

Perception of the benefits of using tracking systems by trucking companies

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ABSTRACT: This article evaluates the perception of trucking companies in the Curitiba metropolitan area about the efficacy of using fleet tracking devices. Trucking company owners and managers were surveyed through a structured questionnaire containing ten items, with responses scored on a Likert scale, in which the respondents were asked to express their level of agreement or disagreement. At the end there was a question asking them to rank the factors in favor of using tracking systems from most to least important. The main factor motivating the use of tracking systems was found to be to reduce hijackings, although the respondents in general considered that this does not eliminate the need for insurance for the vehicle and the load. Another important finding was the perception that information technology, particularly real-time tracking, is important to improve fleet management and to control the logistics flow.

Key words: Logistics, transport, fleet tracking, GPS

Received in 11/20/2008; revised in 11/01/2009; accept in 05/18/2010.

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1. INTRODUCTION

Transport plays a key role along the entire supply chain, because products are rarely manufactured and consumed in the same place. It is also a significant component of the costs incurred in most supply chains. Freight movement absorbs between one-third and two-thirds of logistics costs (Ballou, 2001; Nohara & Acevedo, 2005). According to Abrahão & Soares (2007) transport costs accounted for 60% of total logistics costs in Brazil in 2004, as shown in Figure 1. The composition is also subject to the effects of the economic situation. With the easing of interest rates in Brazil over the past two years (directly affecting inventory costs) and the increase in fuels prices, transport costs have become even more relevant in the composition of overall logistics costs.

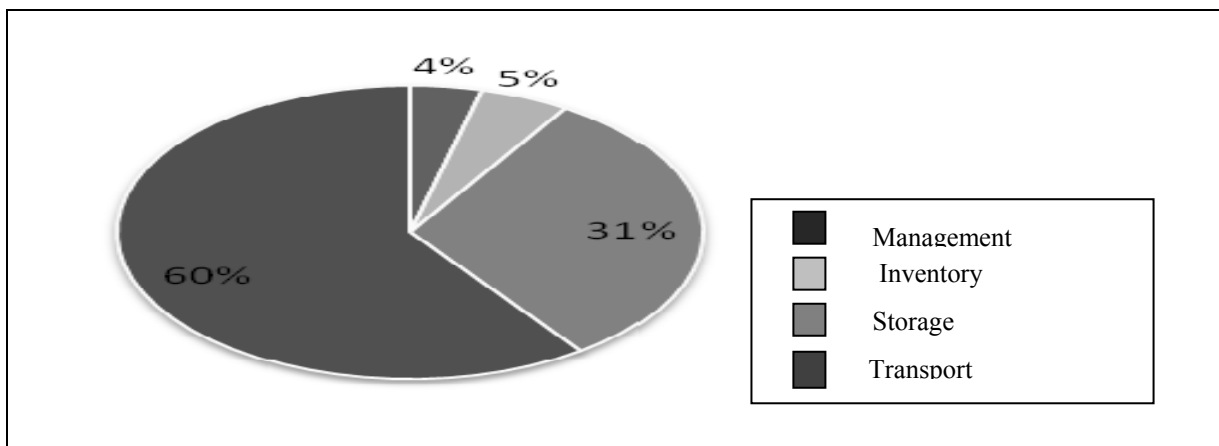


Figure 1: Composition of logistics costs in Brazil
Source: Abrahão & Soares, 2007, p. 2.

For Ballou (2001), transport operations typically receive considerable attention because of their importance and high cost. For this reason, nearly all industrial firms, no matter their size, have one or more managers specifically responsible for transport, whether this is done by the company's own fleet or by hiring outside trucking companies (BOWERSOX et al., 2006).

Among the most important current developments to improve transport activities is investment in information technology, to facilitate planning and control of the operation. Nevertheless, according to Nazário et al. (2000) even with modern technologies that permit exchanging information in real time, cargo transport continues being fundamental to attain the objective of logistics, which is to supply the right product, in the correct quantity, in the right place, at the right time and at the lowest possible cost. Trucks are the main means of cargo transport in Brazil.

