THE IMPLEMENTATION OF AUTOMATIC IDENTIFICATION IN THE DISTRIBUTION PROCESS

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Abstract: Information is an important competitive tool, nowadays. Those, who dispose of them on time, gain the advantage of being able to take decisions sooner than competition. The recency and relevance of information is becoming a necessity also in the field of logistics chain management, especially the 100% traceability of the movement of shipments or goods is crucial not only for the distribution service provider but also for the customer who wants to know where his shipment or goods is. As "Industry 4.0" trends suggest, these requirements are increasingly extended to include data not only on the location of shipments, but on the identification of the owner of the goods, where the shipment was moved from and for what purpose and finally what triggered the activity. This "traceability" is based on the implementation of "perfect" information systems that must be filled with quality and correct data. In addition to data volume growing that will be generated by the various devices, same level of importance seems to be the electronic data exchange among stakeholders. The use of Automatic Identification Tools (AIDC) is the key to data collection in the field of logistics and distribution activities. The paper discusses the possibilities of implementing AIDC using RFID technology in the specific field.

Keywords: logistics, distribution, AIDC, RFID

1. Introduction

The systems of automatic identification currently provide irreplaceable help in identifying, registering and tracking any objects. The most frequently registered objects include goods in business, logistics and production processes and the second most frequently recorded element are people. There are several types of identification systems on the market. Such systems include a barcode labeling system. This technology has greatly shifted the automatic identification far forward and today it is hard to find any goods not marked with this symbol. However, RFID (Radio Frequency Identification) systems slowly take over the role of bar codes. Recently, the scientific discipline called Biometrics, which deals with the direct identification of people exclusively by using the human body structure, has been developing significantly.

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1.1. Characteristics of basic AIDC tools in postal distribution processes

The area called 'Automatic identification' includes barcodes but also magnetic codes used for example on credit cards, or machine-readable OCR that is part of RFID technology [4]. The study of the possibilities of using these technologies in the field of postal and logistics services for the needs of various industries is the subject of study by many authors [1], [2], [3], [4].

Barcodes

Barcodes are considered one of the most important discoveries of the 20th century. It accelerated certain economic processes, created new opportunities for economic growth and radically changed the world of trade.

A barcode is a label that consists of dark and light blocks (lines) separated by spaces. Their primary function is automated data collection. The barcode scanners use special sensors based on either CCD technology or laser scans. The scanner detects the differences in reflection and converts them into electrical signals corresponding to the width of lines and gaps. These signals are converted into numbers, respectively letters that the barcode contains. Each digit or letter is recorded in the barcode using predefined line and space widths. The data contained in the barcode may include anything: manufacturer number, product number, storage location, batch number, or even the name of a person with allowed entrance into otherwise enclosed space, item tracked in logistics chain, etc. The most important barcode parameters are the density and contrast of the code that determine the amount of encoded information. We distinguish between 1D, 2D and 3D barcodes. Some barcodes may only encode numbers, others may encode letters or even special characters, such as a dollar sign or "<" and ">", and so on. Each type of code has its own way of encoding characters into a set of lines and spaces. The theory describes about 200 types of bar codes. The European consumer comes into contact mainly with the EAN barcode system [10], [11], [12].

Radio Frequency Identification (RFID)

RFID includes many different technologies that use different frequencies, protocols and languages to communicate. The best-known RFID standard is EPC. This technology was first developed by an organization known as the Auto ID Center, bringing together global chains, manufacturers, researchers and technology companies - including ZEBRA. EPC consists of technical standards that define the operation of RFID chips and readers and data standards that define the characteristics of the data stored in the chips. The EPC standard is the responsibility of EPCglobal®, a subsidiary of UCC and GS1, who has developed the most widely used standard in UPC and EAN barcodes [10], [11], [12].

1.2. AIDC tools in logistics and storage processes

Real Time Location System (RTLS)

The RTLS platform is based on the ultra-wide band of wireless technology. It allows monitoring of the movement of objects in a defined space and in real time. Such monitoring takes place mostly inside the buildings, halls or other inner spaces. It also complements the Global Positioning System (GPS). RTLS platform consists of active UWB tags, UWB anchors and RTLS Server where the position software runs. The platform is used in production, in-house logistics, warehouses, shops or sports activities [10], [11], [12].

Voice picking of goods

Technology is often referred to as “Pick by Voice” or “Voice Picking”. It represents a comprehensive solution involving hardware and software equipment and implementation into the customer's WMS or ERP system. It is mainly used in the completion of shipments picking in warehouses and distribution centers, but it can also be used for example in the management of production and technological processes, in logistics, etc. [10], [11], [12].

