LOGISTICS MONITORING USING ITS

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Abstract: - Intelligent Transport Systems (ITS) is allowing that society use the ITS facilities to conducting their activities. At this scenario the paper presents a study case that was developed to SEFAZ (Treasury Department) of São Paulo state in order to use ITS technologies applied to conduct his activities, mainly for tax inspection. The study case presented in this paper used the tracking & monitoring technologies to make the monitoring of loads, including vehicles. All study case considers the use of existing ITS infrastructure, as well as the deployment of new infrastructure. In order to implement the tracking & monitoring technologies, the study case consider several dispositive and systems, including a integration with NF-e system (electronic invoice) and CT-e system (electronic transport declaration). The advantage of presented technologies is the ability to identify the loads and vehicles information without disrupting the normal flow or even causes a decrease in speed.

Key-Words: - ITS, BRT, Operation, OCR, LPR, Mobility, Transportation

1 Introduction

The Internet, mobile applications, devices and communication technologies are permitting the world transformation. Several opportunities is are central to bringing of diverse and substantial social and economic benefits to world, however, these decisions affect the design, accessibility and use of these technologies could open wrong ways [1]. This mobility permit to have information in anywhere, then the ITS systems can be more effective permitting to have real-time information. Also the accessible cost of devices and communications channels permit to use in more services in order to inspect the road and supply chain. For SEFAZ-SP (São Paulo Treasury Department) is important to make the inspection of goods to verify if the supplier is doing the correct statement of the goods transport. The cargo transport is a key step in the logistics supply chain, with 70% of all goods is transported via road transportation. So there is the need to adopt technologies that aid in enforcement against tax evasion in this activity [10].

Regarding the tax on transportation of loads, the ICMS (goods tax) represents 87% of the total collected by SEFAZ-SP in 2008, being 74 billion of brazilian reals (R$) refers to the ICMS of a total of R$ 85 billion revenue [1]. It is estimated that this tax evasion could reach about 26% of total (about R$ 18 billion annually) [2]. Possible actions include charges of tax evasion is not declared, simulation of interstate delivery, cargo tampering and others. Besides the issue of tax evasion, a problem that is extremely relevant to companies linked to national supply chains and logistics refers to the theft charges. Around R$ 800 million in losses resulting from theft of cargo in Brazil in 2009, only the southeast (SP, RJ, MG and ES) accounted for 79.88%, and the State of São Paulo, in time, was responsible for 50% of total [3].

The theft of cargo has increased marketing and technology companies to provide tracking & monitoring services, offering logistical support

facilities and technology for this purpose. Together, they account for up to 136,000 trucks - equivalent to 8% of current national fleet of 1.7 million cargo vehicles [4][18].

This paper describes proposals related to electronic tracking & monitoring in order to identify vehicles and loads, with the aim of helping to SEFAZ-SP in the activities of inspection of cargo transportation.

2 Problem Identification

The choice, design and deployment solutions that integrate the technologies for the electronic tracking & monitoring depend on the supervision objectives of SEFAZ-SP. These goals can be broken down into requirements, which can be sorted and grouped into operational requirements for the purpose of SEFAZ-SP, requirements related to the object of tracking & monitoring requirements and the type of operation or fraud which SEFAZ-SP want to monitor.

The definition of the operational purpose is to determine whether a particular technological solution will be used to trace the statistical analysis of evidence of irregularities or if tracking systems & monitoring will be combined with other technologies to support the tax assessment in real time. As for the object, different solutions and technologies are used for tracking / monitoring of vehicles (trucks, trains, ships, etc.) or loads (containers, pallets, boxes, bulk or individual products such as fuels).

The technologies and solutions adopted are also influenced by the type of operation to be monitored, such as operations within the limits of the state, interstate sales or trade. This dismemberment of the goal of monitoring the SEFAZ is used as a guide for each of the proposed technological solution. The needs of SEFAZ are:

- Operational Purpose: Statistical analysis of routes/locations/time/business and Support for monitoring in real time
- Object: Vehicles and Cargo;
- Type of Operation: Sales, Interstate Sales and Export.

To meet the above requirements will use the solutions proposed mechanisms for classification and identification of vehicles, lifting and crossing of loads information through the databases of the NF-e, CT-e and others.

3 Logistic Technologies

This topic aims to present the systems, equipment and devices that can be applied by SEFAZ-SP among the survey described in the scenario of tracking & monitoring of cargo and vehicles [5] and other reports to identify vehicles [6] [7] electronic seals [8] [9] Electronic scales [10] [11] and georreferencig [12] [13] [14].

3.1 LPR: License Plate Recognition

A system for capturing images can be used at checkpoints to automatic reading of plates (LPR) is made through the combination of sensors, cameras, software and other equipment for the recognition of characters on the plates, using algorithms OCR (Optical Character Recognition) in images captured on the road. [6][20][21][22].