This predominance dates to government programs in the 1950s and 60s to build highways and to encourage international auto and truck makers to establish factories in Brazil (Neves, 2005). Currently about 60% of the country's freight is carried by trucks (CNT, 2003). The continuing predominance of this mode of transport is mainly due to the lack of investment in railroads, waterways and coastal shipping.

In a recent article on the prices charged to haul freight, Hijjar (2008) stated these are largely determined freely by the market. Since competition is fierce, the margins are low (Lima, 2006). Managers of companies that ship products need to stay informed about the latest trends in the segment and compare the prices their companies pay against those charged by other logistics firms for the same type of service.

To remain competitive, trucking companies need to make substantial investments to reduce costs and increase efficiency. In the past 20 years, information technology (IT) has made a major contribution to enhance the efficiency of logistics services, generating significant returns on the investments made by trucking companies (Meinberg, 2001, Bouzon & Corrêa, 2006).

According to Bouzon & Corrêa (2006), IT is an essential resource for a modern company, because it permits reducing costs and even providing services that were previously unimaginable, thus generating competitive advantages. In the same vein, Vilardaga (2006) stresses that IT enables firms to change their *modus operandi*, bringing positive impacts on planning, execution and control of logistics, enabling trucking companies to reduce costs and raise their profit margins.

According to Oliveira et al. (2006), among the various technologies available to trucking companies, IT has the most significant impact, making it an essential tool to assure adequate performance. Therefore, the decisions of these companies' managers on the results of implementing new information technologies focus on the competitive edge they provide. Further according to these authors, this edge is directly related to the information quality, since precise and timely information permits rapid operational responses and increases the reliability of the provided services.

According to Nohara & Acevedo (2005), vehicle tracking is one of the most useful information technologies in the transportation industry, by allowing managers to optimize the movement of vehicles and increase security and efficiency. In general, each truck is equipped

with a GPS (global positioning system) receiver and a transmitter that permits exchanging messages between the vehicle and a control center.

Besides geographic location (latitude and longitude), the GPS device can accurately determine the truck's speed. Tracking systems generally allow around-the-clock satellite monitoring. The precision of the GPS receiver can vary depending on the equipment quality, from the tens of meters down to the centimeter range (Akabane & Nunes, 2004).

According to the authors, GPS systems substantially improve the reliability and security of logistics operations, since they permit making route corrections and detecting any unusual stops or deviation from the planned route.

This allows reacting to last-minute changes in plans at minimal cost, making the service more flexible. Besides this, the speedy detection of anything abnormal in cargo movement can keep a simple logistics error from turning into a major problem (Corrêa et al., 2005). Another big advantage of tracking systems is the ability of trucking companies to provide their customers – cargo owners – with real-time information on the progress and estimated time of arrival of their loads, a necessity for just-in-time (JIT) production systems.

As can be seen, transport has a standout position among supply chain logistics activities, making it important to invest continuously in methods to improve its control and management to make it more effective. Information technology thus provides a wide array of tools that help improve management of transport in general, among which vehicle tracking deserves special attention.

This article presents the results of a survey conducted among trucking companies in the metropolitan area of Curitiba, the capital of the southern Brazilian state of Paraná, on their perception of current vehicle tracking technologies, to identify their real contribution to improving operational performance.

The aspects considered are: route control; fleet management; logistics coordination; elimination of the need for insurance; reduction of insurance cost; driver safety; and ability to offer higher-value service to customers.

A survey of this type is justified from a practical standpoint by the possibility of disseminating the potential of this technology to other trucking companies and logistics service providers if the respondents consider it to be effective, considering that it is a tool readily available in the market, nowadays.

On the other side of the coin, any negative perceptions can provide valuable input to allow improving the service, and hence serve as a guide to vehicle tracking service providers in their investment decisions. Although there is a substantial literature on logistics and transport management, both from an academic and practical business perspective, there are few such scientific studies in Brazil on the contribution of vehicle and cargo tracking systems, especially from the user's viewpoint. This work contributes to reduce this lack of knowledge.

We should stress that this study was not designed to assess the management or service quality of the surveyed trucking firms. Our aim was to identify the perception of trucking company owners and managers about the quality and usefulness of tracking systems in allowing them to meet their business objectives.

