

INNOVATIVE TELECOMMUNICATION TECHNOLOGIES IN LOGISTICS

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Summary: Globalization makes logistics face many new challenges. Logistics must unite and integrate a system that appeared as a result of dividing the functions of supply, production and distribution between units located in different parts of the world. This paper discusses new technologies (i.e. mobile, wireless connection, remote access, voice communication) that are available to support logistics activities such as warehouse operations control and transportation management.

Keywords: mobile and wireless technologies, voice communication, GPS, satellite navigation.

1. Introduction

The speed of analysis and transmission, as well as depth and range of information are nowadays a significant element of developing competitive advantage [10]. Taking constant action targeted at increasing the effectiveness of functioning of an organization, requires creating and implementing information systems improving the flow of information, processing its collections and integrating different fields of a company's activity. Nowadays it's hard to overrate strategic importance of information technology. This technology changes the nature of products, processes, companies, industries and even competition [5]. The nature of conditioning the functioning of contemporary companies leads to dependence on that kind of technologies. In majority of cases, without their support, it would be difficult to talk about functioning of a company at all, not to mention achieving appropriate effectiveness of its activity. Expected influence of information technology on the increase of competitive position a company has on the market, turns out to be possible only thanks to correctly created and used telecommunications infrastructure.

A condition of success in modern logistics is implementing innovative technologies. Even now it's hard to imagine effective supply chain management without information systems, automatic identification of goods, or electronic exchange of data [1]. Mobile technologies, wireless connection, remote access, voice communication are contemporary determinants of development. Speaking about new technologies in logistics, we mean warehouses that can talk, systems of radio identification of goods or GPS systems that not only revolutionize transport management but also facilitate everyday life. For example, a taxi driver doesn't need to know a city to reach a given address, and a tourist doesn't need a map anymore to describe their location precisely. All this is possible thanks to satellites revolving around the Earth.

In the article, a special attention is drawn to issues connected with technical tools that support telecommunication processes in logistics, especially in the area of warehousing and transportation, because a dynamic company in future will come into being only if using "global, collective and asynchronous" technologies.

2. Specification of modern logistics

Nowadays, logistics is a field of service sector, and without it, it is hard to imagine functioning of not only global economy but also particular companies with international, national or even local scope [7]. In the field of interest of modern logistics there are key issues such as logistics of supply processes, management of supplies in a company, warehousing and handling supplies, logistic management in production, logistics of distribution/sales, logistic product, logistic center, managing logistic services, transportation in logistics, spatial configuration of logistic network, the role of packaging in logistic processes, waste management (recycling), services as a logistic product, implementing IT-based systems in logistic management, macrologistics, eurologistics, global logistics etc.

Modern logistics is treated as an integrated system and a process of decision making with management and physical circulation of goods and information. Integration of real components of logistics (transportation, warehousing, creating supplies, packaging, activities of customer service) is reflected in creating integrated organizational and information systems [9].

The basis of a sequence of activities in logistics (i.e. mental, manual and machine), appropriately coordinated technically and organizationally, is a practical ability to exchange information between partners (between people and between computers). Information system must connect the company with customers, suppliers, recipients, main departments of a company functioning such as accounting, marketing, production etc. and different areas of logistic activities, e.g. customer service, transportation, warehousing, realization of orders etc.

In management of logistics, therefore, a large amount of data is necessary, concerning [3]:

- location of a customer,
- order volume,
- location of production facilities, depots and distribution center,
- transportation costs from every depot or a production facility to every customer,
- available carriers and the level of services they offer,
- location of suppliers,
- the level of supplies stored at the moment at every depot or distribution center etc.

Flow of information makes up “a nervous system” of logistics, enabling effective managing of warehouse supplies and efficient steering the transportation processes, warehousing and producing, basing on managerial decisions taken upon sent information. Because of complexity of logistic process and large amount of activities that require mutual coordination, companies make use of innovative telecommunication technologies.

In the next part of the article, there have been presented innovative technologies used in two areas of logistics, i.e. warehouse management and transportation.

