Delivery improvement for transport companies

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Abstract

In this paper we propose a solution that improves the synchronization and effectiveness of sending and receiving of goods and merchandise by transport companies. We use a service-oriented architecture for the exchange of information related to the reception of products, such as the predicted time when the delivery should take place or the delay in the arrival. Our solution is based on fleet management systems widely used in the transport companies. The main objective of this paper is to improve the interoperability between providers and consumers, thereby creating a communication environment versed in delivery plans. Another feature revised here is the analysis of vehicle tracking information to obtain accurate knowledge of the movement pattern followed by drivers and usefulness for the companies.

1. Introduction

Within supply chain (SC) management, transport is one of the major activities. It is needed in the flow of products from each network (supply, conversion and distribution) to the next; furthermore, with globalization trends and collaboration between firms located in different places, it has become one of the most important factores during the product life cycle. The transportation industry affects the entire supply chain, including customer service, sales, profits, and the consumer. The ability to move products efficiently has become a competitive advantage to those who are able to manage the movement of raw materials, packaging supplies and finished goods. There is a pressing need to make transportation event management, 'visible' in the logistics supply chain, so that product location and information are available when and where needed.

The mission of the Logistics Committee in the Voluntary Interindustry Commerce Solutions Association (VICS) is to take a leadership role in defining and promoting the adoption of standard practices for planning and enabling the efficient and effective flow of products. VICS and GS1 US, formerly the Uniform Code Council, Inc., are working on establishing a closer working relationship with the American Trucking Association (ATA):

- VICS publishes implementation guidelines for a number of the transportation-related X12 Electronic Data Interchange (EDI) transactions.
- The VICS EDI implementation guidelines for the transportation transactions are being reviewed and updated.
- The ATA, VICS and GSI US are coordinating this effort.

2. Proposal

Fleet management (FM) is a term used to encompass the management of all aspects relating to a company's fleet of vehicles from the allocation of resources to fuel economies. Corporations with large fleets of vehicles require some sort of system to determine where each vehicle is at any given time. FM systems are widely used by transport companies. Unfortunately, in the SC, suppliers, consumers and transport companies do not share the valuable

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information obtained from their FM systems. If a supplier or a transport company uses a FM system, it improves the management of his fleet but not accurate information to consumers is given. The only information that it shows is the state of the delivery. UPS for example show in his Web page states such as "In transit", "Out for delivery" or "Delivery exception". This kind of information could be interesting to a final customer who is expecting an individual article but not to a large automobile company expecting hundreds of goods. Much more accurate and detailed information is needed if the customer wants to integrate transport information from his SC together with his information system in order to accurately forecast plan and schedule.

There exist some companies that provide real-time and predictive traffic information, one of the newest is Inrix Inc., a nationwide provider of traffic information technologies. Information comes via the collection of real-time and historical sensor data from hundreds of public and private sources including real-time GPS data from more than 500,000 commercial fleet, delivery and taxi vehicles. Although it could be a very accurate, we do not believe this to be the best solution for a transport company due to the fact that the set of routes that their drivers use is limited and the interoperability between other companies is zero.

Due to the hundreds of deliveries commonly carried out each week by each company, the most relevant data for any transport company can be retrieved using its own FM system. All the routes followed by the fleet could be stored and used to accurately forecast delivery times.

2.1 Architecture

A method developed for the prediction of future locations was adapted for transport applications. The prediction system, Ontheway [3], yields the possibility of predicting those places visited when a new path is taken. This forecast is made using a database of historical paths. Although there were overstrike paths, often small changes taken on the paths allowed the OnTheWay system to determine the correct destination. The results were very promising because the remaining distance to the destination, measured as a straight line, was on average 69.65% of the total path and the remaining time to reach the destination was more than 70% of the total. The experience was developed in urban and interurban journeys and its success was due to the data gathered on the everyday behaviour of people who joined in the experience. Behaviour was analyzed using the tracks generated by the GPS carried during all the daily displacements.

In the scenario where supplier companies deliver goods to consumer companies, although each route taken by the drivers from the suppliers may be changed daily, the delivery points and depots are nearly always the same and hence periodical repetitions observing global deliveries from the company produce consistent behaviour that could be used to forecast some important data.

This situation allows the generation of a global database with geographical and time series information from whole trips carried out by drivers. The database could be examined to retrieve accurate forecasts of the time needed to complete a delivery or the best routes to use in an exact period of time to reduce the time used by the driver to reach the destination. Retrieved information (forecast of delivery time and the best routes on each moment) could serve to offer a better service to consumers and to enrich the knowledge of the fleet's drivers, both for experienced and new employees, whose learning curve will be increased.

Our proposal is a service-oriented architecture (SOA) which tracks vehicle functions via the fleet management systems. The use of SOA allows loosely coupled software services to support the requirements of different processes and software users. It is not tied to a specific technology and may be implemented using a wide range of interoperability standards.

Our solution allows the exchange of accurate transport information between drivers, suppliers and customers. The flow of information is described here:

1. Paths followed by drivers during their journey are stored by their GPS devices and sent to a central database. These paths include geographic and time series information which allows the construction of a "Vehicle Routing Problem with Time Windows" (VRPTW). The objective of the VRPTW is to deliver to a set of customers under a specified time constraint with known demands on minimum-cost vehicle routes originating and terminating at a depot. Time series information in the database improves the accuracy of the VRPTW and is used to assign routes to the drivers. In [1] we can see an interesting case study and [2] shows one of the newest techniques to solve it. When a delivery is about to be carried out, the communication system of the vehicle connects periodically to the web service "Requester WS" in the supplier server by using wireless access (UMTS, GPRS, GSM) and reports the expected time of arrival.
2. When the supplier software has enough information, it communicates the delivery time forecast to the Web service in the consumer "Local WS". If delays are produced, it will notify the Local WS to prevent chain delays.

3. Finally, the forecast information is integrated into the logic tier of supplier software in order to allow the interoperability of the transport information between supplier and consumer.

2.2 Implementation

We are reproducing the scenario using Royaltek Bluetooth GPS. Due to the impossibility of storing these tracked paths on the device, a Dell Axim X30 PDA was used to store the routes on NMEA format and we transform them to KML format, very useful to obtain a correct visualization on the software Google Earth.

WiFi capability of X30 is being used to allow the communication, but the reduced number of WiFi access points in Andalucia makes it non-viable. So we are studying UMTS devices with storing and processing capabilities.

.Net Platform was used to develop the Web Services on the supplier and consumer information system, so the description of Web services is in WSDL.

3. Conclusions and future work

Although there exist solutions for the forecast of traffic such as the Inrix Inc, we do not think it would be necessary so much data for forecast deliveries time because supplier entreprises have some fixed points to distribute their products.

Using only the drivers' experience on their displacements, we could extract accurate and reliable information to forecast deliver times. This data was only used by suppliers or transport companies but not by consumers, so we think that integration on their information systems could help the interoperability between enterprises. Our proposal improves the current situation using an original system called "Ontheway" and used on the forecast of destinations, to obtain the inexistent interoperability on the transport layer.

Finally, we must highlight that another improvement when the implementation of our proposal will be complete is the creation of a database with knowledge for drivers that improve their routes and reduce their delivery times.

Our future work will be the change of some hardware to enable UMTS communication with online transmission of encrypted data using GPS track function.

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