This article is divided into five sections including this introduction. The next section discusses some previous studies on the theme. The third section then explains the methodology utilized, and the fourth section presents and discusses the results. The fifth section contains our final considerations, some limitations of this study and suggestions for further research.

2. THEORETICAL FRAMEWORK

Based on an extensive study of a large Brazilian trucking company, Aguilera et al. (2003) concluded that vehicle monitoring and tracking systems were adopted mainly because of concern over the increasing number of cargo robberies, as a way to improve risk management.

In a similar study, Malinverni (2005) found that the utilization of tracking systems in Brazil, unlike in many other countries, evolved mainly because of concerns over hijackings. Likewise, Moura & Hamacher (2004) found that tracking systems are mainly used in Brazil to minimize cargo/vehicle robbery and thus lower vehicle and freight insurance costs. Because of the prevalence of hijackings in the country, trucking firms, cargo owners and insurance companies see tracking systems as a significant new technology to reduce losses (Malinverni, 2005; Cardoso, 2001).

According to a report from a special congressional investigating committee impaneled to examine cargo robbery, transport companies suffered losses of roughly R\$ 700 million in 2001 (CNT, 2003). Further according to CNT (2003), between 2001 and 2003, over 200 firms went bankrupt due to problems generated by cargo robbery, and in 2003 alone there were more than 11,000 truck hijackings in the country.

In an article published in one of the main Brazilian trucking industry magazines, Giopato (2005) stated that one of the ways found by trucking companies as well as independent owner-operators was to equip their vehicles with tracking devices. Further according to the article, insurers consider these systems when setting the premiums charged on vehicle and cargo insurance. It is evident, then, that the introduction of tracking systems in Brazil was promoted mainly by concerns over robbery, unlike in many other countries, where improvement of logistics processes was the determining factor.

But even though security is the fundamental factor for investing in tracking systems, Brazilian truck owners and operators have enjoyed other benefits. In a field study of nine trucking companies in the Campinas and São Paulo metropolitan areas, Belizário et al. (2002) found intensive use of information technology. The study focused on large companies, those with over 450 trucks, 1000 employees and annual revenue of at least R\$ 50 million. All of these firms had tracking systems and monitoring centers.

A similar study by Akabane & Nunes (2004) concluded that satellite tracking and communication systems, because of the greater connectivity and visibility, allowed client companies to control their inventories and schedule distribution and production more efficiently, essential advantages for companies working with a JIT strategy.

The systems allowed trucks to be redistributed or diverted in cases of unexpected shifts in demand or production problems. Kilpala et al. (2006) studied the type and level of IT use by logistics service providers in Finland, Norway and Sweden. They concluded that although there were important differences in the information technology adopted by the various firms in each of these countries, GPS was uniformly used in all three countries.

Oliveira et al. (2002) presented an interesting study in which they applied multi-criteria analysis to select actions to improve supply chain management, seeking to reduce or eliminate the most common logistics problems.

The study assessed the importance of 25 criteria in function of three aspects: cost, return on investment and efficacy. Of these 25 criteria, the implementation of a GPS tracking system was the second most important, behind only the criterion that guides the periodic report (ideally twice a day) of industrial production in the materials requirement planning (MRP) system.

The study found that the return obtained from tracking systems could be as high as three times the initial capital outlay. According to May (2006), many companies when

analyzing whether or not to adopt a GPS system only consider the return on the investment. But this is difficult to pin down, because unlike other outlays, such as to buy tires, the benefits of a tracking system include many less tangible factors, which are hard to measure. Macohin et al. (2003) presented a survey of the new competitive factors among Brazilian trucking companies.

They provided respondents with a checklist containing 160 items, divided into six main groups. GPS tracking was considered an important competitive factor related to six of these items. In the next section, we discuss the methodology, to allow a better understanding of the obtained results.

3. METHODOLOGY

The survey was based on a questionnaire containing ten questions, scored on a Likert scale, to be answered exclusively by owners or managers of firms with tracking systems installed on at least six trucks, along with a question allowing the respondents to rank the reasons for using or not using such systems, which could be answered both by users and non-users.

We chose transport companies with fleets consisting of light-duty, medium-duty, semi-heavy-duty and extra-heavy-duty trucks. We classified the firms into small (up to five trucks), medium (from six to thirty trucks) and large (more than thirty trucks), according to the criterion generally used in Brazil by truck dealerships.

