JISTEM - Journal of Information Systems and Technology Management
Revista de Gestão da Tecnologia e Sistemas de Informação
Vol. 9, No. 3, Sept/Dec. 2012, *pp.541-562*
ISSN online: 1807-1775
DOI: 10.4301/S1807-17752012000300006

IMPROVING LOGISTICS SERVICES THROUGH THE TECHNOLOGY USED IN FLEET MANAGEMENT

Mauro Vivaldini
Silvio R. I. Pires
Methodist University of Piracicaba – UNIMEP, Brazil
Fernando Bernardi de Souza
São Paulo State University Júlio de Mesquita Filho– UNESP, Brazil

---

ABSTRACT

Outsourcing logistics has established itself in the area of the LSP (Logistics Service Provider), which offers a range of services to its customers. In this line, transportation is characterized as one of the most important services, and therefore efficient fleet management is essential for establishing a high level of customer service. With advances in technology and vehicle tracking systems, this approach of management has gained new possibilities for the improvement of logistics services. By studying the specific case of an LSP, this paper investigates the use of these technologies in the management of their business and services. The results indicate that the LSP seeks to increase its services and to streamline information in order to respond to customer needs in real time. It is also evident in this case under study that the combination of the technology available together with the fleet management system has become a distinguishing feature for this LSP, one which increases their skills and important information for both customers and business.

Keywords: Logistic service provider, fleet management, logistics service.

Manuscript first received/*Recebido em* 30/12/2010 Manuscript accepted/*Aprovado em*: 10/07/2012

Address for correspondence / *Endereço para correspondência*

Mauro Vivaldini, Universidade Metodista de Piracicaba – UNIMEP MSc in Business Administration and a Ph.D. in Industrial Engineering from UNIMEP, where he works as a lecturer in the areas of Logistics and Supply Chain. Postgraduate Program in Management Assistant Professor Rua Pedro Cereser 165 - Res Paineiras Itupeva – SP – Brazil - CEP 13295.000 (11) 9616.7595 // (11) 4496-4614 // (11) 3687.2830 E-mail: mavivald@unimep.br // mvivaldini@vianetbr.com.br

Silvio R. I. Pires, Production Engineer UFSCar and MSc and Ph.D. in Production Engineering from USP. Has over 25 years' experience in Operations, Logistics and Supply Chain Management. He is a full professor at UNIMEP and a visiting professor at FGV. Methodist University of Piracicaba – UNIMEP Postgraduate Program in Management Professor, Rodovia do Açúcar, km 156 Piracicaba – SP – Brazil – CEP 13.400-911 (19) 3124-1515 // (16) 9783-2714 E-mail: sripires@unimep.br

Fernando Bernardi de Souza, Mechanical Production Engineer from the University of São Paulo (1994), MSc in Mechanical Engineering from the University of São Paulo (1997) and Ph.D. in Mechanical Engineering from the University of São Paulo (2001). Assistant Professor at Universidade Estadual Paulista Júlio de Mesquita Filho– UNESP Department of Production Engineering Av. Eng Luiz Edmundo C. Coube, s/n Bauru – SP – Brazil – CEP 17033-360 (14) 3103.6122 // (14) 9119.0261 E-mail: fbernardi@feb.unesp.br

1 INTRODUCTION

This so-called digital age, full of real-time information, enables companies to be aware of consumer needs and the requirements of various groups of people, or even those of other companies, by better understanding the means to offer products and services and also contributing to their management models. Specifically, the combination of these new technologies in Supply Chain Management (SCM) has provided important advances in the methods used by companies. One example has been the adoption of systems such as VMI (Vendor Managed Inventory) and CPFR (Collaborative Planning, Forecasting, and Replenishment) which are significantly representative of the use of technology and their relationship with the concepts of demand management and their relationship with the elements within the chain (Ramanathan; Gunasekaran; Subramanian, 2011).

However, an important point in the supply chain is how logistics services are managed, whether made through internal management or even by logistics service providers. Whether one or the other managerial model is adopted, transportation management stands out, not only because of the operating cost it represents, but also because it directly affects the level of service intended to maintain with suppliers and customers. In this line of digital evolution, Information and Communication Technology (ICT) has introduced several tools that help in the management of transportation, such as routing systems, freight and fleet management, cargo and vehicle tracking (Marchet; Perego; Perotti, 2009).

Within this context, this article aims to describe the features of tracking systems and fleet management applications that transportation companies can provide to promote and improve services in meeting the deliveries made by Logistics Service Providers (LSP). For this, the authors have analyzed the transportation operations of a large LSP in Brazil. Focusing on how the information from the tracking and freight system relates to the management of service customer level and discussing whether these managerial tools contribute both to the operation and to the relationship with the customer.

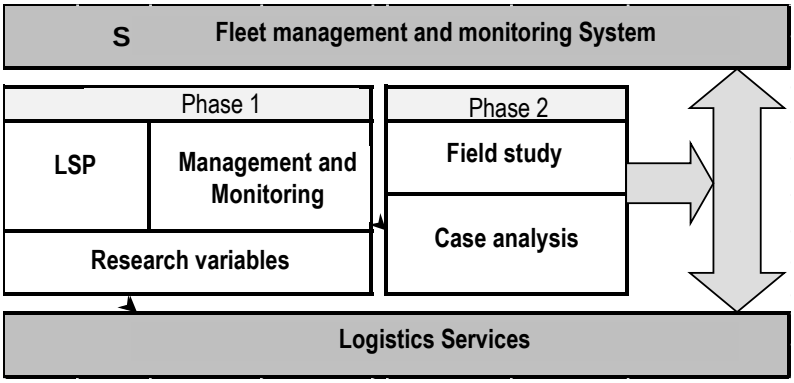
In this sense, one relevant research factor is to demonstrate the synergy between fleet management and monitoring, since the incorporation of different devices created through the advancement of voice and data communication systems via mobile or satellite have transformed the methods of monitoring and managing of transportation and delivery operations (See, 2007).

In addition, the observation, made by Perego, Perotti and Mangiaracina (2011), based on a review of published studies over the past 15 years about information technology applied to logistics and transportation, that studies assessing the use of technology to support transportation management are rare. That fact awards relative importance to this current study, not only due to its contribution to the literature, but also to businesses, by addressing the issue from practical experiences.

