RFID AS A TOOL OF COMPETITIVENESS INCREASE OF RAIL FREIGHT

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Abstract: Nowadays huge of goods is transported by road although there is requirement to greener logistic. Unfortunately if rail freight transport wants to be competitive to road transport, many changes must be done. Slovak railways freight transport has many barriers and bottlenecks and although private carriers are not real competition right now, later situation can change. So there must be new ways how to improve goods transport while anticipating resource and environmental constraints. From that point of view, implementation of RFID technology sounds as good solution for increase of competitiveness of rail freight.

1   Introduction

Railway transport depends on the amount of rail infrastructure, and railway capacity is a function of three basic areas which influence it. Firstly, it is the management of flows and operations, secondly, how efficiently resources and assets are used, and finally overall basic track structure. Railway transport is a core topic to nation economies, as it supports employment as well as economic growth. And also because of its global character, actions must be more effective which asks for stronger international cooperation. Transport is at its crossroad in Europe nowadays. European western and eastern parts are not united and that is the reason why they do not fully reflect the transport needs. To keep transport greener means to use more of railway transport and intermodal transport for freight, which has many advantages in comparison with "traditional" transport, for example:

- relatively low costs on medium and long distances,
- safety,
- less emissions,
- low agricultural land is occupied by railway transport,
- in comparison with road carriers there is lower traffic restriction … etc.

2   Situation of the Slovak Republic

Nowadays there are many various economical opportunities for Slovakia thanks to transport corridors, for example access to new markets or increase potential of logistic functions. New TEN-T corridors help to produce very positive impacts not only on the economies of big cities but also for local urban systems. The main reason is that investments become more attractive and also the increase of local opportunities for innovative systems and new services are predictable. Plus bigger using of communication and information technologies should provide new opportunities for increasing availability in an intelligent way.

2.1   *Characteristic of the Slovak railway freight transport*

There are more than 30 different freight transport operators in the Slovak Republic, but Železničná spoločnosť Cargo Slovakia is still the biggest one. The main business of ZSSK Cargo Slovakia, a.s. is the provision of rail freight transport services, and the company performs transport and commercial activities on the basis of valid license to provide transport services issued by the Transport authority. The market share of the company in the rail freight transport in the Slovak Republic in 2014 amounted to about 80 percent. In addition to the ancillary services directly related to the implementation of freight and combined transport, its second main product is services related to leasing rolling stock, maintenance and repair [1]. National freight transport together with international freight transport was more than 36 million tons of goods in 2014 [2]. Thanks to its solid market position, other private carriers are not real competition right now. On the other hand, huge competition can be felt from the road freight transport which still dominates in the Slovak Republic. Although there are many disadvantages beginning with the customs control (still carried out on Slovakia-Ukraine border) thru differences in technical standards between countries to the different level of infrastructure finally, two biggest advantages – costs and speed – overtrumped disadvantages of the road transport. Another very topical problem is lack of information about containers. It is the reason why it is necessary to focus on automatization on freight railway transport.

Nowadays the registration and numbering train sets out manually. Automatization will bring many positive factors to the train controls. To the main advantages belong for example:

- increasing of service quality,
- possibility to monitor shipment by customers,
- shortening the journey time,
- lower rate of error due to human factors,
- higher efficiently transport thru monitoring,

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- elimination of paper documents, etc.

But there are also other areas where automatization could be useful, for example:

- monitoring of the wagon technical conditions,
- date of last repairs or maintenance, etc.

The system which fits into the required concept of transport telematics is very successfully developed. The system is RFID - Radio-Frequency IDentification based on radio frequency technology.

3 The usage of RFID technology

Some experts believe that RFID is able to replace barcodes in future. Truth is that both technologies have advantages and disadvantages [4]. Among main RFID disadvantages in comparison with barcode belong:

- higher price especially infrastructure components as sensors, terminals and RFID antennas,
- higher demands on data throughput of IS as mass reading of tags could during a short-term overloaded the information system,
- higher price of information carriers,
- it is impossible to read information by eyes (but in this case printable smart labels can be used),
- physical properties of signal spread (for example metal or liquid) and RF devices give restriction,
- the need of a pilot solution to validate the technology parameters.