We chose the firms to be approached in the survey from among the customers and prospective customers of a truck dealership located in the city of Curitiba. We first made telephone contacts with the person in charge of each firm to invite them to participate in the study. We then sent the questionnaire by e-mail to those who expressed willingness to participate.

Of the 51 questionnaires sent, 21 were answered within a month. We then sent a follow-up message to the firms that had not responded, but only obtained three more responses, a disappointing result. So we decided to print hard copies of the questionnaires and personally visit the companies. This resulted in a further 21 responses, for a total of 45 questionnaires answered. Mainly because of the decision to visit the firms, the data gathering period wound up taking six months instead of the 45 days originally planned, from August 2007 to February 2008.

The final response rate (45 of the 51 companies originally approached) was good. The main reasons for the good response rate were the previous relationship between the interview subjects and one of the authors, who works for the truck dealership mentioned above, and the persistence to pay personal visits to the firms that had not answered the electronic version of e questionnaire.

The items on the questionnaire were formulated to allow for the identification of the level of perceived contribution of the use of fleet tracking system to improve logistics processes.

The items covered the following aspects: route control to avoid deviations by the driver; fleet control and management; logistics coordination; elimination of the need to contract insurance; reduction of insurance costs; security against theft of the cargo and/or truck; driver safety; and added value services to clients. Chart 1 below presents the items on the questionnaire. The respondents had to choose from among the following responses on questions 1 to 10: "strongly agree", "agree", "neutral", "disagree" and "strongly disagree". The final question asked them to rank the various aspects in order of importance.

Preliminary questions

Respondent's position: _____

Supplier of the tracking system (if used): _____

Likert scale items

If your company uses a tracking system, for each of the following statements please indicate your level of agreement or disagreement:

1. We use tracking devices on our trucks because the insurer gives us a discount on the premium.
2. Our company was worried about the possibility of drivers deviating from their routes for personal reasons.
3. Using the tracking system means we can forgo insurance against robberies, which provides savings.
4. Knowing the load's exact location enables better coordination of deliveries with other activities.
5. Our clients require (or prefer) to have their products carried by trucks equipped with tracking devices.
6. The tracking system helps us control and manage our fleet.
7. We use the tracking system to keep our trucks from being hijacked.
8. Tracking allows us to add more value to our services, so we can charge more.
9. Our drivers feel safer working with a tracking system on board of the trucks.
10. The tracking systems available in the market today are very efficient.

Degree of importance item

11. Even if your firm does not use tracking devices, please rank the factors that in your opinion justify the use of cargo tracking systems, from the most important (1) to the least important.

- () route control, to avoid deviations by the driver
- () fleet control and management
- () logistics coordination
- () elimination of the need for insurance
- () reduction of insurance cost
- () security against losing the cargo and/or truck to thieves
- () safety for the driver
- () service with greater value for clients

CHART 1 – QUESTIONS ANSWERED BY THE SURVEY PARTICIPANTS

Source: Authors.

4. ANALYSIS OF THE RESULTS

The sample consisted of companies of all sizes. Chart 2 below shows the composition according to fleet size.

Up to 5 vehicles (small): 8 companies
6 to 30 vehicles (medium): 24 companies
More than 30 vehicles (large): 13 companies

CHART 2 – COMPOSITION OF THE SAMPLE ACCORDING TO FLEET SIZE

Source: Authors.

Among the respondents, twelve were the firms' owners, four were directors, fourteen were maintenance managers, four were fleet managers and eleven occupied other positions, most of whose job titles related to logistics. Hence, all of the respondents were in a position to provide well-informed answers to the questionnaire's items. Only five of the companies stated that they had not yet implemented tracking systems.

This shows that the technology is widely spread. We analyzed whether the choice not to use the technology was in some way associated with firm size, based on the premise that smaller companies have less capital to invest in more sophisticated technologies.

We found that the non-user companies were all either rated as small (one) or medium-sized (four), the largest of which had eleven trucks. This indicates that size possibly does have an influence on the issue. All the same, seven of the eight small firms (with up to five trucks) already used a tracking system, indicating that these systems are not beyond their reach. Chart 3 below presents the suppliers of the tracking systems used by the surveyed trucking companies.