2. METHODOLOGY

The study began through a data collection plan described by Yin (2010), which mentions that the formulation of propositions and variables helps to limit and direct the focus of the study. This initiative also assists in the data collection of empirical research; it reflects a set of questions which can be applied and by means of the responses or observations made in the field the questions generate information, hypotheses and propositions or new variables. Therefore, during the first phase of this research a theoretical review of Logistics Service Providers (LSP) and tracking systems and fleet management was carried out. The aim was to understand the role of the LSP in the market, how they work with their clients and how they master new services through the application of technological tools used for fleet management and tracking. Based on the theoretical review, the variables were drawn from the research, as presented in section 4, which guide and restrict the search to its main focus: to investigate how information tracking and freight control systems in an LSP relate to the management level in customer service. Figure 1 illustrates how the methodology of this study was organized.

Figure 1 - Basic Structure for the Search



Source: Elaborated by the authors

In the second phase, during the period of May 2009 to March 2010, the field research was carried out. The intention was to obtain a practical view of the tracking system and fleet management applied by transportation professionals from an LSP and two of its service providers (one in management and the other in fleet tracking). The selection of these companies was made for convenience because they possessed critical data for the purpose of this research (Collis; Hussey, 2010).

The manager responsible for the LSP and two technicians responsible for the other two technology companies directly participated in this research. Other professionals involved in routine operations and transportation within the LSP were consulted and observed, as they were able to provide data on the suitability of the tools, both in the creation of real-time information and in the preparation of managerial reports.

During five years of field studies on logistics, the authors analyzed the LSP, the object of this study, by observing the methods of service management practiced in serving customers. During this period they followed the implementation of the fleet management system and the management of deliveries made to customers, thus gathering information and data about the functionality of these systems. As an example

of such functionalities, we can mention the conversion of monitoring data as an instrument used for management, which can give an alert on a late delivery, on speed, on a product fault or damage, or on a truck break down, etc.

In addition to information obtained by observations and records of conversations, other data were collected through semi-structured interviews, the script of which was based on the variables of the research presented in Section 4. Data were analyzed in depth, according to the technique of within-case analysis (Eisenhardt, 1989). At this stage, the information transcription stages, codification of concepts and interpretation of results were carried out in detail. The long period of research and interaction with the LSP and technology companies also assisted the authors in understanding the different processes, their purposes and the benefits derived from their use.

3. LITERATURE REVIEW

In order to analyze the importance of the application of information systems to the management of the fleet used by the LSP, the study presents a theoretical view on logistics outsourcing, characterizing the role and importance of the LSP, as well as an overview of the fleet management and monitoring system used.

3.1. The Logistics Service Provider (LSP)

This section discusses the vision of outsourced logistics services, understanding the role of the LSP and how the theory describes its activities in order to maintain and master new services.

3.1.1 The outsourced logistics service

Characterized by several organizational differences, outsourcing is consolidated in various industries and does not differ in the provision of logistics services. Initially, the management of logistics processes was more focused on storage and transportation, without paying much attention to the strategic processes of the supply chain (Novaes, 2002). According to Lonsdale and Cox (2000), outsourcing has occurred more frequently in support activities than in those activities related to the primary chain. In the case of an LSP, they may assume primary activities or not, but still remain directly involved in the client's business.

Svensson (2003) believes that companies are reducing the number of subcontractors and increasingly focusing activities on a single subcontractor. This increases their dependence on the supply chain and on the chances of having an LSP with a larger sphere of activities being performed for any company or supply chain (SC). This reflects the thinking of McIvor (2003), where he suggested that outsourcing should take into consideration the ability of the contractor to integrate the activities and the contracted sub-activities. However, according to Berglund *et al.* (1999), there are two main influences that lead firms to outsource: the size of the demand and the size of the chain.

From an adaptation of the topics suggested by Bolumole (2001) and Jaafar and Rafiq (2005), a summary of the motivations and reasons for a company to outsource their logistics services, as well as the possible reasons why they decide on a partner, follows:

- To focus efforts on their own business and find new markets;

- To reduce logistics costs and avoid investments in assets which are not related to their core business;

- To have a complex supply chain due to a fragmented supplier base;

- To increase product return;

- To coordinate logistics activities with a more global view;

- To improve and monitor services and logistics activities levels;

- To have greater flexibility and efficiency in logistics operations;

- To have access to new information communication technologies (ICT) and logistical expertise.

For Dornier *et al.* (2000), the services provided by Third-Party Logistics companies (3PL) fall into a model that combines both physical (i.e., warehousing and transportation) and managerial services. As the complexity and need for customization of different companies increase the integrated nature of logistics, the number of specific companies that offer their services have also increased. However, for the aforementioned authors, logistics services are divided into four different types: basic services, which do not require significant coordination; physical contractual logistics services, allowing the outsourcing of some of the physical services while the company still maintains control of management; management contractual logistics services, which subcontract the management of a existing warehouse or fleet transportation; and finally, integrated contractual logistics, which incorporates physical services and managerial roles under the logistics operator.

From the simplest form of outsourcing to the most sophisticated, the acquisition of logistics services is a complex activity, because it is the purchase of a process, very different, however, from the purchase of goods and components. What an LSP provides is a series of transactions that require more sophisticated interfaces and monitoring from the contracting party. A successful outsourcing is one where all the parties involved have a clear understanding of the objectives, purposes, expectations and skills required (Bolumole, 2001). On the hand, Ayers (2001) believes that the LSP is an instrument of partnership within the SC through the knowledge and infrastructure that it possesses. For Ballou (2001), instead of completely having their own and total logistics capacity and maintaining a large logistics organizational structure, some companies choose to share their logistics capabilities with other companies or contract out their logistics activities in order to have their services performed by companies that specialize in providing such activities, called third-parties.

The initial trend of outsourcing logistics processes, which contribute to the formation of the LSP, arose from the lack of expertise in the processes of distribution, concentrated primarily in transportation and storage activities, i.e. the so-called basic functions of logistics. Later, companies that outsourced in order to obtain the benefits and to facilitate the integration of their SC realized that these services could be understood as part of the chain. Those organizations that outsourced for operational reasons, or as a way to reduce costs, restricted the involvement of the LSP to only that of the basic functions of logistics (Bolumole, 2001; Christopher; Towill, 2001). Therefore, the degree of outsourcing varies and outsourced activities differ greatly

depending on their scope and complexity, ranging from the simplest to the most sophisticated logistics solutions (Stefansson, 2005).

3.1.2 The market for logistics services and its importance

Logistics is a key element for the development of systems within the SC and companies using an LSP are acquiring a key element in the development of its SC (Rafele, 2004). Svenson (2003) points out that the tendency of companies is to sub-contract a greater number of activities in the downstream flow and less in the upstream, thus maintaining a greater reliance on processes related to the former Data presented by Jaafar and Rafiq (2005) point to about 4% of services being contracted upstream and 52% downstream.