Direct Part Marking (DPM)

DPM technology is used for permanent marking of objects. It serves as universal tool for automatic data collection and error checking. It is a barcode that is inextricably linked to the item or product to be labeled. Basically, used code is two-dimensional Datamatrix code, that can encode many characters in a minimum area. Datamatrix symbols can be read in many directions and with minimal number of errors. Typical areas of application are product tracking, process management and quality control of marking in various industries, such as in the automotive, pharmaceutical and food industries, in the manufacture of electronics, beverages and cosmetics, in tobacco processing, in health care, in supply etc. [10], [11], [12].

2. Aim and methodology

The identification and monitoring of the movement of mail (cage) containers by means of new technologies enables easy administration and management of container logistics. The main requirements include the traceability and control of container movements as well as the accumulation of transport units in distribution centers. The following section presents the options for implementing AIDC using RFID technology in the national postal operator's environment to ensure "real-time visibility, identification and monitoring of cage containers on wheels". Another aim is to verify the influence of the metal construction of the mail container on the readability of RFID tags and thus on the change of RSSI value. The presented results come from a pilot test measurement realized in the postal transport network during real operation.

3. Mail container monitoring system

The data collecting relates to the monitoring of active network elements and to the need to maximize the effectiveness of their management in the circulation process. The goal of the measurement was to identify the specified number of transport units in real time and at the right place (in terms of correct logistics behavior) [1]. All these aspects are important not only for the contractual customers of the postal operator (bulk mailers) but also for the postal operator itself. Bulk mailers, usually in accordance with the contractual terms, ensure the pre-processing of postal items (pre-sorting, marking of postal stamps, sticking of postal stickers, assembly into transport units, etc.), that means that mail containers are also used directly on the sender's premises. On the other hand, containerization at the postal operator premises takes place at different levels of the postal transport network (at different processing centers where consignments are consolidated and deconsolidated) [5]. This follows the need of a postal operator to ensure efficient and secure postal transport between individual nodes in the network but also an effective management of assets in relation to the circulation of means of transport and packaging (return of means of transport - crates, containers; overview of free/insufficient capacities in individual distribution centers, etc.). One of the ways how to solve this situation is using of AIDC with the possibility to monitor the transport units in real time.

Pilot measurement

The first step in the shipping of containers is to scan them in relation to their destination. The container must pass through the correct gate, respectively designated place of dispatch (at the place of loading), then the consignments are placed in a container and loaded into a means of transport (postal vehicles). However, if the loading area is different from the specified requirement, the system will provide an error message and it is necessary to provide correction in the information system to correct connection to the place of dispatch. The entire information flow management should allow traceability and full real-time control, as well as matching containers with specific shipments [2], [7], [8].

The implementation of the system offers several benefits: [3]

- increasing of the efficiency of shipment processing
- optimization of container logistics
- elimination of container accumulation
- elimination of container losses
- improving of the traceability of consignments
- reducing of repairs and maintenance costs

Selected processing centers and postal operator nodes were equipped with the necessary equipment for measuring and testing purposes based on the created web application [6], [7], [8]. Individual reading devices are connected to the database server via mobile internet. Middleware that was connected to the central server was used to manage and filter the data. Using the application, the postal operator could check the location of the containers at the selected processing centers.

During the measurement, attention was directed to a selected part of the postal transport network and selected logistics and distribution centers (Fig. 1): [7]

- Main postal transport network (MLTN) - represents the part of the logistics transport network that connects the main logistics centers to each other.
- Regional postal transport network (RLTN) - represents a part of the logistics transport network that connects the main logistics centers with distribution centers in its own district.

