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TRACK & TRACE SYSTEMS APPLICATION IN THE SUPPLY CHAINS

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Key words: *Supply chain, track, trace, information technology, communication technology, bar-code, RFID, OCR.*

Abstract: *Thanks to applying of the newest achievements in the information and communication technologies (ICT), Truck and Trace systems experienced their rapid development. Users can benefit from the wide range of services as real-time giving the information about the traffic conditions; generating different traffic messages or signs on traffic displays; displaying warnings about traffic accidents, and traffic jams, including the expected delays on the route;location of the vehicle and/or load, and so on. ICTallow the control and adaptive road traffic management. For such applications implementation, it is necessary to possess adequate data.*

If the supply chains are understood as series of the basic logistics functions (transport, reloading, storage), it is not difficult to conclude that they coincide with the information chains that represent adequate physical activities. Related to the information flows' management, it is to expect that the information flows are precursors to the commodity flows. The information flows need to ensure timely and smoothly functioning of the physical processes in the logistics chains, with optimal costs.

The article considers some of the characteristics and the possibilities of implementation of the Truck and Trace technologies in the supply chains. Special attention is paid to some basic load identification technologies used to support the Truck and Trace systems, as thebarcode, RFID,and OCR.

1 INTRODUCTION

Although popular and today very present, logistic chains are exposed to various risks, ranging from prolonged retention of items on reloading places, to the theft of shipments, directing shipments to the wrong addresses, and even damaging the shipment or spoilage of perishable goods. So-called "cold chains",e.g. in the pharmaceutical supply chains, they are exposed to special risks.Also, counterfeitproducts and illegal exports and imports can easily enter unsecured supply chains.[1]All participants in the logistics chain are interested in raising quality. Giving information about the vehicle and the goods during the transport process is one of the quality parameters to whom is given a greater importance.Today's information systems of many forms of transportation, with the use of information technologies such as

GPS, GTIN, RFID, GSM, the Internet, and others, are able to provide,to stakeholders, information about the goods in transportation, such as the current location, status and expected atime of departure of the consignment.

The high volume of global industries implemented these technologies, but with limited capabilities in the international transportbecause of poor coordination between logistic operators. So, one can say that tracking technologies are implemented fairly little in the global logistics networks[2], and thatthe intermodal transportation is steel characterized byinefficiency, lack of speed, poor quality, inadequate information on the movement of goods and transport means, as well as the unpredictability and uncertainty about the exact time of arrival of the goods.AbtinHamidiin his interview said: “A lot of them (inefficiencies - author's note) are operational in nature like track and trace. In one typical transaction, there is something like 16 calls for track and trace between broker/dispatcher/customer. There is so much activity to trace one truck and it just seems silly that with something like Uber it is automatic.”[3] For now, the most visible results have been achieved in the postal traffic, although there is still much room for improvements.

In many distribution centers, for logistics and production tasks, wireless devices are used, but only a few organizations have fully automated their processes. The most commonly, fully or partially, automated procedure are the functions of selection, reception, dispatching, and inventory management. According to a research of the Peerless Research Group [4] major areas in which mobile/wireless solutions are used are: warehouse operations (71%), shipping, receiving, dock and yard (61%), manufacturing plants (39%), distribution centers (38%), logistics (27%), and transportation/freight/fleet (21%). When evaluating mobile data collection devices, 99% of respondents view ruggedness as the top criteria. The very next criteria are scanning accuracy together with the communication capabilities 96%. Mostly satisfied with current data collection technologies are 64% of the respondents.

For data collection, currently, barcode and RFID are mostly in use, but nowadays OCR is coming into focus. A comparative analysis of the satisfaction with different concepts is shown in [4]. Basics of the automatic data collection systems are explained in [5] and here will not be discussed. It seems that the barcode will be a leading technology for a longer time. QR code allows storage of more data on less space and it is to expect its bigger share in the future. Mobile devices give the strong support to this technology. RFID technology gives excellent performances in some applications, e.g. warehouses stocktaking and parcels registering, because it doesn’t need visual contact between the marks and readers. Some of RFID applications are explained in [6], [7]. Barcode and QR code are easy to read for different devices, but not for humans. For humans, OCR technology is the most convenient technology. It allows more compact and readable record, even written by hand, but also demands special, more complex hardware. Some of theexamples in OCR use can be found in [8], [9], etc.

2 TRACK AND TRACE SYSTEMS

As the literature survey shows, the use of track and trace systems provide many positive results to all participants in the logistic chains. Polls show that professionals predict a rise in investment in mobile solutions and the increased use of tablets and mobile printing of barcodes, but they still insist primarily on the reliability and robustness of devices and systems they use.

Barcodes best fit in cases where their primary function is identifying of parts or items in difficult circumstances, such as the identification and tracking of luggage of passengers in the air transport.The barcodes are very durable in rough handling and severe conditions but require much more space on the labels and documents than it is required for OCR. OCR can contain up to six times more information than a standard barcode on the same surface.

RFID has an advantage when it is difficult to provide a line of sight between the tag and the reader, and especially in cases of warehouses stocktaking.