On the other hand there are more advantages, for example:

- automatic identification can be done without direct sight,
- huge data capacity,
- information is given in real time which will improve the quality of production,
- it is possible to not only read information but also write (if necessary),

- increasing the quality of inventory management by reduction of losses and inventories,
- as it is contactless technology, the identification of the object requires neither precise positioning nor visibility,
- at the same time hundreds of tags can be identified,
- during the process the information could be added ad hoc,
- reducing the operation costs by unattended operation,
- encryption possibility,
- counterfeiting is difficult.

RFID has many ways of use in freight traffic, especially by rail. For example:

- exact location of the consignment is clear,
- cargo is protected against thefts or losses,
- information is topical and in-time,
- information can be collected on consignment.

Because of that, the RFID tag must be placed at the designated place to prevent thefts, losses or consignment damages during the transport.

There are many countries where wagons tracking is carried out by barcodes. But they are not suitable in bad or dusty weather as reading can be distorted. But RFID tags are readable as well. Also reading distance is several times bigger in comparison with bar codes.

4 RFID technology in the Slovakian railway transport

Freight wagons marking composed of letters and numbers system. The system is the same for all railways, members of International Union of Railways (UIC) and Organisation for Co-operation between Railways (OSJD).
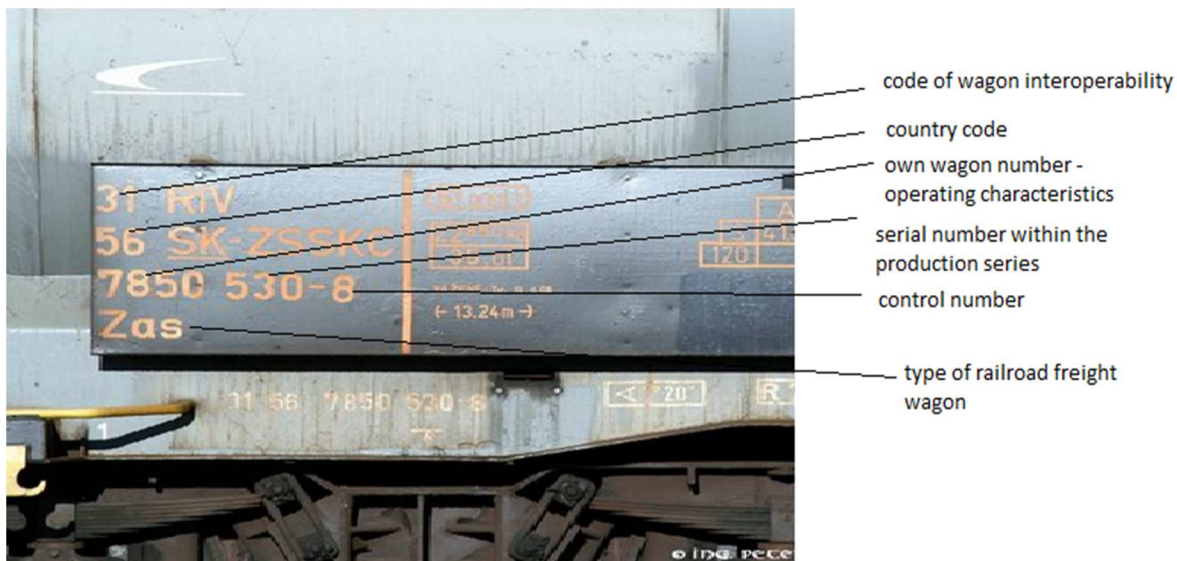

Figure 1 Railway freight wagon's marking

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The identification of wagons (currently in the Slovak Republic) is carried out by hand, railway stations employees identify a train set or wagons. Employees personally come over to a wagon and write back numbers to the consignment note. After that the numbers are put into the information system in the computer unit by another employee. Such wagon identification brings risk of errors.

Applied RFID technology allows to read a wagon's number automatically after passing through the gate [5], [6]. Then transmitting signal from an active RFID tag is transmitted to the computer unit. It is managed by an employee, who detects the change of state of the wagon. Important information is that RFID tags contains huge amount of information about wagons. That means more than only 12 digit-wagon-numbers but also the date of the technical inspection, the condition of the wagon, the type of goods, goods quantity carried in wagons and lots of other information.

