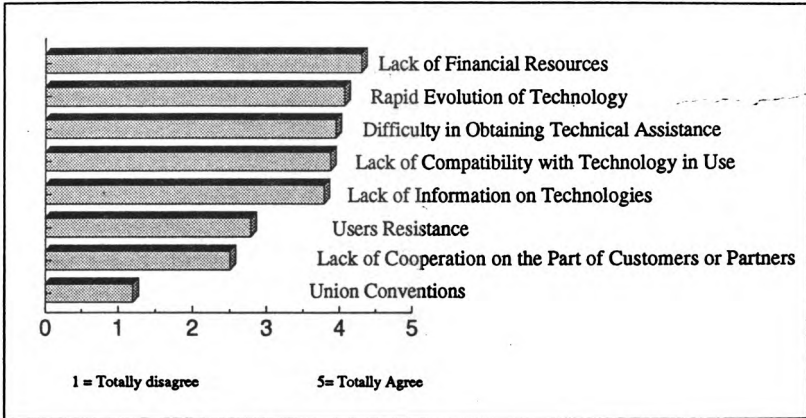
Figure 6 lists the motives behind the acquisition or development of computer software. It is interesting to note that the first three motives are the same as those advocating the use of information technologies as shown in Figure 4, namely: customer service enhancement, improved operations planning, and facilitating dispatch. The fourth motive, reducing costs, comes very close to the second and third ones. It seems likely that motor carriers have greater expectations with respect to increased efficiency when it comes to using computer software than they do as a result of using information technologies. Again, it looks like these motives translated into results. Indeed, 74% of respondents report either large or small cost reductions as a result of using computer software. Only 8% claim that costs have actually increased and 18% report no change. Furthermore, 95% of respondents claim that service quality has improved either to some extent or to a large extent as a result of using computer software or decision support systems.

Figure 6
Motives Behind the Use of Computer Software



Finally, when asked what obstacles are preventing or retarding the implementation of information technologies and decisions support systems, respondents are advocating the lack of financial resources, the too rapid evolution of technology, the difficulty in obtaining technical assistance, the lack of compatibility between new technology and the one currently in use, and the lack of information on new technologies (see Figure 7).

Figure 7
Obstacles Preventing or Retarding the Implementation of
Information Technologies and Decision Support Systems



4.3 Major Findings

Motor carriers' use of new information technologies and decision support systems is certainly increasing. Meanwhile it is interesting to analyse the differences between carriers in their use of these technologies.

Not surprisingly, large (more than 100 employees) and small carriers (less than 100 employees) are showing some differences, but not as much as could be expected. Looking at information technologies, the use of on-board computers and communication devices are quite the same for both small and large carriers. The reasons for acquiring these technologies are also alike. Large carriers are yet greater users of EDI and internet. A second difference is the expected use of these technologies within 3 years, which appears to be more important for the large carriers.

The differences between small and large carriers are more significant when the use of software applications for decision support systems is considered. The larger firms are using that kind of tools a lot more than small companies. Moreover, they are greater users of on-line (real-time) applications for

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dispatching and pricing, for instance. But, for both groups of users, the motives for adopting these systems are much the same.

As illustrated in figures 4 and 6, cost reduction is not the main motive for acquiring new information technologies and decision support systems. Customer service enhancement is the main reason, improved operations planning and communications with both drivers and customers being important incentives as well. This is emphasizing the importance of the following: the development of third party logistics, the redefinition of the type of relationships between carriers and their customers, and the impact these issues have on the use of information technologies.

The survey shows that an important number of respondents offer other services than transportation: 42.5% are offering warehousing services, 67.5% can take charge of their customers distribution problems, and 25.0% can even offer complete logistics support to their customers. Thus it is possible to conclude that a part of the Quebec trucking industry is evolving towards integrated services and value added activities.

Third party logistics also means shippers are going to work with a smaller number of carriers when it is not with a single one. From the carrier's point of view this will mean that a larger share of revenues will come from fewer customers. Actually, in average, the 10 most important customers generate 65% of total revenues. The median is even higher at 77.5%, which means that many carriers are really doing business with a limited number of shippers.