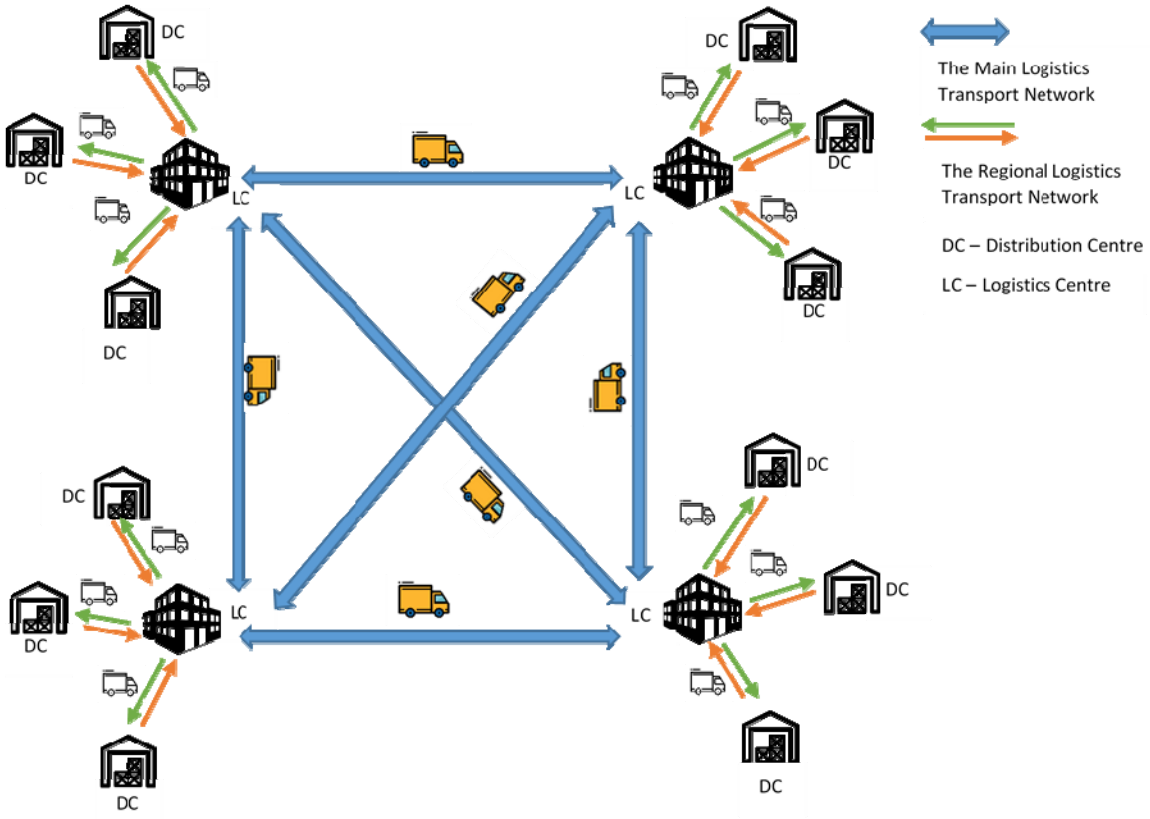

Fig. 1 Transport of logistics units carried out via a two-level postal transport network [7], [8]

This way of measurements made it possible to identify individual containers and measure the time spent at each distribution center as well as to monitor processing time at the selected center and the time of movement between individual logistics and distribution centers (Table 1).

After installation of all modules in the selected logistics and distribution centers of the postal service provider, RFID tags were placed on all containers for specified processing centers (main logistics centers and distribution centers at regional level). During testing, the system recorded containers what allowed the assessment and classification of strengths and weaknesses. A positive finding is that "passive UHF labels placed in mail containers were read every time, so we got 100% of readability."

Table 1 The results of the first cycle of measurement

	Container 1	Container 2	Container 3	Container 4	Container 5	Container 6
Shipping time (cycle 1)	8:12:00	6:14:00	0:46:00	3:41:00	3:42:00	8:12:00
Time spent on the main postal network (cycle 1)	15:48:00	17:46:00	23:14:00	20:19:00	20:18:00	15:48:00
Number of RFID reads	5	4	2	4	4	4

Conclusion

Based on measurements and pilot testing, it is possible to determine the implementation conditions of the AIDC technology of the postal operator in order to track and identify the location of the occurrence of the mail containers in the distribution process. According to the results, the readability of RFID tags was 100% despite the metal construction of the transport device. An important aspect in the container logistics system is the software platform and data processing and reporting. To sum up the results of measurements carried out at selected logistics and distribution centers, is it clear that the test system provided to the postal operator realistic picture of the location and movement of the mail containers. A key advantage of RFID technology is its usability for monitoring containers across the EU postal network.

Equally important aspect of this research, as well as further researches in this area, is the direction towards so-called intelligent logistics in relation to the building of supply chain ecosystems that interconnect the whole value system into a manageable and unified unit. The supply chain has worked for years as a series of separate processes. This situation is changing via digital transformation, so integrated and transparent systems emerge. Postal operators are no exception as they are connected to logistics chains by their distribution processes.

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