Equipment supplier	Number of companies that use the system
Autotrac	12 (30%)
Sascar	10 (25%)
Jabur Sat	5 (12,5%)
Control Loc	4 (10%)
Rodosis	3 (7,5%)
Lo Jack	3 (7,5%)

CHART 3 – SUPPLIERS OF TRACKING SYSTEMS AND PERCENTAGE OF USE BY THE SAMPLED COMPANIES

Source: Authors.

Note 1: Some companies use more than one supplier.

Note 2: Ten other suppliers were cited only once each and are not listed here.

We first tallied the responses to the five alternatives: "strongly agree", "agree", "neutral", "disagree" and "strongly disagree". Chart 4 shows the frequency of each of these responses for items 1 to 10.

Item	1	2	3	4	5	6	7	8	9	10
Strongly agree (5)	4	7	1	21	12	19	14	3	7	3
Agree (4)	19	18	3	16	19	16	20	14	21	14
Neutral (3)	8	7	7	3	7	4	4	10	6	11
Disagree (2)	6	5	20	0	2	1	2	11	6	11
Strongly disagree (1)	3	3	9	0	0	0	0	2	0	1

CHART 4 – RESPONSES OBTAINED TO ITEMS 1 TO 10

Source: Authors

We then assigned a score to each of the responses, from 5 for “strongly agree”, 4 for “agree” and so on, down to 1 for “strongly disagree”. The loosening of the methodological rigor (conversion of ordinal into scalar measurements) by this scoring scheme is often used in scientific studies based on Likert scales. This permitted calculating the mean and standard deviation of each response.

As can be seen in Chart 5, items with average scores above 3 indicate a tendency of the respondents to agree with the statement, while averages below 3 reflect a tendency to disagree. Although the distribution of responses is far from normal (something that is practically impossible when using a Likert scale, especially a five point one), the sample size is large enough to apply Student’s t-statistic to calculate the confidence intervals for the mean of the responses.

Item	1	2	3	4	5	6	7	8	9	10
Mean	3.38	3.53	2.18	4.45	4.03	4.33	4.15	3.13	3.73	3.18
Standard eviation	1.10	1.15	0.96	0.64	0.83	0.76	0.80	1.07	0.93	1.01
Confidence interval	3.02 to 3.73	3.16 to 3.89	1.87 to 2.48	4.25 to 4.65	3.76 to 4.29	4.08 to 4.57	3.89 to 4.41	2.78 to 3.47	3.43 to 4.02	2.85 to 3.5

CHART 5 – RESPONSES TO ITEMS 1 TO 10

Source: Authors

Note 1: $\alpha=0.05$.

Note 2: For items 8 and 10 the center of the scale (3.0) lies within the confidence interval, preventing inferences about general agreement or disagreement of the respondents about these statements.

Analysis of items 1 and 2: “We use tracking devices on our trucks because the insurer gives us a discount on the premium” and “My company was worried about the possibility of drivers deviating from their routes for personal reasons”.

The majority of the respondents “agreed” with these statements. However, few agreed strongly, indicating these are not issues that users of tracking systems believe to be highly important. These responses are broadly similar to those found by Malinverni (2005), Cardoso (2001) and Moura & Hamacher (2004), whose works were discussed above.

The fact that insurance underwriters are requiring the use of tracking systems, or at least giving discounts on coverage for firms that use them, evidences the belief that these systems are an effective means to discourage theft of the cargo and/or vehicle.

The respondents also believe the systems discourage their drivers from deviating from the planned route for personal reasons, such as to visit relatives or friends, and from stopping at roadside bars and nightclubs along the way. This result also agrees with the finding of Akabane & Nunes (2004) with respect to the precision of locating trucks equipped with tracking devices.

Analysis of item 3: “Using the tracking system means we can forgo insurance against robberies, which provides savings”. The majority of the respondents “disagreed” or “strongly disagreed” with this statement. Only one participant fully agreed, leading to the assumption the company had decided to drop insurance coverage after contracting the tracking service.