3. New technologies in warehouse

Modern warehousing is a vast and complex area in a logistic chain. It is necessary to use advanced IT tools to support it. They allow not only for identification of goods, but also for complex processing of data. These technologies not only support warehouse processes,

allow for monitoring movement of cars and electronic exchange of data, but mainly they play the role of an interactive tool of communication [12].

In modern companies the attention is increasingly paid to mobile solutions that make it possible to manage a supply chain from any place [1]. Using mobile terminals together with installation of internal wireless network, allows warehouse workers for easier localization of stored goods, immediate access to information about them, and also, thanks to installing specialist software, it allows for supporting different warehouse operations concerning, among others, inbound and outbound goods, stock take, localization, blocking the storage place, completion of a shipment. Nowadays the terminals (diode and laser ones, collectors of data or phasers) are equipped with elements such as LCD touch screen, keyboard, Flash memory, Bluetooth etc., i.e. similar or identical to those installed in smartphones [12].

Using wireless communication technology allows a worker to freely move around a warehouse or a production hall. Being connected to the main IT system, they are able to see and edit data. The basis for mobile solutions is wireless infrastructure that allows for implementation of local wireless network in a warehouse area. It is made up of wireless switches that control network traffic, and access points with the function of antennas transmitting data from mobile devices to the system.

A few elements make up a complete mobile solution. These are devices for registration of data, devices for data management, devices composing wireless infrastructure and data management applications [2].

Data registration devices may be bar code scanners or RFID scanners, allowing for automatic and flawless identification of goods. Registration of data takes place through reading the data from symbols on products, bulk containers and pallets. On the market there are both wire and wireless scanner models. Scanners may have strengthened or tight casing, therefore can be used in specific exploitation conditions, i.e. high humidity, dusting or low temperature, and also in case of mechanical damage or a fall. Some solutions may be carried on the forearm or fingers, enabling a worker to register data even if their hands are busy, for example with carrying packets.

The simplest devices for scanning bar codes are manual diode scanners that base their functioning on CCD (Charge Coupled Device) technique. These scanners are designed for the needs of not very big warehouses, where scanning takes place with little efficiency. Manual laser scanners have bigger quality of scan and can scan at a bigger distance. More advanced scanners allow for exchanging data between a scanner and a base station. Technologies based on radio transmission of data or Bluetooth are usually used for that purpose. Significantly bigger possibilities are typical of terminals that not only allow for collecting data but also its storing and processing [15].

Data management takes place through data management software (e.g. ERP application), installed on mobile computers. These can be mobile computers of industrial or corporate class. The first ones usually have strengthened cases, resistant to mechanical damages and extreme environmental conditions. Mobile computers of corporate class are designed for workers working in the field, e.g. drivers, suppliers; these are smaller in size and offer full functionality of a mobile phone.

Mobile devices speed and automate a warehouse worker's job, mainly through:

- registration of warehouse replenishment, inbound and outbound goods – a worker is equipped with a mobile terminal,
- registration of warehouse replenishment, inbound and outbound goods,
- eliminating mistakes in loading goods,
- registration of history of product formation,

- informing about failures.
- creating production applications for materials and realization.

Mobile solutions are scalable, which means they can be implemented gradually, together with a company development or growing needs. Firstly, the elements of key significance should be implemented, a switch and access points which enable the network functioning. Later on, during exploitation, their modification can be made, including new mobile computers, scanners or increasing the number of access points. Also mobile devices undergo constant modifications, thanks to which models are more efficient, functional and more comfortable to use. They are also equipped with new operational functions, such as movement detection technology, where a special sensor detects movement allowing for registering the falls of the device, for switching it into hibernation mode when it is not used, for dynamic change of the screen into horizontal or vertical, depending on the settings of the device.