Regardless of their performance in the logistics flows, the LSP is gaining ground by leaving the client more dependent, as research has indicated a reduction in logistics assets as one of the main factors which have led to the outsourcing of these services. Then, naturally, the company that fails to invest in these assets will tend to have greater difficulty assuming these operations and not contracting them, to the extent that, although the most important services are still transportation and storage, many others have also been incorporated by the LSP, with the intention of serving their clients, mainly to strengthen the services and add value to their SC (Langley, 2012).

For Simchi-Levi *et al.* (2003), the process of logistics outsourcing offers both advantages and disadvantages. The big disadvantage is the loss of control of a specific function by the contracting party. However, the benefits are:

- Focusing on core strengths. The use of an LSP allows the contracting party to focus on core competencies.

- Providing technological flexibility. As technology advances, the LSP tends to update its resources, which are part of its business; however, for some companies, this requires investments which are not always available.

- Other flexibilities, which make available other options for delivery services that the LSP is able to offer.

Vaidyanathan (2005) reports that the LSP, with its knowledge of SCs and global relations, is a strategic option for providing innovative solutions in logistics, in inventory control and in the demand management, by finding the best allocation levels, multimodal transportation, storage, offering ICT, global coverage and also by acting on behalf of manufacturing and service industries. Companies tend to gain competitiveness when they have a tailored logistics service.

Chapman *et al.* (2003) see the logistics sector as a classic example of the birth and development of a new and relevant service, which no longer only focuses on transportation services and tends to meet all the logistical needs of a client. This viewpoint demonstrates the flexibility that the LSP has in the market for the possibility of offering services. Generally, the LSP functions as an extension to the relationship with one's customer, achieving greater understanding and greater reliability in the operational process and in those services provided to it. Therefore, the LSP gains confidence and increases its range of service options, thus building up a broader portfolio of activities.

The LSP may be entering a fourth phase, whose evolution of collaborative concepts throughout the SC, as well as their vision of using chain management as a

distinguishing feature and competitive advantage, has resulted in the LSP incorporating new attributes. This, combined with the use of technological tools, means that the LSP differs from just being a mere executor for a chain integrating agent (Langley; Allen, 2005; Lieb; Bentz, 2005). Halldórsson and Skjøtt-Larsen (2004) consider that the LSP must have the ability to create proficiency for its customers, creating a partnership in logistics solutions, as well as having the ability to learn from its customers. Therefore, every new client or change of client will have its own learning curve, creating new skills and proficiencies for the LSP.

Hoek (2001) states that the LSP will have significant opportunities to expand their services, since their actions are already directed towards the SC, tending towards both the functional areas, through its traditional services, as well as within the production and marketing activities. The author also points out that with the expansion of integration processes within the SC, the market will become more dependent on the LSP. Alternatively, Langley and Allen (2005) highlight the importance of the relationship between the LSP and the client as a way to expand their services. The authors highlight the expectation for the LSP so that it is more dynamic in providing technology and operational solutions, such as the receipt of service requests, product traceability, and control in the delivery process as a customer need.

3.2. Fleet management monitoring systems

The intention here is to provide a conceptual basis for monitoring systems and fleet management, which are functionally different. Fleet management focuses on providing the company with a means to manage its assets through control of the different variables involved in the process. Monitoring has as its objective, the exact product location, tying in with other variables related to the performance of the assets and the professional staff involved.

3.2.1 Fleet monitoring

For See (2007), the current logistics systems require real-time monitoring and interaction with fleet vehicles in order to achieve high utilization and rapid responses to customer needs. The technology needed to support real-time logistics requires mobile communication, GPS (Global Positioning System) and GIS (Geographical Information Systems), combined with information systems. According to Rodrigues (2009), this technological tool is called AVL (Automatic Vehicle Location), which is the combination of the positioning and communication system, allowing the position of the vehicle to be known while performing operations associated with this information. In a simplistic manner, which covers:

- Acquisition of data:

Embedded devices acquire data on the state of the vehicle or data provided by the driver. The geographical position is usually data generated from GPS receivers embedded within the vehicle. The position can also be established by means of radio frequency, with the assistance of its own antennas, or by calling network positioning with the support of mobile phone operators;

- Communications:

These are technologies for the reception and transmission of data between a central base and a vehicle. This communication can be by satellite, radio frequency or cellular mobile phone services, such as GSM (Global System for Mobiles);

- Information management:

These are systems that perform information management, supporting processes associated with the journey of the vehicle. In short, it manages the sending and receiving of data.

The position information is sent to a module (computers / servers) which is stored, creating a record of positioning and vehicle information. In turn, the server compiles the information and produces the information according to the customer's needs. The client, once in possession of this information, can create its own database and extract from it whatever is convenient for his management.

In the same vein, See (2007) calls the set of equipment needed for fleet management and information, RTFMS (Real-Time Fleet Management System). It consists of three major components: a system for logistics information service (LIS - Logistics Information Service), a data terminal in the vehicle (MDT - Mobile Data Terminal) and infrastructure to support the communication system.

The Magazine Log-Web (2009) summarizes the application of this fleet management technology in two modules: Tracking and Monitoring. The tracked vehicles can be located in real time via coordinates and this provides the communication interface with the central monitoring station and, by means of monitoring, physical information may be obtained, such as times of opening doors, starting and ending of route, stoppages etc.

3.2.2 Fleet management

The information submitted in this topic is based on several fleet management sites (Angels-Brasil; Assiste; Elogfretes; Fleet; Produsoft; Sigmax; Sythex; 2010). Their concepts have been adapted by the authors and the main points presented by the companies that sell this type of product are summarized.

These systems are seen as a tool for operational control and fleet management for various types of operations, e.g., distribution, vehicle rentals, passenger transportation, and etc. Its purpose is to generate information that will help in decisions related to the fleet and the professionals involved in the various processes and operations.

The systems are flexible and adaptable to different types of ERPs (Enterprise Resource Planning) available in the market, enabling and facilitating the integration of applications already installed in the existing structure of the company, for example, cost structuring, purchasing, control of employees, assets, etc. Table 1 presents the main controls and reports generated by the fleet management system. This information can be used by companies in real time.