RFID technology implementation brings:
- correct shifting of wagons which brings correct trains forming,
- detection of wagons downtime,
- train speed monitoring,
- statistical evidence of wagons,
- monitoring of the wagons movement on the railway system.

Lacking in information system is adequate to mentioned conveniences in Slovak railway stations. It means that detection of wagons number is hand done, and then database is creating by manual register the wagon in the system. If RFID technology will be applied, such database will be accomplished automatically. Slovak Railways, which missing electronic documents and records about the date and time of arrival and departure of the train set now, will be fully informed just in time. Information from the RFID tag will be transmitted in to the information system, in which will be possible to locate a particular wagon, records of dangerous goods, identified individual consignment and other features.

5 Proposition of tracking system for loading units and train set

The identification of the exact trains and cargo units positions, further collection of information about the consignment and safety of transported cargo are the main role of the RFID technology in railway transport.

RFID identification has many advantages, especially:
- increase the safety of the cargo unit,
- reducing of operating costs for printing documents,
- easier and quicker reporting of the cargo unit,
- operation cost savings (for example mailing costs, archiving, office supplies..)
- labour saving and labour costs savings,
- maximizing effectiveness,

- saving work of employees,
- location tracking,...etc.
But also railway companies use RFID will bring many benefits such as:
- better evidence of train sets and individual wagons,
- check trains arrivals and departures to and from the stations of destination for consignments,
- monitoring of the shipments,
- in case RFID are with sensors, there is possibility to have additional information about temperature, acceleration of moisture, grade or pressure.

6 Selection of suitable RFID tags under specific conditions and its methodology

Lots of different RFID tags are on the market nowadays. User selection is because of it difficult and good methodology will facilitate RFID selection [7]. Specification of parameters in the program displays a best result or results.

Step 1 is defining supplies of different producers and choosing a right system. Depends on requirements, the system can be passive, semi-passive or active.

Step 2 is defining objects of transport that are wagons and loading units from various producers.

Step 3 is selecting of suitable tag. Important is material, where RFID tags will be placed but also distance, because by then is possible to select the frame rate. Frame rate may be low, high, ultra high, microwave frequency or the latest frequency is the ultra-wideband. Requirements for registration of the RFID tag can be divided into read-only tag, tags on one write or rewritable tags.

Step 4 is necessity to solve the problem how big internal memory is required. Standard is 96 bit memory, but the memory tag can be programmed 96 bit + 1 or even the possibility to program the tag memory with integrated sensors 96 bit + 1 + sensor (acceleration, thermal, pressure, moisture, sensitive to chemicals, ...)

Step 5 the RFID tag is well defined, but the contractor may still consider the use of active, semi-active or passive tag. During making a decision, into account is taken a need of own power supply. Last question is, if there is possibility of using own resources to communicate with the sensor.

Step 6 is selection of suitable RFID tag is finished.

7 The concept of placing and data reading by RFID technology

Figure 2 shows possible placement of RFID tag should meet the required functions plus reached maximum uptime. Simultaneously must not be threatened by environmental influences. It is important that the tag is placed on the wagon in a manner best suited to the location of the reading device on a railway line. Even when train speed is high, location of tag must meet criteria, especially that reader was able to thoroughly and

quickly read information from the RFID tag. Design of reading device and its construction must be resist to the climate changes and external environment as changes of temperature, wind, solar radiation, humidity would damage a device designed to read the RFID tags contents which are placed on wagons. Construction equipment, as well, must be adapted to mention various conditions. The construction must be fixed to the ground on a concrete foundation, which, in case of bad weather, to avoid damage or destruction.

Figure 2 Possible placement of RFID tag in real conditions [3]

Conclusions

Nowadays shows, that way, how to improve railways services in Slovakia is to implement RFID technology. It brings benefits to all involved partners – for railway companies, carriers and customers as well. The main benefits are:
- possibilities to optimize logistics ways and processes,
- quick information among all partners which are involved and government offices,
- reduction of costs,
- higher efficiency of supply chain...
RFID is modern technology which significantly can change the capabilities of involved company to acquire data about the properties and location of any entity that can be physically tagged and wirelessly scanned within certain technical limitations.

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