The synonym of the most modern warehousing technologies are currently the solutions of voice communication. The idea of this solution is based on two-way communication between the computer system (e.g. WMS – Warehouse Management System) and a user (a warehouse worker). Voice technology is vastly used in warehouse management, beginning from small food warehouse, through pharmaceutical warehouses to big area logistic centers. Contrary to what may seem, these solutions are relatively simple to implement and operate (after about half an hour training, a worker is ready to realize the tasks). Full return on investment occurs after 12 months at the latest. Warehouse management based on voice technologies contributes to an increase in exactness of picking and outbound goods (on the level of 99,99%) and a decrease in operational costs. Similarly important is higher comfort of work and efficiency of work of a worker who is not concentrated on holding in his hand a notebook or an electronic terminal, which significantly facilitates his work and increases the possibilities of moving freely [4].

4. Innovative solutions in transport

The areas especially interested in implementing innovative telecommunication solutions in transportation are:

- satellite navigation – localization and positioning of products,
- managing the load – secure movement of objects (citizens, tourists, goods etc.),
- fleet management – increase in effective use of available resources through reducing the transportation without a load or not full use of the fleet capacity or optimization of routes,
- road traffic management – increasing the road capacity of crossroads and transportation routes, support of multimodal distribution chains,
- help for the disabled – facilitating the access to public institutions for elderly and disabled people, through technical changes in the fleet and infrastructure of public transportation and systems of informing.

The number of services using satellite navigation together with mobile internet access is sharply increasing. Innovative services offered for transportation are [5]:

1. Informing about congestions on roads. As of July 2011 Google maps illustrate the intensity of traffic on a selected route in Poland. Because there isn't a public system TMC/RDS yet (Traffic Message Channel/Radio Data System), data comes from mobile phones of users who have installed the newest version of Google Maps and have agreed to send via internet anonymous information about their geographical position. It allows

for calculating the time necessary for a given road section and the speed. Combining this data with results of other users gives information about congestions on a given route. Modern navigations are able to give an alternative route that will allow for avoiding the congestion. In the newest models of navigation devices by Garmin, it is possible to subscribe a service of road cameras PhotoLive located along a given route (where they are available). In this way, it is possible to check where the congestion is. It is predicted that Garmin will soon cooperate with GDDKiA that has 362 such cameras, the image of which is so far transmitted online only in their service for drivers.

2. Informing about conditions on the road. The Garmin Link services, offered by Garmin company allow for using the function of searching Google Local for local special points and services connected with traffic, e.g. the ones that give alerts about road works. Moreover, when one starts to run out of fuel, the system checks the prices of fuel in the nearest gas stations: basic, middle class, premium or oil. Other useful services within the subscription are: friends search engine Ciao!, the weather, cinemas repertory, local events, sending to GPS, flight status, currency converter, telephone directory. This service is available thanks to the fact that all new Garmin devices allow for using the Internet through a special SIM card dedicated for data transmission.
3. Complex information about the route and the destination. GPS navigation system offered by Google, basing on the Internet, informs in a voice manner about the direction of travel ("turn-by-turn"), shows the route, displays the newest maps and information about companies in the area. Mobile phone users may display their route into a satellite image of high definition. What is important, an exact address of the destination isn't necessary, it's enough to give a name of a place (e.g. "Złote Tarasy"), just like with Google Maps. If in a given country a Street View service has been implemented, it is possible to see images of places where one should turn, and of final destination.
4. Electronic guides. One of the applications of Ovi Maps, offered by Nokia [8], is a specially designed guide for mobile phones by Lionel Planet. It is based on an assumption that a user is interested in places in the nearest area. The application makes accessible short information, e.g. about the nearest sights or restaurants. Other programs in this package inform about what is happening in the neighborhood and makes it possible to book a hotel through HRS system (Hotel Reservation Service – www.hrs.com).
5. Intelligent Rescue System (IRS). This is a system which sends location data of a user only in case of an accident, a theft or on demand of the owner, but during ordinary using it doesn't send or record in the system the information about driven routes. ISR system was introduced at the end of 2008. Currently it includes about 7000 cars. It was created according to the assumptions of eCall system by EU. It involves a 24-hour monitoring station (PSAP - Public Safety Answering Point), cooperating with emergency services and a dedicated device installed in a car, enabling an automatic detection of accidents or manual call for help. The system operates upon GPS technology and GSM transmission (GPRS/SMS).