Table 1 - Fleet management controls and reports

Control	Reports
Assets (vehicles, equipment, tires, etc)	Individual assessment of equipment
Legal obligations	Assessment of equipment groups
Staff performance assessment (drivers)	Equipment performance
Maintenance (Planned maintenance)	Min and max fuel consumption averages
Tires	Exceptions vision (out of the average)
Fuel	Cost and performance parameters
Warranties	Preventative maintenance to be carried out
Services performance	Corrective maintenance
Requisition of parts	Actual cost assessment per piece of equipment
Purchasing and application of parts	Km/tire and per piece of equipment etc.
Costs per branch, per vehicle etc.	Records of tires and equipment
Parts and inventory	General records

Source: Elaborated by the authors

The system can maintain a secure access procedure, limiting information and inputs according to the company requirements. Many reports may only be generated by management, or by the corporate area, for example. This is applied in an interactive form with the user so that they can filter out whatever they want or what they deem to be important. In the same manner data inputs can be made with the system. To sort this process, the system is divided into modules that perform and control different tasks and information:

- Vehicles: registration of vehicles and other equipment, hour meters and odometers, insurance, documentation, traffic tickets, accidents and other events, fleet age, etc.

- Tires: tire registration, movement, shipping and receiving of re-treads, evaluation of the tire retread performance, number of retreads, statistics, etc;

- Fuel and lubricants: average consumption and identification of abnormalities. Integration with electronic fuelling system, CTF (Control Total Fleet) type which is a fully automated fuel supply system that aims to streamline and optimize fuel supply;

- Suppliers (purchases): registration, classification and specialty. Record of purchases, records and evaluation, quotation system, past records, etc;

- Fleet production: record of travels, production by vehicle, driver, routes, customers. Integration with highway "no-stop" toll type systems, and with customers.

- Preventive and corrective maintenance: plans for predefined maintenance with warning for stoppage times. Generation of service orders and integration with storeroom, purchasing and parts control;

- Employees: registration of drivers, operators, mechanics, salesmen, etc. Control of documentation, traffic tickets, accidents, records , productivity, etc;

- Warehouse: registration of products, inventory, integrated control with different business units, average costs, maximum and minimum stock, etc;

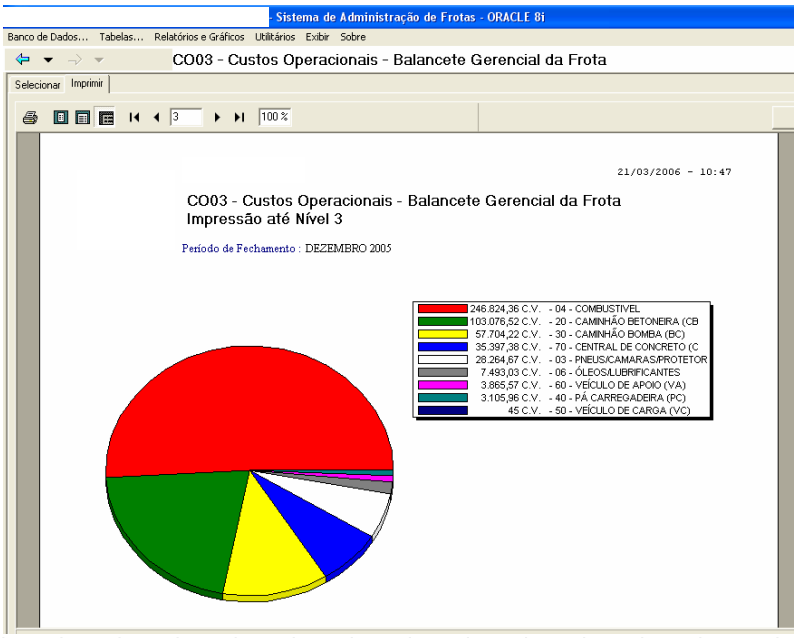
- Costs: direct and indirect costs. It makes the apportionment of indirect costs and appoints the costs per unit as they occur.

In order to better illustrate what the system is and how the integration occurs with users, here are some examples of tables and graphs that the system provides:

- Cost planning and cost center: the structure types of existing cost centers within the organizations;

- Fleet Costs (managerial): allows analyzing by type of expenditure costs at the level of detail desired, as shown in Figure 2:

Figure 2 - Example report (graphs of fleet costs)



Source: Provided by the company Produsoft

- Cost per period: analysis of the cost per vehicle for the various events that it experiences;

- Average age of the fleet: visualize the year of manufacture, manufacturers and models.

- Simulation of tire purchase: allows the quotations for the purchase of tires. In addition to helping to visualize the performance of the tire according to its application within the vehicle (cost/km);

- Analysis of the performance of tire retread: evaluates the cost per kilometer travelled by the retread and its application in the fleet;

- Participation of tire brands: overview of the total fleet with its share of each brand of tire;

- Defect statistics: allows the evaluation of what has compromised the fleet and its operation;

- Fleet availability: the system displays the fleet availability as a percentage of the fleets based on workload, idle time and time stopped for maintenance;

- Record by supplier visualizes spending according to work orders for each supplier, by period, by detail like applied parts, price, invoice, etc;

- Driver's license points and traffic ticket amounts: indicates driver's points by type of traffic infraction that was committed, and the records that describe the amounts spent on traffic tickets.

Finally, the system has different configurations and can be shaped for many types of applications. The intention of this section was to clarify and illustrate how it works by understanding the practical application of the analysis presented in the case study.

4. RESEARCH VARIABLES

Based on the theory presented, in this section the variables (named V1, V2 etc.), which guided the field search, will be discussed. The intention is to allow for a better tracking system and fleet management adopted by the LSP and then, according to these variables, to provide a focus on the aspects related to the improvement of logistics services offered by a LSP to its customers from the adoption of these tools. Therefore, the variables give more emphasis on the ways in which technology tends to be characterized as the possible distinguishing feature in LSP for those logistics services provided.

V1-Generating greater service reliability:

With information being generated in real time, it is possible to meet different customer requests, such as locating a delivery, show if there have been failures and generate mitigation actions in advance. The monitoring related to the management of available data allows to view the performance of the contracted service, as well as their own fleet and delivery team (Chapman, 2003; Marchet; Perego; Perotti, 2009).

V2-Making the client more dependent on the LSP:

By investing in fleet technologies creating information relative to delivery and customer service provided, it is assumed that the LSP incorporates an apparatus of solutions that would be difficult for the client to undertake (Simchi-Levi *et al,* 2003, Mcivor, 2003; Langley, 2012).

V3- Favoring the integration with the client:

To provide customer information in real time, or generate reports to inform them on the status of their deliveries and any other occurrences, is a distinguishing feature, because this integrates the services provided with that of the client's business (Langley; Allen, 2005; LIEB; Bentz, 2005).