According to Gartner, track and trace technologies enable a product's status to be captured through the value chain, and to retrospectively identify and verify its path. Solutions typically include elements for (1) associating products or materials with unique identifiers (UIDs); (2) capturing events at various points in the supply chain; and (3) performing analytics and reporting on the information. Some solutions include messaging to share information with regulatory agencies or trading partners, and some also support capabilities for product authentication. [10]

Track and trace systems usually consist of three main components:

- Portable Data Terminal (PDT),
- Workstation for monitoring and control, and
- Track and Trace Host computer with special software.

2.1 Process of shipments monitoring by using Track and Trace systems

Shipments monitoring process starts in the receiving phase, with consignments bar-code label gluing. The labels contain the reception number. This tracking number is registered in all the reception documents. The process of reception is unique for all transport units, regardless of whether they are automated or not. In addition to tracking shipments, track and trace systems monitor containers in which the consignments are located. Containers are monitored by printing and gluing bar-code labels when closing. The structure of barcode labels for container contains information about the serial number of the container, the type of container, and the places of the preparation and the destination. For acceptance of all data Track and Trace system, including those from non-automated transport companies, there are established centers for remote data entry and shipments tracking in stages of receipt and delivery. Non-automated centers provide a list with information about shipments they received: the number of shipment, delivery status, the name of the recipient, the method of delivery, etc.

2.2 Pros and cons of the Track and Trace systems

Track and Trace systems contribute to increasing the efficiency of delivery, operations productivity, income, and quality of service by reducing or eliminating the unnecessary and cumbersome paperwork. As it was mentioned in 2.1, it is not necessary that all transport companies are automated. But,implementing of track-and-trace systems requires not only technology on the packaging lines.It demands achange of management within the entire supply chain. There are several ways companies can leverage track and trace to produce business benefits [11]: basic regulatory compliance, improved operations, competitive advantage, vast management, combat parallel trading, avoid brand damage, improve recall management…

Some advantages and disadvantages, however, could arise from the type of system applied to GPS vehicle tracking. There are three main types of GPS vehicle tracking, tracking wireless phones based on passive monitoring and GPS satellite tracking in real time. About it, see [12].

It is hard to find complaints about the Track & Trace system use in terms of technology, and the results achieved. The main objection could be given from a psychological point of view. Transport companies want to gain control over the movement of shipments and vehicles, and some truck drivers are considered endangered due to loss of privacy. Also,there is much debate about the use of GPS tracking in criminal cases. Some examples of that are shown in [13].

3 INFORMATION FLOWS IN INTERMODAL TRANSPORT

Today's users have at their disposal a number of options for the transfer of information, and they can use:www (the Internet, intranet, extranet), e-mail (internal and external communications, channels for ads), telephone (desktop and mobile), telefax, PC (desktop, portable, HD, USB memories, …), and/or documents on different media and in different forms.

Establishing of adequate flow of information in an integrated transport system improves its functioning, facilitating the management and planning of the transport process, and increases the quality of transport services. Track & Trace function provides a complete overview of all shipments thanks to a clearly structured appearance, ranging from ordering to delivery.The whole supply chain as well as details about a specific shipment can be viewed using the Internet.Whenever a change or new information on consignment occur, shipments tracking history is updated and clearly displayed.A search of shipments can be according to the criteria of one's choice (order's number, thenumber of air waybill (AWB), the number of the ship's bill of lading (B/L) ...). According to Villadangos, the most relevant problems lay in the fact that there is a set of highly variable components, "given that the freight loads are to be network elements in each transport and the algorithms have to adapt themselves to different situations: distinct elements, different measurements to gather, different working conditions for the system, etc."[14]At the same time, the communications system needs to be designed to facilitate the transmission of information from each wagonto the railway infrastructure".

The Internet offers many opportunities for modern user-oriented doing business in the field of transport. This is good illustrated in an example of the Finnish railways, which were the main initiator and bearer of the project on the use of the Internet [15] to track the movement of goods in transit.

