REAL-TIME TRACKING AND INCIDENCES MANAGEMENT

Improving the Transportation of Industrial Equipment through an ICT Solution

Asier San Nicolás, Ignacio Angulo, Asier Perallos and Nekane Sainz
Deusto Institute of Technology - DeustoTech, University of Deusto, Avenida de las Universidades 24, 48007, Bilbao, Spain

Keywords: Goods traceability, Transportation of industrial equipment, Fleet management, Incidence recovery.

Abstract: This paper describes an ICT solution for real-time tracking and fleet management which can be applied in distribution of industrial equipments, in order to improve the traceability of such goods. The solution includes a support sys-tem for the driver that is capable of reporting the route that has to be followed and notifying incidences that occur during the trip, resolving them as soon as possible. A first prototype has been developed and its functionality validated through a simple test case. In addition, future actions to improve the system are shown.

1 INTRODUCTION

In few years, logistics processes have improved substantially resulting in an increase of the productivity, competitiveness and quality of services, through new technologies (Cleland, 2007).

There are three main industries: agricultural, pharmaceutical and the unexplored sector of the distribution and transportation of equipments where traceability, as well as the capacity to get an efficient fleet management, route planning and incidences recovery, will increase the productivity of the manufacture companies.

The result of the work described in this paper is an ICT solution for real-time tracking and fleet management which can be applied in the transportation and distribution of manufacture equipment. This innovative solution is able to manage routes, as well as onboard support to the carriers, enabling an agile response to incidences. In following sections the related work, the context as well as its functional requirements, technical description, challenges and innovative contributions are presented to end with a prototype and some results obtained in a test scenario.

2 RELATED WORK

The importance of tracking goods has reached such a point that is being regulated by law in some countries. For example in Europe, Regulation 178/2002. This is one of the reasons because most of the projects about tracking are focused on the food industry, the Trace FP6 project or those ones based on RFID technology and described in (Abad, 2009); (Kelepouris, 2007); (Manikas, 2009). There are other critical sectors as the pharmaceutical one. Thus, the PharmaX initiative is proposed to shed light on the pharmaceutical traceability and overall-process regulation, (Huang, 2010). Other related challenge is the use of ICT to improve logistic processes in intermodal transportation, as is being done in TIMI project.

When performing, they are seeking the following benefits: processes automation, turnover increase, and stock management improvement (Bertolini, 2010). Other sectors are for example, Galeria Kaufhod in retail clothing market using RFID to automate logistics processes of the store, (Al-Kassab, 2010) and Dell Company who changed from barcodes to RFID (Crowl, 2006).

The transportation of industrial equipment has some additional technological challenges to be faced, such as interoperability with manufacturing information systems, real-time fleet and goods traceability, management and monitoring of the route and job actions, providing of onboard information to carriers, and real-time incidence management and recovery. The result of our work is an ICT solution with real-time tracking capacities for improving the incidence recovery timing in the transportation of industrial equipments.

San Nicolás A., Angulo I., Perallos A. and Sainz N..
REAL-TIME TRACKING AND INCIDENCES MANAGEMENT - Improving the Transportation of Industrial Equipment through an ICT Solution.
DOI: 10.5220/0003498402100213
In *Proceedings of the 6th International Conference on Software and Database Technologies* (ICSOFT-2011), pages 210-213
ISBN: 978-989-8425-76-8

3 FUNCTIONALITY AND TECHNICAL FEATURES

The scope of the project covers all the stages included in the distribution process of industrial equipment. At this point, functionalities, (Figure 1), and its technical implementation are described.

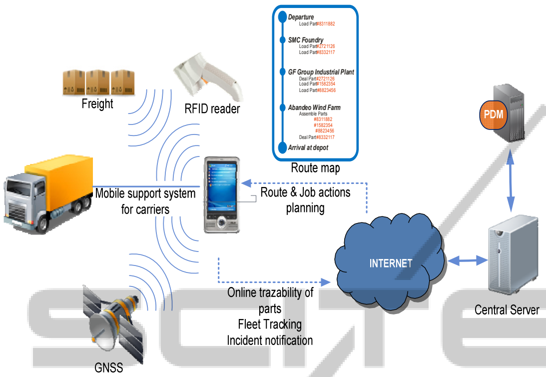

Figure 1: Architecture of the proposed solution.

