The use of AVL integrated with RFID for the transportation of fractioned cargo

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Abstract: - This work has as purpose to describe and evaluate the integration of different technologies with the purpose of improving the transportation and highway distribution of cargo. Through a comparative analysis, advantages and disadvantages of the methods currently used in logistical processes will be demonstrated.

Keywords: - AVL, RFID, logistics, fractioned cargo, georeferral, barcode

1 Introduction
The supply chain is gaining focus and the attention of executives in today's competitive world, and these attentions are increasingly directed to improve the efficiency and reduce costs. This challenge together with the need of making products available within the right time and on the right place have been caused the companies to invest more and more in new technologies.

The globalization opens space for companies be able to participate and compete for markets that up to then under exploited, as it is the case of companies specialized in logistical operations.

2 Technologies
Among the new technologies, are those developed to meet the demands of Supply Chain demands, such as WMS - Warehouse Management System, routers (software that show the best route alternatives for deliveries), the AVL system – Automatic Vehicle Location, besides software used to minimize losses and reduce the failures in the goods delivery processes.

Technology is something important within the Supply Chain Management, in which it is further highlighted with the advent in the market of the so-called intelligent tags. These intelligent tags use radio frequency to identify products. The name given to this system is Radio Frequency Identification, frequently referred to as RFID.

In spite of having functions that are very similar with the bar code, widely used in CDs - Distribution Centers of the companies, and being considered a technologic advance, it is more and more evidenced that this intelligent tags tend to be something complementary to the bar code, however, something that would revolutionize the supply chain management, bringing real time information.

2.1 AVL
It is the name given to the positioning and communication systems that permit the knowledge of the position of a vehicle and the realization of associated operations.

AVL is not a technology, but a concept of using technologies. Several distinct technologies may be used together, according to each application, with the purpose of providing the user with a tool for support to the support of a series of transportation related activities. These activities go from the simple tracking of a vehicle for purposes of security, up to the monitoring of large fleets for a logistical control.

The knowledge of the vehicle position, as well as other information collected about its status, and the status of the cargo transported permit the performance of a series of operations, such as the monitoring and tracking, logistical control, risk control, fleet management, among others.
2.1 Components of AVL System

2.1.1 Data Acquisition
The devices installed in the vehicle acquire data about its status, such as data provided by the driver, geographic position, its status, among other information.

2.1.2 Communication Systems
These are the technologies for transmission and reception of the data between an operating center and the vehicle. This communication can be carried out through satellites, radio frequency or mobile telephone service.

2.1.3 Information Management
These are the systems that make the management of the collected data, analyzing the processes associated to the travel of the vehicle, transforming in information and giving the functionality to the system, and managing the sending and reception of the data.

2.2 RFID
The electronic tags operate based on an electromagnetic field where waves in certain frequencies manage to transmit information without the need of wire (wireless) and the tags being within a vision radius or any action by a person. In order to transmit information through electromagnetic waves, the electronic tags comprise a small chip, also known as integrated circuit, where the EPC - Electronic Product Code and other possible information are stored and an antenna to capture the electromagnetic waves.

The identification by radio frequency basically consists of passive or active electronic devices (tags) that are programmed with information and attached to objects that need to be identified or tracked, such as pallets, vehicles, boxes and units. The costs of the active tag are higher than the passive tag, besides they have a limited useful life. The passive tags operate without battery and their supply is provided by the reader itself through electromagnetic waves. This kind of tag is cheaper and has theoretically unlimited useful life. They can be of read or read/write type, used for short distances and require a higher power reader.

The other devices that comprise a RFID system are basically:

- **Antenna:** component that generate the magnetic field that activates the tag and sends information to the reader;
- **Reader:** receives the information captured from the tag, decoding it and making it available to a software;
- **Software:** it receives the information decoded from the reader and interfaces with the transactional systems of the company.

2.2.1 Advantages
- Durability;
- Autonomy;
- Information storage capacity;
- A RFID reader may read several tags quickly;
- The RFID tags may be read at longer distances, as well as they can read products that are not within its visual reach/range.

2.2.2 Disadvantages
- High initial cost;
- The RFID readers may fail in the reading of the tags for several reasons: distance and positioning of the tags in relation to the reader, materials such as metal or liquids may distort or absorb the RFID tag signal, electromagnetic waves, background noises generated by another equipment and the speed at which the tags move through the reader.

2.3 Barcode
It comprises a graphic representation made of dark parallel bars with different thicknesses, printed on a surface at spaces determined by standardized technical specifications for each kind of code. Its main function is to acquire data for the management of automated information input to a computerized system, where a reading device (Scanner) performs, through an optical process, a scanning over the barcode, capturing signals through the application of a light beam and reflection of that variation by blank spaces.