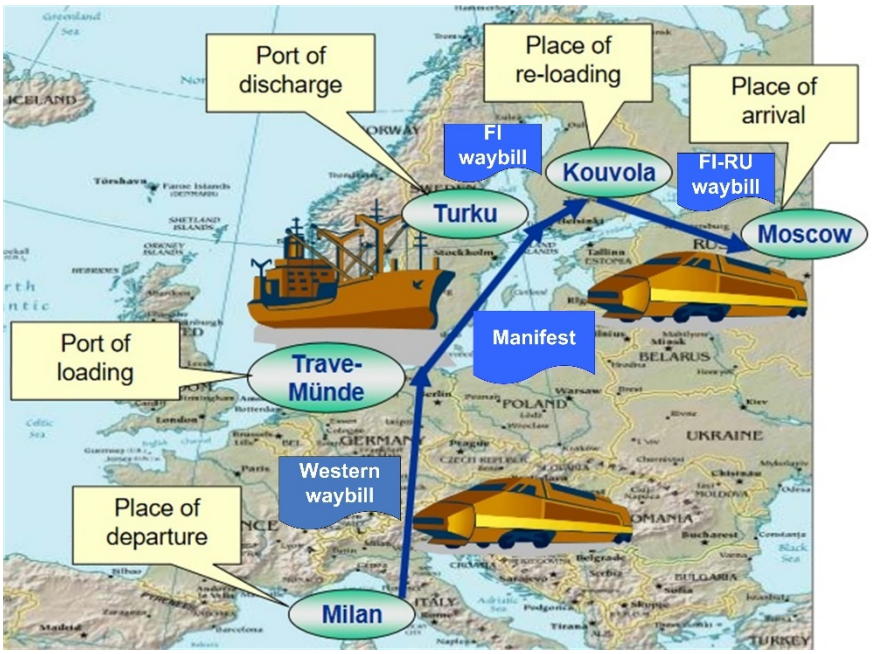

Figure 1 An example of an intermodal chain - material and the information flows
***Source:Authors' compilation on the basis of S.-L. Holmberg's article*[16]**

On an example of transport of goods from Milan (Italy) to Moscow (Russia) [9], there can be seen flows of goods and information during the transportation and the idea of using the Internet. A part of this transportation chain is shown in figure 1.

RailTrace service has emerged as a result of a study ofthesedays'situation and analysis of clients' needs carried out in 1997[17]which showed that customs services and recipients got

information about the upcoming shipment when it is practically on their destinations. Railway operatorsdue to the lack of timely information couldn't optimize their resources, notably mobile capacities (wagons and locomotives).RailTrace is a part of a wider project named TEDIM [18].It was realized as an information system that integrates, processes and disseminates information related to managing of the delivery of consignments, i.e. waybill data about the wagons, and multimodal and container shipments to various stakeholders and operators, globally over the Internet.

The implementation of this system has enabled:

- more effective planning of wagons' capacities;
- faster response to the clients' questions on the status of the wagon;
- a search of consignment, not a wagon, as up to now it was the case in the railways
- improving and speeding up the reports on deviations
- simplifying the search procedure and its lifting to a higher level
- improving the control of the transport on the "critical" sections;
- simplifying and accelerating of customs procedures at borders;
- improving the exchange of information between the parties involved in the process.

Direct results of the project were improving the quality of services for users, more efficient planning of wagons' capacities, and last but not of the least importance, time-saving in formalities at borders.

4 CONCLUSION

Establishing of adequate flow of information in an integrated transport system improves its functioning, facilitating the management and planning of the transport process, and increases the quality of transport services. Track and trace technology can reduce costs and challenges in the transportation of parcels and containers in the logistics chains. As the research showed, track and trace systems offer benefits to all stakeholdersin the logistic chains. It is to expect a rise in investments in the mobile solutions together with the increased use of tablets and mobile printing of barcodes. Althoughusers can use different devices for the barcode readings, the most of the usersinsist on the reliability and robustness of devices and systems they use.

Barcodes showed good results in cases where their primary function is to identify parts or items in the hard and demanded environment with rough handling, e.g. the identification and tracking of luggage of passengers in the air transport. They are durable but require much more space on the labels and documents than it is required for QRC, RFID or OCR. QR code becomes increasingly popular, especially in the labeling of the single packages and containers.RFID has abigadvantage in cases where it is difficult to provide a line of sight between the tag label and the reader, particularly in cases of warehouses stocktaking. OCR has a very concise record which can contain up to six times more information than a standard barcode on the same surface. A special advantage of OCR is its readability for humans.

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ПРИЛОЖЕНИЕ НА СИСТЕМИТЕ ЗА ПРОСЛЕДЯВАНЕ И ТРАСИРАНЕ ПРИ ВЕРИГАТА НА ДОСТАВКИТЕ

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Ключови думи: *верига на доставките, проследяване, трасиране, информационни технологии, комуникационни технологии, бар код, RFID, OCR.*

Резюме: *Благодарение на постиженията на информационните и комуникационни технологии (ИКТ), системите за проследяване и трасиране също бележат напредък в своето развитие. Ползвателите се възползват от широката гама услуги, предоставяни в реално време относно условията на трафика, уведомяване за възникнали пътни инциденти или наличие на задръствания, както и очаквано закъснение на превозното средство, неговото точно позициониране и т.н. ИКТ позволяват контролирано и адаптирано управление на автомобилния трафик. За да намерят приложение подобни системи е необходио наличието на съответната надеждна информация.*

Ако приемем, че веригите на доставките включват набор от логистични функции (транспорт, претоварни операции и складиране), то тогава няма да бъде трудно да се определи, че те всъщност са равнозначни на информационните вериги, които включват серия от физически операции. Във връзка с управлението на информационните потоци, може да се определи, че те предшестват товаропотоците. Необходимо е информационните потоци да осигуряват навременно и правилно функциониране на физическите процеси в логистичните вериги при оптимални разходи.

Настоящата статия има за цел да разгледа някои от характерните черти и възможности на технологиите за проследяване и трасиране при веригата на доставките. Специално внимание е отделено на някои важни технологии за идентифициране, използвани при проследяването и трасирането, като баркодовете RFID и OCR.