V4 - Fleet and delivery information management qualifies an LSP:

Having technology does not mean the ability to respond to the needs of or improve customer services. The LSP needs to generate reliable information that complements and streamlines its management, transforming it into a distinguishing feature capable of

providing operational results. This attribute perceived by the customer is what qualifies the LSP in winning or expanding its services (Langley; Allen, 2005)

5. CASE STUDY

Aiming to analyze how these technological tools relate to the fleet management and how monitoring can contribute to the LSP services; the study analyzed how an operator transforms information into an instrument of operations management.

5.1. The Operator (LSP)

The operator is a company dedicated to logistics in the food sector, serving large networks of fast food outlets, restaurants, hotels and hospitals in Brazil. All customer services are carried out with its own fleet.

The point-to-point delivery schedule is performed via software routing, organized by type of business, customer, region, date and delivery times. For example, if a large food-service network has sufficient volume to organize exclusive routes, the routing will be carried out according to the pre-established delivery frequency and the date and time. When this exclusivity is not possible, the routes are organized by region, meeting the corresponding customer's schedule, also in compliance with the dates and times agreed upon with each customer.

Bearing in mind that all contracted requirements for their clients must meet the agreed delivery times, the level of accuracy for the delivered products and cold quality (for frozen and chilled products there is a specific temperature range to be maintained), having information regarding how the route and delivery are being performed becomes crucial in order to meet the objectives negotiated with each client.

During this follow-up carried out by the LSP, the fulfillment of the agreed level of service is an important factor for the sales outlet to maintain a minimum inventory as well as the necessity for quality products.

The LSP uses a tracking system combined with management software oriented to the management of fleet and routing information. This system communicates with the LSP ERP and obtains the necessary information to make operational and managerial reports. The operational reports consist of modules that allow data inputs generated by the delivery operation and fleet utilization, for example, the information about the temperature of a product delivered indicated by a client, or a mechanical problem in the vehicle reported by the driver. To collect this information, a cellular phone device PDA (Personal Digital Assistant) or Handhelds (Palmtops) types with Bluetooth receive information from the ERP and inputs from operators, drivers and sale outlets.

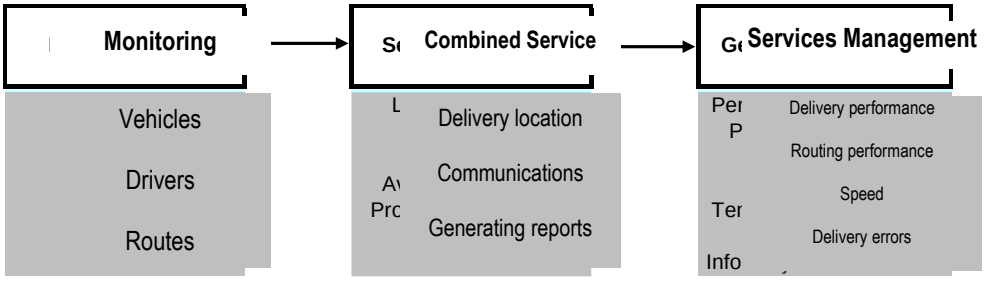
Management reports are generated from a combination of information that is collected from the tracking system and the information sent by the PDA, serving the various analyses needed to manage the operation and delivery services. The inputs from this data supply the fleet management system, thus generating the necessary information for its managers.

5.2. Utilizing information on fleet management and services

This section analyses how the LSP uses technology and the information generated for management and fleet monitoring and management services.

As shown in Figure 3, the analysis is based on 3 parts:

Figure 3 - Use of information systems for vehicle tracking



Source: Elaborated by the authors

(1) Monitoring: allows to track where the vehicle is, the behavior of their staff and if the route is being carried out according to plan, as follows:

- Vehicles: the GPS location system demonstrates where the vehicle is located. Through this position the positioning rules can be established according to the route that must be followed, such as stops and points of product delivery or collections. This monitoring also allows to create alerts when certain rules are not being followed;

- Driver: defining the route and the variables that must be obeyed by the driver; it is possible to monitor if the professional is following the set route, time and pre-defined stops. The system can also monitor their drivability, like maximum speed, sudden braking, engine revs, consumption etc;

- Route: with defined routes and tracking system, monitoring points and times are created to permit to follow whether the route is being carried out according to plan.

Figure 4 illustrates a screen shot guidance for operators / managers with some real time information.

Figure 4 - Example of a vehicle monitoring screen

Source: Provided by company Angels-Brasil

(2) Combined Service: through the monitoring of information, combined activities that complement, streamline and monitor the operation, are described as follows:

- Locates and limits delivery and stop offs points. All product deliveries or pick-ups shall be construed as an individual route. This is defined with all possible variables relative to stops for delivery, fuelling stops, rest etc. After all these processes are concluded , it creates monitoring points that warn when there should be a stop or delivery or fueling and other variables related to the travel;

- Communication with drivers: by connecting the PDA to the communication system (via telephone or SMS), the system manages to establish real-time communication with the driver, providing him with notes and information and obtaining from him the events along the travel and the route;

- Delivery reports: through the PDA, a data electronic form that should be completed by the driver and the delivery point is created, allowing to monitor the delivery and characteristics that can be evaluated, such as the temperature of product delivery during unloading;

- Driver's drivability: it can follow up the driver in real time, monitoring if he meets the pre-set speeds, and if he follows the defined roadmap and their respective stopping points and if he drives in compliance with procedures that aid in the performance of the vehicle and the average consumption. There is also, upon completion of the route, i.e., the return of the driver, a report that shows all the deviations from the route, whether related to speed, driver drivability or even non-compliance of stopping points;

- Indication of vehicle and equipment problems: It is possible to visualize if stoppages occur due to a technical problem, if the product temperature is within the established standards, if the doors were opened at unauthorized points, etc;

3) Management Services: with the information generated through monitoring and the combined services, it is possible to extract a lot of information and reports that become management tools, such as:

- Delivery point performance: based on the time of arrival and departure of the vehicle, the unloading time at the delivery point is obtained and consequently its performance. With this information, it is possible to work with the client on the impacts that this has on costs and on services, especially when it is tied to various route deliveries, as any delays at the initial delivery points will impact on the following:

- Route Performance: with the appointed times set for the route and deliveries, it is possible to assess whether the route taken is compatible with the planned. This facilitates adjustments and therefore improves the delivery service and the time of arrival at the point of delivery or collection;

- Driver's speed and drivability: it provides the driver's behavior relative to the speed and drivability by route. With this information, a record for each driver is created, which can be evaluated with more elements in a less subjective manner. And it also allows punitive and corrective actions (whenever necessary) upon their arrival, i.e. during the final accounting for that route;