3.1 Planning, Route Monitoring and Job Actions Management

The planning server receives information about the pieces that will be needed to transport. This is done by integrating our server with the Product Data Management (PDM) system. The integration is done using SOAP messages to a web service developed for the PDM system. As result, the planning server can get information about the materials needed for each task, their physical characteristics, the place of collection and delivery, and all actions needed for final assembly of parts. This information is used to generate truck routes. The actions included are the collection or loading of materials, unloading and subsequent assembly and installation of different components that make up each end equipment, so as maintenance activities required by them. Once established the routes through a simple algorithm, these are sent to the staff by the “carriers supporting device” to be executed in the shortest possible time. This route is stored in what has been called a route document, which is an XML with a unique identifier that includes hierarchically the stops on the route, the actions to be carried out at each stop and parts involved in every action. Both route points as actions are displayed in the order they should be performed. It should be mentioned that after delivering it to each vehicle it can be dynamically altered during the course if it is necessary.

Any transfer of information between planning server and each onboard device will be carried out by sharing and updating this document.

3.2 Fleet Online Tracking and Traceability of Parts

The document with the route and list of actions is stored in an onboard mobile device, implemented on a smart phone. This device is responsible for sending periodically the position of each vehicle, so all vehicles can be monitored through a basic real-time fleet tracking system as well as storing routes performed by each vehicle for further analysis. Moreover, all the parts handled by the system are labeled with an RFID tag that allows tracking and ensures the proper selection of the different parts involved in each job action. Traceability of the parts is performed by the carrier with the help of a portable RFID reader. The information stored by the tracking system can locate the source of each piece installed in an equipment and the current location of each piece supplied.

3.3 Carriers Supporting Device

Each employee responsible for a vehicle has a mobile which hosts a resident application, with driving support to reach each stop on the route established, and which shows the list of job actions to be carried out at each point, the parts or materials involved in a particular action, and allows validating the implementation of these actions through the traceability system. In addition, through GPS, system notices the driver when is arriving to a point of the route, helping him find the place.

3.4 Incidences Management

The system distinguishes between manual incidence (required by a worker) and automatic (directly sent by the mobile device); and from emergency incidence, which must be notified immediately to the planning server, or informative because it does not significantly affect how the transport service is done. When materials are being recorded by RFID and a product that should not be read is registered (part is not included in the route document) or when concluding an activity without validating document specifications, an automatic incidence is generated and written in the XML file, indicating the details and where it has occurred. Apart from this, the application allows writing an incidence manually by the driver himself filling out a simple form. If in this form the incidence is marked as urgent, it is sent to the scheduler at the time. In these cases the scheduler can plan again the route of one or more trucks, shorten the route of the truck concerned or just do nothing.

4 TESTING AND EVALUATION

In order to validate the system developed, a test route has been created for a truck with 3 stops: Gamesa, Acciona WindPower and WindFarm “La Muela”, which must initially be accessed sequentially. At each stop, a number of actions must be made: in Gamesa, to charge 3 turbines of type A and a propeller blade of type A; in Acciona WindPower, to discharge the propeller blade of type A and to charge two propeller blades of type B and one turbine of type B; finally, in WindFarm “La Muela”, to discharge 3 turbines of type A, one turbine of type B and two propeller blades of type B. See the route details in Table 1.

This route will test the basic functionality of the current system: communication platform, fleet and foods tracking, on board support information, and incidence detection. Other capacities, such as intelligent planning of routes and job actions, will be developed and tested in the future.

Table 1: The initial route, its location coordinates and the job actions Numbers in brackets represent the units

Place	Long.	Lat.	Act.	Parts
Gamesa	-2.8587	43.2855	C / C	Turbine A(3)/ Blade A (1)
Acciona Wind Power	-1.6391	42.6119	D/C/C	Blade A (1)/ Turbine B (1)/ Blade B (2)
Wind Farm	-1.1575	41.5930	D/D/D	Turbine A(3)/ Turbine B(1)/ Blade B (2)
C:Charge. D:discharge				

Once the carrier is authenticated by the mobile solution, the route of Table 1 is downloaded from the Planning Server. Once route is shown by the mobile application, transport service starts driving to the first destination. Fig. 2 shows how the Planning Server is receiving positioning from each vehicle.

When vehicle approaches the desired place (Gamesa), the location icon in the mo-bile application changes of color and warns us. Once in destination, the driver chooses the option “Actions TODO” in the application menu. After choosing the action “Charge”, mobile device establishes Bluetooth connection with the RFID reader and records appropriate part IDs (turbines of type A and propeller blade of type A) to complete the action. Figure 4 shows the user interface of the mobile application which enables to perform the functionalities described above.