This result strengthens that of the first item, indicating that the use of tracking systems often occurs at the behest of insurers (Moura & Hamacher, 2004), which naturally would not urge their use if they believed this would eliminate the need for freight insurance altogether.

Analysis of items 4 and 6: “Knowing the load’s exact location enables better coordination of deliveries with other activities” and “The tracking system helps us control and manage our fleet”. The majority of the respondents “strongly agreed” or “agreed” with these two statements. Only one respondent indicated disagreement with the sixth item and none strongly disagreed with either of them.

This result indicates that the respondents believe tracking systems are able to improve their logistics processes and management, corroborating the increasing importance of such systems to improve the performance of logistics systems. This fact has also been noted by various of the authors mentioned in the literature review (Oliveira et al., 2002; Macohin et al., 2003; Akabane & Nunes, 2004).

Analysis of items 7 and 9: “We use the tracking system to keep our trucks from being hijacked” and “Our drivers feel safer working with a tracking system on board of their trucks”. The responses to these two items show that most participants “agreed” or “strongly agreed” with these statements as well. None of them “strongly disagreed” with these two statements.

This result also strengthens that of the first item, because it shows that the respondents – like insurers – believe tracking systems are effective at preventing hijackings, with theft of the load and/or the truck. Prevention of hijacking is an important reason in Brazil for installing tracking devices, as found by several authors (Cardoso, 2001; Aguilera et al., 2003; Malinverni, 2005; Giopato, 2005).

Analysis of items 5 and 8: “Our clients require (or prefer) to have their products carried by trucks equipped with tracking devices” and “Tracking allows us to add more value to our services, so we can charge more”. The analysis of the responses to these items shows that in the respondents’ opinion, clients want to hire trucking companies that have tracking systems. But the opinions were divided over whether this allows charging more for the service, since sixteen respondents “agreed” or “strongly agreed” and thirteen “disagreed” or “strongly disagreed” with the statement in item 8 (while ten were neutral).

This corroborates the observations about the setting of freight rates in the trucking market made by Hijjar (2008) and Lima (2006), namely that competition is fierce and margins are narrow. The great dispersion of responses caused the confidence interval about the mean to include the central point on the scale (3.0), which does not permit inferring the predominance of either disagreement or agreement with the statement (see Chart 5).

To a certain degree these results are in line with our expectations, based on the findings reported in the literature review section. In the first place, the practice of giving discounts on cargo insurance by underwriters (Moura & Hamacher, 2004) when the cargo owner contracts carriers that have a fleet tracking system explains the result obtained for the fifth item.

Second, the use of tracking devices by trucking companies has become a commodity, which justifies the result on the eighth item. As Slack (1999) explained in a generic way, having a tracking system may at first have been an “order winner”, but it soon became a “qualifier” after these systems became common and expected in the market.

Analysis of item 10: “The tracking systems available in the market today are very efficient”. The opinions on this item were also mixed: seventeen respondents “agreed” or “strongly agreed” with the statement, but eleven were neutral and twelve “disagreed” or “strongly disagreed”.

This result reveals something interesting, and to a certain extent not envisioned when we prepared the questionnaire. In this case the dispersion of responses also caused the central point of the scale (3.0) to fall within the confidence interval, preventing inferences on general agreement or disagreement with the statement (see Chart 5).

Perhaps the most surprising aspect is that the respondents in general agreed, in some cases strongly (see the responses to items 4 to 7, for which there was practically no

disagreement), with statements that emphasized the benefits brought by cargo tracking, but this was not reflected in the perception of the quality of the solutions.

This apparent paradox needs further study. It is possible that there is some relation between the equipment supplier, or the type of system, and the perception of unsatisfactory quality. This might also result from inadequate training of users, not allowing them to take full advantage of all the resources available. Another possible explanation is deficient logistics processes by the trucking companies, even though the systems provide good information. Figure 2 below graphically represents the information on the level of agreement with the ten items on the Likert scale presented in Chart 4 and discussed in this section.