Partnerships between carriers and shippers thus appear to be an important phenomenon. When asked if they were engaged in some form of collaboration or partnership, respondents replied as follows: 70.8% were engaged into partnership with some customers, 58.3% with some other motor carriers, 27.1% with other logistics specialists and 10.4% with carriers from other transportation modes.

Are these new relations between motor carriers and shippers an incentive for using new information technologies? Our analysis shows at least one significant correlation: all of the 10 carriers using EDI are also involved in partnerships with some customers. This also suggests that you don't use

EDI if you are not involved in that kind of collaboration, which is the case for 12 carriers. Nevertheless, the correlation with other technologies and decision support systems is yet to be determined.

CONCLUSION

We have reviewed some of the main information technologies and their utilization in the motor carrier industry, and more specifically their use by Quebec trucking companies. It appears that a number of such technologies are increasingly being used and, as a result, that "virtual" integration between shippers and carriers, as well as customer service improvements and productivity gains may be observed. It also appears that the information revolution is just taking off. Not all carriers are at the same level of intensity or sophistication with respect to the integration of information technology to their operations. These differences are even more evident concerning the use of decision support systems and planning software.

What appears to be a major factor in the decision to use information and decision technologies is the presence of more formal relations between carriers and their customers. Not surprisingly, third party logistics implies better communications between organizations working together. But it also means that communication and decision processes within the organization have to be improved. Doing business as partners can be more complicated than doing business as competitors. Motor carriers need better tools to respond more quickly to their customer's requirements and to deal with the unavoidable hazards of transport and logistics.

References

- Allen, J.B., R.M. Crum and D.C. Brauschweig, "The US Motor Carrier Industry: The Extent and Nature of EDI Use", *International Journal of Physical Distribution and Logistics Management*, vol. 22, no 8, 1992, pp. 27-34.
- American Trucking Association, "EDI Capable Carriers, Technology in Trucking", Management Systems Council, ATA, 1995.
- Anderson, D.L., L.M. Hebert and D.H. Hess, "Changing Service Value Through Technology and Information : A Less-Than-Truckload Perspective", Proceedings of the Council of Logistics Management Annual Conference, Cincinnati, Ohio, October 16-19, 1994, pp. 241-258.
- Cohen, W., "Taking to the Highway", *US News and World Report*, September 18, 1995, pp. 84-87.
- Emmelhainz, M.A., *Electronic Data Interchange*, Van Nostrand Reinhold, 1990.
- Giannopoulos, G.A., "Mobile Data Communication and Electronic Data Interchange, Technology in Road Freight Operations in Europe: An Evaluation of Some Pilot Applications", Proceedings of the 75th Annual TRB meeting, Washington, Jan. 7-11, 1996.
- Gopal, C. and M.L. Fox, "Electronic Commerce and Supply Chain Reengineering", Proceedings of the Council of Logistics Management annual conference, Orlando, Oct. 1996.
- Hall, R.W., "Application of Computer Integrated Transportation (CIT) to Commercial Vehicle Operations", Proceedings of the 75th Annual TRB meeting, Washington, Jan. 7-11, 1991.
- Johnson, A.D., J.B. Allen and M.R. Crum, "The State of EDI Usage in the Motor Carrier Industry", *Journal of Business Logistics*, vol. 13, no 2, 1992, pp. 43-68.
- Ratiff, H.D., "Logistics Management: Integrate your way to an approved bottom line", *III Solutions*, Vol. 27, no 10, October 1995, pp. 31-33.
- Sunstrum, A.L. and F.H. Howard, "Strategic Alliances Enabled by Electronic Commerce", Proceedings of the 31st Annual Meeting of the Canadian Transportation Research Forum, Winnipeg, Canada, May 26-29, 1996, pp. 252-265.
- Udo, G.J. and G.C. Pickett, "EDI Conversion Mandate: The big problem for small businesses", *Industrial Management*, Vol. 36, no 2, March/April 1994, pp. 6-9.
- Walton, L.W., "Electronic Data Interchange (EDI): A Study of its Usage and Adoption within Marketing and Logistics Channels", *Transportation Journal*, vol. 34, no 2, 1994, pp. 37-45.