Once all actions assigned in the first stop are correctly performed, carrier drives to the second one, Acciona WindPower, where two actions are planned. The first one, which is discharge a propeller blade of type A, is performed validating the RFID code. And in the second action, which should be charging one turbine of type B and two propeller blades of type B, RFID reader only registers two propeller blades, so when employee ends this action, the application will alert him indicating that some materials are missing.

Figure 2: Initial planned route and tracking position.

Figure 3: Carrier support mobile application.

Accepting this issue, an automatic incidence is automatically sent to the Planning Server. The route will be changed by adding an additional stop where retrieve lost (see Figure 4).

This route is sent to our mobile device and with the updated route we can continue the job. Now we have a new stop (Eólicas Riojanas, S.L.) where we have to collect the material we needed (one turbine of type B). Thus, arriving at WindFarm "La Muela", we can discharge all the components we have.

After finishing the test we can conclude that we obtain the expected results, detecting incidences in real time and minimizing the time needed to manage them.

Figure 5: Route changed: an additional stop.

5 CONCLUSIONS

The result of our current work is an ICT solution with real-time tracking capacities for improving the incidence recovery timing in the transportation of industrial equipments. It is considered an innovative solution because it faces technological challenges concerning to this transport, such as interoperability with manufacturing information systems, real-time fleet and goods traceability, management of the route and job operations, onboard information to carriers, and real-time incidence management and recovery. Now, a first prototype has been successfully validated.

The current implementation of the system uses passive RFID tags that should be verified by a portable HF RFID reader which connects to the mobile device by simply sending ID codes of the RFID tags. These passive tags can be replaced by active ones which can store more information and improve the reach of the reader. In that way, the employee does not have to validate each individual piece with the portable RFID reader, but can perform the tasks of loading and unloading of materials being automatically validated. Consequently the traceability of goods can be carried out in a non-intrusive way (without modifying the behavior of transport staff). This will made the system portable to other areas such as rail or pharmaceutical. Other important aspect of future work must be to improve the way in which the planning of the routes and job actions is done, because a non-automatic process is used in this moment. A higher level of automation in the task of rescheduling, based-on the use of Artificial Intelligence techniques, is a desirable issue.

ACKNOWLEDGEMENTS

This work has been funded by the Ministry of Industry, Tourism and Trade of Spain under Avanza funding program (Grant TSI-020100-2008-582). Special thanks to Avangroup Business Solutions, S.L. for their support.

REFERENCES

Cleland-Huang, J., Settimi, R., Romanova, E., Berenbach, B. and Clark, S., 2007. *Best Practices for Automated Traceability. Computer, Vol. 40, Issue 6, pp. 27-35.*

Schwägele, F., 2005. Traceability from a European perspective. *51st International Congress of Meat Science and Technology (ICoMST), Meat Science, Vol. 71, Issue 1, pp. 164-173*

Abad, E. et al. 2009. RFID smart tag for traceability and cold chain monitoring of foods: Demonstration in an intercontinental fresh fish logistic chain. *Journal of Food Engineering, Vol. 93, Issue 4, pp. 394-399.*

Kelepouris, T., Pramatari, K., Doukidis, G. 2007. RFID-enabled traceability in the food supply chain. *Industrial Management & Data Systems, Vol. 107 Issue: 2, pp. 183-20*

Manikas, I., Manos, B. 2009. Design of an integrated supply chain model for supporting traceability of dairy products. *Int. Journal of Dairy Technology, Vol. 62, Issue 1, pp. 126-138*

Huang, G.Q., Zhifeng Qin, Ting Qu, Qingyun Dai. 2010. RFID-enabled pharmaceutical regulatory traceability system. *2010 IEEE International Conference on RFID-Technology and Applications (RFID-TA), Guangzhou, China, pp. 211-216*

Bertolini, M., Bottani, E., Rizzi, A., Volpi, A. 2010. The Benefits of RFID and EPC in the Supply Chain: Lessons from an Italian pilot study. *The Internet of Things, Part 4, pp. 293-302*

Al-Kassab, J., Blome, P., Wolfram, G., Thiesse, F., Fleisch, E. 2010. RFID in the Apparel Retail Industry: A Case Study from Galeria Kaufhof. *Unique Radio Innovation for the 21st Century, Part 4, pp. 281-308*

Crowl, S., Mares, V., Moore, M. 2006. Radio Frequency Identification (RFID) application at dell computer. *IEEE Engineering Management Conference, Austin, TX, USA, pp. 28-30.*