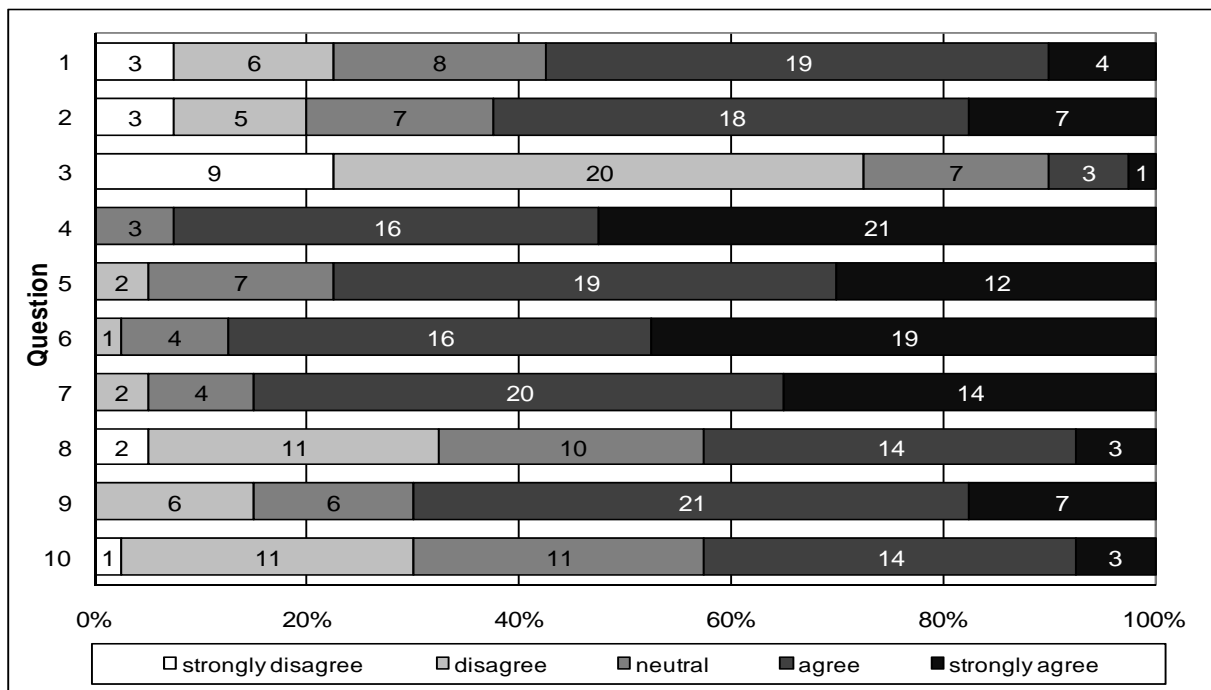


Figure 2: Responses obtained
Source: Authors

On the whole surveyed companies were favorable to the use of tracking systems. The number of favorable responses was greater than the unfavorable ones for all items except the third. Consensus was particularly strong regarding better coordination of deliveries with other activities (item 4), the requirement (or preference) of clients for trucks equipped with tracking devices (item 5), the possibility of more effectively controlling and managing the fleet (item 6) and the prevention of hijackings (item 7).

The last item on the questionnaire was prepared to permit an analysis of the relative degree of importance of eight alternatives justifying the use of tracking systems, in the eyes of the respondents. They had to rank the alternatives from most important (1) to least important

(8). Chart 6 shows the results. Each line shows the number of respondents who defined the degree of importance indicated in the first column for the alternative of the particular column (indicated in the heading).

Importance	Control of route deviations	Fleet control and management	Logistics coordination	Elimination of the need for insurance	Reduction of the cost of insurance	Security against hijacking	Driver safety	More valuable service
8	5	1	2	24	2	1	2	3
7	6	3	5	6	10	3	5	4
6	5	1	5	4	6	5	3	12
5	3	7	3	4	8	2	10	7
4	4	6	5	1	5	7	7	6
3	8	6	7	1	8	7	7	5
2	11	9	10	2	4	5	6	5
1	3	12	8	2	2	15	5	2
M	4.3	3.2	3.7	6.7	4.8	3.2	4.1	4.8

CHART 6 – RESPONSES TO THE QUESTION ON THE FACTORS THAT JUSTIFY USING TRACKING SYSTEMS

Source: Authors.

Note 1: M = weighted mean, 1 = most important; 8 = least important.