The optical reader converts the light information into digital data compatible to a computing language, capable of verifying the validation of the symbology (a form in which the information in the bars and spaces of the symbol are coded).
Where the bar is dark, light is absorbed, and, where the bar is clear (spaces), the light is reflected again to the “scanner” recognizing the data therein represented. There are countless symbologies currently used for commercial purposes; among the most popular we can highlight UPC - Universal Product Code, EAN - Europe Article Numbering and Code 39. The EAN and UPC codes are international systems that help in the unequivocal identification of an item to be sold, moved and stored. The world’s best known and more used is EAN-13. The numerical structure of the code, that generally is under the bars, represents the following information, for example: 7898357417892 where the three first digits represent the prefix of the organization responsible for controlling and licensing the numbering in the country in case of 789, they represent GS1 BRASIL – Associação Brasileira de Automação. The next digits that may vary from 4 to 7 represent the identification in the industry that owns the brand of the product in the above example it is 835741 (6 digits). The digits 789 represent the identification of the product determined by the industry and the last digit (2) is called verifying digit that helps in the security of the reading. In total, EAN-13 code must have 13 digits. It is worth highlighting that the numbers of the company vary from company to company, the numbers that identify the item vary from item to item and the verifying digit must be recalculated and at every variation in the numbering. There are other kinds of standard codes for several applications.

2.3.1 Advantages
- Low operating cost;
- Largely used on a worldwide basis;
- Global standardization;
- Low maintenance.

2.3.2 Disadvantages
- Printing failures compromise reading;
- Reading made only by an approximation;
- Subject to damage.

3.1 Full truck services
The cargo is collected at the facilities of the shipper; is transported in the same vehicle, to the warehouse of the addressee, without passing through the warehouses of the carrier. This kind of service occurs whenever there is enough cargo to fill a vehicle so that it is not necessary to use the carrier terminal to handle the cargo.

3.2 Local fractioned cargo services
The cargo is collected in the facilities of the shipper and moved to the warehouse of the carrier. The screening and the reshipment is made in the distribution vehicles, which do the deliveries directly to the addressees located in several points in the same city or in other near locations. In this case, only the local warehouse of the carrier is used.

3.3 Long distance fractioned cargo services
Similarly to the prior item, however, another operation of unloading/screening/loading occurs in a regional warehouse of the carrier. This additional intermediate operation becomes necessary for the goods to be separated again by delivery route and reshipped in local vehicles. In this case, the regional terminal receives goods from several points in the country. Then, the unloading of the goods from the several regions is made, and these are again separated by route and reshipped in the delivery vehicles, which are generally smaller.

3 The highway cargo transportation
When a shipper requests the service of a carrier to dispatch a batch of goods and take it to a certain destination, its expectations can be summarized in having the order effectively delivered to the addressee, without damage and without losses, within the term agreed and upon the payment of a reasonable freight. For the carrier, the issue is more complex.
3.4 Long distance fractioned cargo services with intermediate transit terminals

The same case as above, but with existence of intermediate terminals of the carrier, to reorganize the shipments according to transportation corridor.

4. Difficulties in the transportation of fractioned cargo

Many carriers face problems in the distribution of fractioned goods. There are, most of the times, human failures, that generate extra costs related to the resending of a cargo that was mistakenly exchanged, for instance. This is worsened by the type of cargo and distance to the point of delivery.

5. Proposal for application of RFID technology

The use of intelligent tags together with the tracking systems would help in the processes of transportation and distribution of fractioned cargo. The model proposed considers that after the separation and assembly of the delivery route schedule, RFID tags would be attached in each product, before the loading for delivery, replacing the current bar codes. The data from all products loaded to a truck would be constantly read by an onboard system, through antennas installed in the cargo section, and compared to that of the distribution center. Combined with the georeferred delivery route schedule, a load of products registered would be able to leave the distribution center and each delivery would be specific to a pre-recorded geographic point.

6 Conclusion

With the introduction of the RFID tags technology a some years ago, the process of replacement of the current bar codes for the identification of products and goods has been evolving in a gradual manner. The fact is that the two methods revolutionized the goods storage, distribution and trading processes. The proposal presented in this article, with the placement of RFID tags on the products to be carried, is a point to be approached, once in the future, these products will leave the manufacturing plant already bearing such intelligent tags, containing the
manufacturer data, and being able to be recorded with other information of the resellers. But even today, many companies present points that must be approached and analyzed in order to predict the future of RFID technology, among which privacy invasion. The model of integration of these tags in the current AVL systems, already used by many carriers, contemplates benefits, such as agility and efficiency, reduction in the failure indexes and as a consequence, reduction in the extraordinary expenditures.

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