Information recorded by the LPR can be used for cross-checking of documents such as NF-e and CT-e available on the database of SEFAZ-SP

3.2 RFID: Radiofrequency Identification

Given the current identification of plates and vehicle (6) also describes the data collection vehicle or its cargo by means of RFID (Radio Frequency Identification). RFID technology allows the identification / location of a given object using radio frequency at short range (typically 0.5 to 5m) and can be used both for identification of vehicles and identification of cargo through containers, pallets, cases, individual products or bulk Through reading equipment (readers and antennas) installed at strategic locations, can become a key tool in an integrated solution for tracking.

3.3 Weighing Electronics

The electronic scales currently used for monitoring the weight of cargo transported through the static or dynamic weighing stations in the road can provide weight data for crossing vehicles and tax documents.

3.4 Cargo Scanners

In the area of security and monitoring logistics (mainly port / customs) are used X-ray equipment to inspect trucks and containers, tanks or chests loaded and containers (boxes, etc..) inside the vehicles

This equipment allows for the inspection from 25 to 30 vehicles per hour, and can be fixed or portable. The main advantages of using X-ray scanners for cargo are: [15][16]

- The technology is non-intrusive "under the viewpoint of user. It is not necessary to

install internal devices. There is equipment that penetrate up to 400 mm of steel;
- There are equipment options for mobile operations.

3.5 Electronic Seals

The seals are electronic devices used to control loads indicating or preventing unauthorized access to cargo carried in compartments and / or stored.

The different models of electronic seals provide different levels of functionality [8]:

- All mechanical seals provide protection / physical (sealing);
- Seals with electronic memory capacity allow the recording and subsequent reading of the payload data, typically through active RFID technology (with the use of battery-powered tags) or passive (using tags externally energized by the RFID reader);
- RFID electronic seals with memory capacity and processing allow to record the date / time of violation;
- GPS (Global Positioning System) location, allowing the seals to record the location of the violation, together with the date / time;
- Reporting of violations in real time via cellular (3G), digital radio or satellite communications.

3.6 Electronic Crawllers

Overall crawlers electronic components may include tracking, communication, detection of deviation from the final destination or theft of the vehicle, storing and processing data, generating data for locating and monitoring by the SEFAZ-SP from the implementation of procedures operations that will use the data generated by the companies responsible for monitoring the fleet.

Tracking with GPS technologies and communication: The GPS consists of a set of satellites and an electronic information system that provides a receiver moving in the same position with reference to Earth coordinates (5).

4 Proposed Solution

To solve the problem presented in the objectives topic is necessary to use an integrated solution, consisting of vehicle identification, means of communication and integration with the database of tax payment. For this purpose, this paper proposes two scenarios in order to attend the mentioned objectives.

3.5 Scenario 1: Vehicle identifications and electronic seals

This scenario represents a technological and operational advanced, because it represents the combination of electronic seals to other technologies mentioned on topic applicable technologies to SEFAZ-SP, see figure 1.

Figure 1: Scenario vehicle identification and electronic seals

The operational model of this scenario is:

1. At the origin is applied in the electronic cargo seal by the factory, and recorded data of NF-e, CT-e and vehicle;
2. When you travel on the road the vehicle is classified and identified via OCR or monitoring via RFID portals. The seal can be fitted with electronic tracking device that allows real-time monitoring;
3. Selected vehicles are diverted to checkpoints with RFID reading equipment, where the seal will have the data captured;
4. Vehicle data, location, NF-e and CT-e can be crossed for identification of tax evasion and / or adulteration of goods.

The technologies involved in this scenario are:

- Classification system for vehicles: B-WIM, optical scanners or other sensors for classification;
- Vehicle identification: portal surveillance cameras and software with OCR or RFID reading equipment with antennas;
- Electronic seals, and their equipment in reading and writing RFID taxpayers of origin, destination and checkpoints;
- Electronic panel of dynamic messages;
- Communication system with central and / or vehicles.

The main strengths of this scenario are:

- Potential for cross data of the seal (both vehicle and load, if any) with the databases of NF-e and CT-e allowing the identification of goods adulteration;
- Indication of seal violations. Additionally, if equipped with electronic tracking device will allow the real-time monitoring.

However, this scenario presents the following points of attention that must be taken into consideration:

- The seals generate an electronic accessory obligation to factory both in the application of devices, in recording data and in reading them;
- There is no standardization of RFID seals, either in its communication interface, either in its features (feature tracking and reporting, data recording and other functions);
- The infrastructure of reading and writing of the seals should be taken into consideration as well as their cost (especially if the seals are disposable);
- The identification of the seal in NF-e and CT-e at the time of installation is important to prevent exchange of the seal during transportation, but the field is currently optional in the tax documents.

5 Conclusion

The IT'S technologies, mainly in the area of monitoring and electronic tracking offered various options for the detection of violations and theft of vehicles and their loads during transport in real time which can be used for monitoring purposes.

The application of ITS helps streamline the activities performed in the areas of logistics and the combination of various solutions offered by ITS allow us to provide more appropriate results and the lowest error rate.

In the case of SP-SEFAZ the main objective is to use the ITS as is to reduce tax evasion through cross of tax information with information related to freight services

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