Navigation systems used in transportation begin to cooperate with the network. Today, information about geographical position isn't enough anymore. It must be combined with data available in the net. A problem is the way of presenting the information to interested users. A pioneering solution seems to be displaying the information on a windscreen of a car, just like in combat aircraft (so called HUD technology, head-up display). Such a solution was proposed by MVS-California company. It consists in the whole windscreen becoming a navigation display, thanks to a 3D projector. Besides, the clues of the

navigation may be displayed on any pane, it doesn't need to be a very expensive holographic screen. Such a system makes use of so called extended reality. It means that a virtual image is put on a view behind the windscreen. In this case it is a red line (Virtual Cable) that leads a driver. It can be supposed that this solution will prove more effective than arrows and a meter calculating the number of meters till the next turn, used so far. Thanks to extended reality, problems with reaching the right street will disappear, even if there is a roundabout or crossroads with several exits. Additional advantage of the technology is the fact that a driver's attention is not distracted from the road, as they don't need to move their sight from the windscreen to the navigation screen. Nota bene, Virtual Cable won the European Contest of Satellite Navigation in 2011 [5].

5. Benefits and restrictions coming from the use of modern technologies in logistics

The most important advantages of using modern technologies in the area of logistics are that they are fast, mass and relatively low cost. Access to information, not dependent on a place or time, enables effective realization of activities and exchange of data in actual time. Concentration of many technologies and functionalities (communication, access to the Internet, localization and navigation, reading and recording information) in one device and constant evolution of equipment and software make the access to modern technologies cheaper and more common [12].

Using modern communication technologies in the area of logistics brings a lot of advantages. Among them, it is worth mentioning [2], [10]:

- lowering operational costs,
- full control and access to data,
- possibility of increasing workers' efficiency and more effective use of a workforce,
- reducing mistakes in logistic processes,
- shortening the time of processes,
- securing a high level of information security,
- shorter time of documents circulation,
- eliminating the circulation of paper documents.

Those technologies are connected with certain restrictions. These are technical restrictions (resulting from the size of displays on mobile devices and their memory capacity), security restrictions (bigger risk of losing the device) and information restrictions (connected with the quality of provided information).

A certain restriction is also availability of tools that are necessary to exploit these technologies and also insufficient telecommunication infrastructure or lack of it. For example in Europe there has been a discussion going on for years, on how to implement eCall. All new cars were supposed to be equipped with this system as of the year 2011, but the date has been postponed for several reasons:

- the service requires introducing one harmonized solution in whole Europe that would ensure inter-operationing of transmissions of voice and audio connections,
- the necessity to generate minimal collection of obligatory data about exact location and time of an accident,
- creating a common protocol of data transmission, so as to avoid a danger of misleading or wrong interpretation of given data.

These issues are difficult to solve. European Committee publicized their recommendations in this area: "member countries should make sure that their mobile

network operators implement a mechanism of operating the indicator of eCall notification in their networks. This mechanism must be implemented by 31st December 2014. Mobile network operators should deal with eCall notification in the same manner as any other directed to the European emergency number 112” [14].

6. Conclusion

Dynamic and fast development of globalization processes wouldn't be possible without changes in logistics. Globalization makes logistics face many new challenges. Logistics must unite and integrate a system that appeared as a result of dividing the functions of supply, production and distribution between units located in different parts of the world. The necessity to cooperate, concerning the functions of supply, production, distribution and logistics in a global scope, resulted in creating the supply chains. The biggest challenges for contemporary global supply chains are longer time of order realization, longer delivery time (and burdened with bigger insecurity), the need for repeated consolidation and deconsolidation of shipments and considering various types of deliveries in terms of time and cost of delivery. Meeting these targets isn't possible without the support of information technology, both software and hardware.

Telecommunication solutions are offered in the form of various services. They are based on using available information and advanced IT tools. They are the foundation of work in modern warehouses and global distribution networks. They are solutions that significantly support organizing a logistic process. Modern technologies (GPS, GSM, RFID) used together with advanced systems of computer support (simulations, following movement, steering) increase significantly the safety of people and stored and revenue transported consumer goods, and are the means towards winning a market and increasing.

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