- Information on errors and delivery time: it is possible, in real time, to see whether there was any occurrence in delivery enabling immediate corrective actions to be taken that do not cause losses to the client. This information also feeds the performance data related to the efficiency for that delivery, the types of errors and delays, the

professionals involved with the error and, as a result, there is the creation of a plan with corrective actions in order to correct processes and professionals;

- Delivery temperature: it is crucial in the food industry, especially in restaurant networks, hospitals and fast food chains, which is the case of the LSP currently under study. In this case, there are two temperatures to be assessed. The first refers to the vehicle's (cold compartment - trailer or trunk) which lets you know how the refrigeration equipment has performed, and how it was throughout the route for the quality of the temperature and creates assessment records, if needed. The other temperature to be evaluated is the delivery temperature, which can only be recorded directly in the PDA by the receiving managers. This information creates a database to generate performance records and temperature quality, for example, by delivery unit (sales point), by route, by type of vehicle etc;

- Delivery and quality complaints: the delivery point may, by the PDA, record delivery failures, such as missing products or damage or even a factor of poor service (such as the driver's service, for example). With this information, it is possible to assess the types of complaints which are more frequent, if there are any complaints about the quality of products forwarding them directly to the manufacturer. If frequent complaints about a specific product appear, it is possible to act in a preventive manner by avoiding recalls or preventing such goods from being sent to new outlets;

- Creation of Delivery Reports: with all this information, a delivery report can be generated which will be assessed daily by managers, enabling them to understand what happens on each route, each delivery and with each client, as the report already highlights abnormalities, or any deviation from established routines. Based on these reports, various information and analysis reports can be extracted, which enable and assist in decision-making processes related to new routes, the change of route or delivery time change at some point etc.

The LSP under study performs about 70 routes per day and the analysis of information is critical to decision-making processes such as: reassessment of routes; re-evaluation of sales outlets; verification that the vehicle needs attention for maintenance, etc.

As the fleet management and monitoring systems work in an integrated manner with the company's ERP, the information generated by the PDAs is used by the fleet management system, such as:

- Fuel consumption (km / l): considering the time of departure up to the time of arrival, the PDA collects information from the on-board vehicle computer and transmits it to the central, which forwards the same information to the fleet management, enabling access, in real time, of the fuel consumption of the vehicle;

- Driver performance: points relating to the drivability in deviating from established standards, such as speeding, braking and acceleration, for example, going straight to the professional's record card in the fleet management. The fleet management system can generate a report of the performance of its professionals and it is possible to check whatever is abnormal. This is used frequently in the case of an accident or breakdown of the vehicle;

- Anticipation of service order: once problems are perceived, whether by drivers or by the onboard computer, the PDA sends some information about the problem that, for the fleet management, becomes a work order that needs to be carried out by the workshop;

- External fuelling and services: provided by the drivers, the service or fueling must be recorded in the PDA and is automatically transmitted to the fleet management system which updates all information relating to that vehicle.

5.3. Improvements and results obtained

Based on the information collected during the interviews as well as the observations and explanations made by professionals of the fleet operations base, with regard to how they worked before the new system was implemented, Table 1 lists the improvements obtained with the fleet management system, highlighting the agility obtained with real-time information and the possibility to act quickly in correcting problems.

Table 1: Comparison of service improvements

Before	After
Monitoring	
Vehicle The vehicle is promptly located when required via phone or via monitoring.	Based on the route taken the vehicle is monitored and is required to comply and remain within the pre-established boundaries (called a fence). If he deviates from this, the system alerts the base for actions to be taken.
Driver Contact via phone. Drivability and speed are analyzed after he returns from route.	On - screen view alerts if the times and the routing are being met. Real-time alert for speeds out of established ranges, or for unscheduled stoppages or non-routine events. Analysis and corrective measures implemented up on the return of the professional.
Route Monitoring performed with the driver via cell phone.	Monitoring during real time on a computer screen, with alerts and reports on unscheduled events.
Combined Service	
Locating the delivery Made by contacting the driver when arriving at the point of sale (via phone call or text message), or monitoring.	Appears in real time on a computer screen, highlighting unscheduled deviations from the established routes. The customer also has access via the information portal available exclusively for this purpose.
Communication with the driver According to the need or pre-established rules (inform when you get to the point of sale, inform fault occurrence, etc.).	The system tells you where the vehicle is, the driver communicates via text message in case of occurrences, or the driver calls directly if necessary, i.e., the base can follow him and contact is immediate (voice or text message).
Delivery Report Printed and completed by the driver and the client	Available on the PDA display, and sent in real time to the base where it can be viewed by the management.
Drivability Available only after returning from route, after extracting data from the on-board computer of the truck.	The report can be viewed in real time or printed out upon the return of the driver with immediate guidance and measures to be taken. Furthermore, screen alerts occur when excesses occur (speed above 80 km / h).
Vehicle problems The driver warns via phone.	The breakdown is highlighted on the screen. If the problem is related to electronic issues, the system can advise the operators, for example, of a fault in the cooling system of the vehicle (for refrigerated trailers).

Service management	
Delivery point performance After receiving the report, on the return route, the LSP professionals assessed if at the point of sale there was a delay in unloading.	The excessive time taken for unloading can be viewed immediately and the operation can act upon this occurrence relative to their intentions for releasing the vehicle for other deliveries.
Management Performance Only one day after the return from route was it possible to evaluate the performance of the route, time taken, average distances, errors, delays, etc.	In real time it is possible to see the delays and have a report on how the deliveries stand for that day, but also the consolidation of information from the route was streamlined with pre-established working times (e.g. from 0800 hrs. to 1800 hrs. per day).
Information about errors and complaints Complaints about delivery time, temperature, quality of products upon delivery, shortages and other occurrences, when named in the delivery report were analyzed by the LSP, at the first opportunity upon the return of the driver, and a second time in operational meetings where the assessment of relevant facts to measures to be taken (if necessary) were decided.	Now seen in real time and it is possible to act immediately and take action, either from monitoring information or from the PDA recordings (electronic delivery report).