Note 2: The weighted mean only makes sense assuming that the ordinal sequence can be substituted by a scalar sequence, i.e., that the distance between two options is always constant (which once again represents a loosening of the methodological rigor of the study).

The weighted averages for each alternative are presented in the bottom line. We analyzed the results from two perspectives. First we present an analysis of the factors considered least important, which thus had higher weighted averages. Then we present the analysis of the factors considered most important by the respondents.

Analysis of the least important factors: The results in Chart 6 show that “elimination of the need for insurance” was considered the least relevant among all. This result indicates that the use of tracking systems, although reducing the chances of being robbed (as discussed before), does not eliminate the need to insure the cargo and vehicle against hijacking. It is possible to infer that the need for insurance continues to exist because of other possible loss events, particularly traffic accidents, over which tracking systems have smaller impact.

The second least important factor indicated by the respondents was “reduction of insurance cost”. This result indicates that even though insurers charge lower premiums when carriers use tracking systems, as discussed in the literature review (Moura & Hamacher, 2004), this discount is not that important in the decision to use a tracking system.

Analysis of the most important factors: As can be seen in Chart 6, “security against hijacking of the cargo and/or truck” and “fleet control and management” are the most important in the respondents’ perception. This combination of most relevant factors came as

a surprise to us. We believed that the acquisition of a tracking system was still prompted mainly by questions related to security (Cardoso, 2001; Aguilera et al., 2003; Malinverni, 2005; Giopato, 2005) and that the possibility of better fleet control would only be a positive “side effect”, perceived *a posteriori*. However, the respondents considered the two reasons equally important for a decision to use fleet tracking.

5. CONCLUSIONS

The results of this survey among trucking company owners and managers were in general in line with the findings reported in the previous literature. Nevertheless, some results represent important findings.

Although the sample was composed only of the actual or potential customers of a single truck dealership, we believe the fact that it sells a wide range of vehicles, from light-duty to super-heavy-duty trucks, means the sample was not overly skewed. In other words, there are no reasons to believe that the respondents are any different to the general population of trucking companies operating in the study region. Therefore, we believe the results obtained can be extrapolated with relative security to the universe of all cargo carriers in the Curitiba metropolitan area.

The responses show that tracking technology is well disseminated and is no longer only feasible for large companies. It is also evident that this general use of tracking systems by providers of transport and logistics services means it no longer represents a big competitive advantage. Instead, in many cases it has become a requirement for cargo owners to hire a trucking firm.

Analysis of the more specific results shows that two main factors prompt companies to use tracking systems: an effort to increase security against hijacking and an attempt to improve logistics coordination and fleet control. These factors seem to be equally important. This is a valuable finding, since it indicates there is a good level of awareness within trucking companies of the strategic importance of logistics coordination, seeing as how tracking systems were initially adopted in Brazil mainly to reduce hijacking.

Future studies can examine in more depth the reasons for firms to use tracking systems and might well reflect diverging opinions on the efficacy of these systems. We believe this can be related to the quality of the service offered by the many vendors or the type of system utilized (some communicate via satellite, others by cellular phone or radio). It is also possible

that the perception of unsatisfactory quality partly results from a lack of user training in all the system's resources. The data analyzed in this study do not shed light on this question.

Another interesting aspect that can be analyzed in future studies is whether there are significant differences in the perception of the utility of tracking systems according to the size of the company. In this study we did not try any segmentation in this respect, because the sample was too small to provide any statistically significant evidence. It would seem that larger companies should consider fleet management and logistics coordination to be more important factors than small firms would.

Despite the interesting results obtained, this study has some limits that reduce the broadness of its conclusions. The main one is that we used a regional sample, represented by customers and potential customers of a single truck dealership, which sells models from only one maker. This limits the ability to make inferences, mainly in the case of carriers operating in other regions of the country.

In the final analysis, we believe this examination of the use of fleet tracking systems is relevant to stimulate debate on the importance of these systems, not only for reasons of operational security, but also for more strategic motives of logistics coordination and integration. Transport is obviously fundamental to the logistics of the great majority of productive endeavors, and using the state of the art in tracking systems to improve the efficiency and flexibility of the services rendered can make trucking companies, their clients and the country's entire economy more competitive.

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