Source: Elaborated by the authors

According to comments from those managers interviewed, the success and on-time deliveries rates increased 2% and 3% respectively (2008 to March 2010). One cannot attribute this result solely to the implementation and improvements made in the fleet management system under study, as other initiatives were taken by the company, such as training of drivers, corrections in the selection and the loading of products in the warehouse, but it can be confirmed that it did make its contributions. However, aspects perceived by the interviewees as improvements can be pointed for directly reflecting on the level of service offered to the customer:

- The findings made from the delivery results, for deviation occurrences, for average consumption, driver performance, etc., became much faster, allowing managers to have more reliable analyzes and for remedial measures to be taken much more quickly. According to the background, the reports that came back only on the next day were analyzed, and, furthermore, did not see events happening at the time of delivery. This optimized the actions to be taken on eventual failures and advanced the consolidation of information for management meetings by at least a day:

- It was possible to visualize the performance of partial deliveries during the day, to be able to monitor critical cases with greater accuracy, to demonstrate commitment to schedules and the importance of keeping to the established routes for the professionals;

- Information such as average fuel consumption for a specific vehicle or even a driver, which used to depend on accounts made following the finalization of the route, has now become immediate. Consequently this makes the average fuel consumption of the fleet more reliable, for the categories of vehicles, as well as for the individual drivers, allowing actions and decisions to be taken on a vehicle or on a professional, such as sending a vehicle for maintenance or for warning a driver;

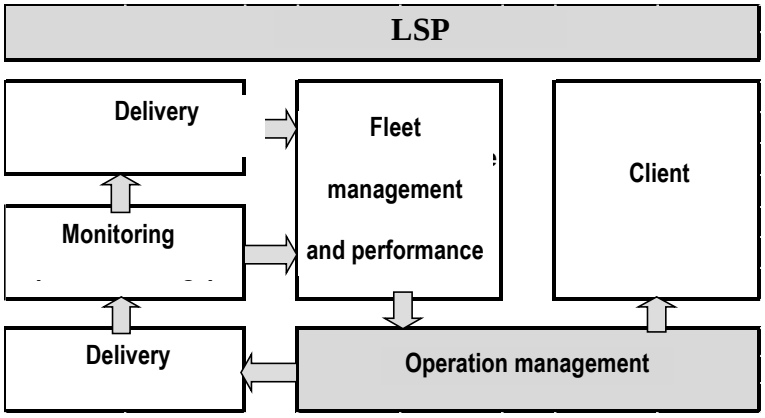
- Greater integration with the customer by allowing access for points of sale and information about the vehicle that will make the delivery. This also strengthens the credibility of information examination, which is passed on by means of consolidated reports to the client, as the system has made it possible to deal with complex data manipulation, besides the ease of locating and communications for certain events and urgent needs;

- The fast and reliable information about the location of the fleet assists with routing and in the better utilization of vehicles, facilitating the programming and stopover. In this regard, information from the various respondents indicate that the LSP has an average index of 95% fleet availability scheduled for the day, prior to the implementation of the system, this index did not exceed 90% (with the same aforementioned exceptions).

6. CASE ANALYSIS BASED ON RESEARCH VARIABLES

From the data relating to delivery, the system analyzed by the authors prepared the information for the routes on the PDA, which accompanies the driver and acts as a data collector during the operation. Thereafter the monitoring comes into operation, not only during deliveries en route, but also during the monitoring the delivery service. The data collected feed the fleet management system and the company database so that the operations management can assess the performance and take the necessary actions needed to correct problems or improve the process, as shown in Figure 5.

Figure 5 - Management and monitoring of the LSP fleet



Source: Elaborated by the authors

The LSP bases its information base (relative to delivery processes) on the data obtained by monitoring and fleet management. It is assumed that the intention was to improve the operational performance in the area of transportation as a whole through the standardization of delivery procedures performed by drivers. Consequently, the benefits from the changes and greater agility allowed quick access to information which became a distinguishing feature when made available to the customer.

On the other hand, the implementation process allowed the internal team to visualize and to track the movements of these deliveries always in real-time, demanding actions and solutions to be taken with agility and speed. So if and when necessary, the

LSP provides rapid solutions, and is able to improve their index of delivery errors, resulting in a better service for the client. Therefore, it can be said that there is evidence on the variable V1, as the system presented can provide a higher reliability for those services offered by the LSP.

The on time delivery h and error-free service are a relatively strong factor for obtaining customer loyalty and makes the customer ever more dependent. On the other hand, investments in the construction of these infrastructure systems, software and customizations, plus the time required (in the case studied, the technicians worked for about 3 years on the new system), are also an asset rather too complex and costly to be undertaken by the customer. For this specific case, this position supports the variable V2, because actions of this nature performed by the LSP make the customer become more dependent on their services.

Taking into consideration that the client interacts with the process, allowing them , at the time of delivery, the possibility to make considerations and complaints in respect to the service provided, the customer ability to actually have the confirmation of actual data recorded by the system itself, such as arrival time and temperature, and also to be able to access the portal by verifying the confirmation and expected arrival time of its delivery stimulates and promotes integration with the LSP. Therefore, regarding the delivery processes, the variable V3 is very much in evidence.

In turn, the whole apparatus designed for fleet management and delivery and the relationship created to improve customer service, considering the investments in technology and the development of solutions, support the variable V4 because they make the LSP more qualified and more prepared for the market.

Along these lines, actions such as those practiced by the LSP under study correspond to the comments made by Bolumole (2001) and Jaafar and Rafiq (2005) on why companies seek to outsource their services with an LSP. The results seem to indicate that the LSP seeks to obtain information on services and agility, such as monitoring deliveries and responding to the real-time needs of its customers. This position is also supported by Saura *et al.* (2008), which reinforce the idea that, by incorporating technological tools into their business, the LSP improves the quality of services offered to its customers.

7. FINAL CONSIDERATIONS

With the expansion of the LSP market and the diversity of activities that have been established by such service providers, improving the services offered by them is important for the understanding of the business and to be aware of their customer needs. In this respect, knowing how a delivery process occurred and having the resources to understand the level of service provided at each point of sale becomes a distinguishing feature in providing such services. Considering that it is common for the LSP to be questioned by customers about their current delivery status, the adoption of these technologies and management systems help and facilitate customer service. However, improvement of logistics services through information technology made by these agents cannot be evidenced only by this activity, it is necessary to move forward in other areas and processes, therefore opening opportunities for broader studies involving not only different types of operations, but also different types of LSPs.

The study assesses the management system of an LSP through the application of technologies related to tracking and fleet management, with the intention of obtaining improvements in the services provided for its customers. Consequently, it is also possible to state that the fact that the LSP is provided with information regarding their vehicles and drivers may also favor the management of their own business. Therefore, the case exemplifies that the installation of systems or tracking information of the fleet it is not enough, that is, the crucial element is that they are integrated into the needs of the LSP, turning these technologies into management tools that perform and contribute to the services, according to customer requirements and their own business needs.

This study has discussed the features and how technology tools for fleet management and monitoring contribute to the services offered by the LSP, by means of the presentation of a case study, given the observation made by Perego, Mangiaracina and Perotti (2011) that this type of study in logistics literature is rare. However, the authors acknowledge its limitations for being a unique case, suggesting that further studies explore issues about the difficulties encountered by LSPs in projects of this nature, in the participation of clients in this type of development and in how these technologies relate to other LSPs in relation to their management.

REFERENCES

Angels-Brasil. (2010) *Information on fleet monitoring*. Available at www.angel-brasil.com. Access date 12.10.2010

Assiste. (2010) *Information on fleet management*. Available at www.assiste.com.br. Access date 16.12.2010

Ayers, James B. (2001) *Handbook Of Supply Chain Management.* Florida, CRC Press, LLC,

Ballou, Ronald H. (2001) *Supply Chain Management.* Porto Alegre, Bookman, 2001.

Berglund, M, PV Laarhoven; Sharman, G., & Wandel, Sten. (1999) Third-Party Logistics: Is there a Future? *International Journal of Logistics Management* , 10, 1, p. 59

Bolumole, Yemisi A. (2001) The Supply Chain Role of Third-Party Logistics Providers. *International Journal of Logistic Management* , Vol. 12, n.2, pp.87.

Chapman, L. Ross, Soosay, Claudine, & Kandampully, Jay. (2003) Innovation in Logistics Services and the New Bussiness Model: a Conceptual Framework. *International Journal of Physical Distribution & Logistics Management,* Vol. 33, n. 7, pg. 630-650.

Christopher , Martin; Towill, Denis. (2001) An integrated model for the design of agile supply chains. *International Journal of Physical Distribution & Logistics Management*, vol. 31 n. 4, pp. 235-246.

Collis, J.; Hussey, R. (2005) *Research in Management* (2nd ed.). Porto Alegre: Bookman.

Dornier, Phlippe-Pierre; Ernst, Ricardo; Fender, Michel; & Kouvelis, Panos.(2000) *Global Operations and Logistics.* São Paulo: Atlas.

Eisenhardt, K.M. (1989) Building theories from case study research. *Academy of Management Review, 14* (4), 532-550.

Elogfretes. (2010) Fleet management information. Available in www.elogfretes.com.br. Access date 16.12.2010.

Fleet. Information on fleet management. (2010) Available in www.fleet.com.br. Access date 16.12.2010.

Halldórsson, Arni; & Skjøtt-Larsen, Tage. (2004) Developing Competencies Through Logistics Third Party Logistics Relationships. *International Journal of Operations & Production Management*, Vol. 24, n.2, p.192-206

Hoek, Remko I. Van. (2001) The Contribution of Performance Measurement to the Expansion of Third Party Logistics Alliances in the Supply Chain. *International Journal of Operations & Production Management,* V. 21, n. 1/2, p. 15-29

Jaafar, H. S.; Rafiq M. (2005) Logistics Outsourcing Practices in the UK: a Survey. *International Journal of Logistics: Research and Applications* , vol. 8, n. 4, pp. 299-312.

Langley, C. John Jr,; Allen, Gary R. (2004) Third-Party Logistics Study. Results and Findings of the 2004 Ninth Annual Study. Retrieved from the Internet www.tligatech.edu on 16/08/2005.

Langley, C.J. (2012) The State of Logistics Outsourcing. Results and Findings of the 16th Annual Study. Third-party logistics study. Available in www.3plstudy.com, accessed 20/03/2012.

Lieb, R.; Bentz, B. A. (2005) The Use of Third-Party Logistics Services by Large American Manufacturers: The 2004 Survey. *Transportation Journal* , Vol.44, no. 2 pg. 5.

Lonsdale Chris; Cox, Andrew. (2000) The historical development of outsourcing: the latest fad? *Industrial Management & Data Systems*, Vol. 100, n.9, p.444-450.

Marchet G. Perego A., Perotti S. (2009) An exploratory study of ICT adoption in the Italian freight transportation industry, *International Journal of Physical Distribution & Logistics Management,* Vol. 39 n. 9, p.785 – 812.

McIvor, Ronan. (2003) Outsourcing: insights from the Telecommunications Industry. *Supply Chain Management*: *An International Journal*, V. 8, n. 4, pg. 380-394.

Novaes, Antonio Galvão. (2002) *Logística e Gerenciamento da Cadeia de Distribuição*. São Paulo. Editora Campus.

Perego A., Perotti S., Mangiaracina R. (2011) ICT for logistics and freight transportation: a literature review and research agenda. *International Journal of Physical Distribution & Logistics Management* Volume: 41, Issue: 5, p.457 – 483.

Produsoft. (2010) Information abou fleet management. Available at www.produsoft.com.br. accessed 16.12.2010.

Rafele, Carlo. (2004) Logistic Service Measurement: a reference framework. *Journal of Manufacturing Technology Management,* V. 15, n. 3, p. 280-290.

Ramanathan U., Gunasekaran A., Subramanian N., (2011) Supply chain collaboration performance metrics: a conceptual framework, *Benchmarking: An International Journal*, Vol. 18 n. 6 p. 856 – 872.

Revista Log-Web. (2009) *O controle das operações em suas mãos*. Edição 87, maio de 2009, p. 12.

Rodrigues, Marcos. (2009) AVL: Enfim mais recursos e custos menores. Available at www.kretta.com.br, accessed 15/05/09.

Saura, I. G.; Frances, D.S.; Contri, G.B.; Blasco, M.F. (2008) Logistics service quality: a new way to loyalty. *Industrial Management & Data Systems*, Vol. 108, n. 5, p. 650-668.

See, Win-Bin. (2007) Wireless technologies for logistic distribution process. Journal of Manufacturing Technology Management, Vol. 18, n. 17, p. 876-888.

Sigmax. (2010) Information about fleet management. Available at www.sigmax.com.br. Acessed16.12.2010.

Simchi-Levi, David; Kaminsky, Philip; & Simchi-Levi, (2003) Edith. *Cadeia de Suprimentos: Projetos e Gestão*. Porto Alegre, Bookman.

Stefansson, Gunnar. (2005) Collaborative Logistics Management and the Role of Third-Party Service Providers. *International Journal Of Physical Distribution & Logistics Management*. V. 36, n.2, p. 76-92.

Svensson, Goran. (2003). Sub-Contractor and Customer sourcing and the occurrence of disturbances in firms inbound and outbound logistics flows. *Supply Chain Management: an International Journal*, v. 8, n. 1, p. 41-56.

Sythex. (2010) About fleet management. Available at www.sythex.com.br. Accessed 16.12.2010

Vaidyanathan, Ganesh. (2005) A Framework for Evaluating Third Party Logistics. Communications of the ACM. Vol. 48, n.1 p.. 89-94.

Yin, R. K.(2010) *Estudo de caso – Planejamento e métodos.* São Paulo. Bookman, 4ª Edição.