INNOVATIVE TRENDS IN LOGISTICS

INOVATIVNÍ TRENDY V LOGISTICE

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Abstract

Innovations are based on a focused search for changes and a systematic analysis of the economic and social potential which these changes offer. Innovation Management is a systematic approach to the implementation of those changes which should aim to improve the products, processes, or position of an enterprise. Concepts which are often discussed in the context of logistics include efficiency, organization, or value-creating chain. By contrast, the concept of innovation occurs quite rarely in this domain. It is considered mostly in the technical dimension of the logistics solutions including, for example, a more efficient use of warehouse technology, introduction of energy-saving vehicles (or autonomous transport systems), or implementation of high-performance information systems.

Abstrakt

Inovace jsou založeny na cílevědomém vyhledávání změn a na systematické analýze možností ekonomických nebo sociálních inovací založených na těchto změnách. Inovační řízení je systémový přístup k realizaci změn, které by měly mířit ke zlepšení produktů, procesů nebo pozice celého podniku. V souvislosti s logistikou se velmi často hovoří zejména o efektivnosti, organizaci nebo hodnototvorném řetězci. Pojem inovace v logistice se naproti tomu objevuje spíše zřídka. Většinou se jedná o technickou dimenzi logistického řešení jakými je např. efektivnější využití skladovací techniky, použití úspornějších vozíků, resp. autonomních dopravních systémů, implementace výkonnějších informačních systémů apod.

Key words

Innovation, information technology, autonomous transport systems, supply sequencing, picking

Klíčová slova

inovace, informační technologie, autonomní dopravní systémy, sekvenční zásobování, pickování

INTRODUCTION

Innovations which allow a reduction in the costs and an increase in the efficiency of planned and performed processes are beneficial for every organization. Increased efficiency is important not only from the short-term perspective, but also with respect to sustainability and applications in the workplace and in the whole company.

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Innovative trends in logistics are related to the concept of Industry 4.0. Covering also the concept of the Internet of Things (IoT), this term basically refers to modern devices equipped with built-in controllers which can be operated remotely via the Internet. Today, experts often discuss the compatibility within the IoT.

At present, there is a gradual integration of various logistics activities throughout the value-creating chain, from the provision and delivery of raw materials, through the production and identification of goods to the packaging and distribution to the customers. The integration of these logistics activities is closely related to the implementation of information systems in the manufacturing technologies, machines, equipment, and hardware used.

The largest spread of innovations can be seen in warehousing where both the qualitative and the cost aspects of the process are affected mainly by labor force, more precisely the combination of features including, for example, experience, diligence, responsibility, stress resistance, manual dexterity, but also loyalty to the employer. Given the real qualities of people who are available on the labor market for the area of warehousing and handling as well as the conditions which the warehouse manager can provide to them in the existing cost framework, it is practical to eliminate the impact of the labor force on the quality of the picking as much as possible [4].

1 FULLY AUTOMATED WAREHOUSE

A Warehouse Management System (WMS) enables automatic management of warehouse operations across all logistics processes, from ordering goods from a supplier to shipping them to a customer. Different methods of automatic identification are used, such as barcodes, Radio Frequency Identification (RFID), wireless data transmission, and voice technologies [3].

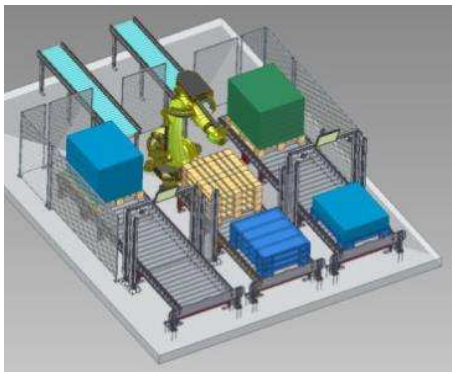

Fig. 1 Scheme of a fully automated warehouse system [3]

The main advantages of automated warehouses include automated put-away and picking operations (i.e. at the receiving and dispatch of goods), minimizing errors resulting from manual control and management, tracking and order keeping, reception checking, monitoring and inventory updating, as well as unattended operation.

Fig. 2 Automatic warehouse stacker [1, 2]

Automated warehouses are suitable to store from hundreds to tens of thousands of inventory items, or if there is a large turnover requiring an extremely rapid picking response and a minimal error rate of the process.

2 PICKING SYSTEMS (PICK BY SYSTEMS)

Picking is one of the most cost intensive operations in the warehouse. It is also among the most important processes influencing performance indicators for each warehouse. The way picking is performed and organized has a significant influence on the accuracy and quality of the logistics units produced. The growth in picking operations is caused by the continuous reduction in the volume of supplies and the increase in their frequency caused by the effort to minimize inventory levels in the supply chain and the increasing number of online stores. Thus, warehouse managers are constantly forced to deal with the issue of streamlining and improving the picking process.

Semi-automatic picking methods use either a combination of manual item selection with automatic transport of crates to the picking area, or automated transport of a warehouse operator to the location where the item for picking is stored. Forklift trucks, automated stackers, roller conveyors, or horizontal and vertical rack systems are preferably used.

The most widely spread picking technologies include [4]:

- Pick-by-Light (by means of data displays mounted to the shelf trims),
- Put-to-Light (an opposite approach to Pick-by-Light technology),
- Picking Cart,
- Pick-by-Voice (picking with voice navigation),
- Pick-by-Point (picking locations are indicated by a kind of strobe light beam),
- Pick-by-Frame (picking with a movable frame where the correct slot is indicated by a light signal),
- Pick-by-Box (designed for automated picking of small components),
- Pick-by-Vision (picking by using augmented reality and smartglasses).

Pick-by-Light [6]

The technology uses data which appear on a display located directly on the trims of a shelving or gravity rack. It includes simple light indicators and one or more confirmation buttons. A control center provides instructions directly to a warehouse operator who is located in a predetermined storage section.

Fig. 3 Pick-by-Light [8]

Fig. 4 Pick and Put-to-Light [9]

Put-to-Light [9]

The Put-to-Light technology is based on the opposite principle to Pick-by-Light. The warehouse operator collects goods required in a picking order and puts them to designated crates or containers in given positions which are also equipped with displays showing necessary data. The displays identify the goods by means of barcode scanners or RFID. After putting goods into a crate the operator confirms the action by pressing a button.

Pick-by-Voice [7]

The warehouse operator receives information about picking through a headset and confirms its acceptance and comprehension by a voice command. The communication consists of a simple dialogue. The operator carries a terminal located on a belt or on a wrist which is connected by cable or wirelessly to an earpiece with a microphone (headset). Each

operator has his own voice profile recorded in the terminal which enables the system to cope with differences in pronunciation and facilitates voice analysis. When one task is completed, the operator receives the next location address for picking. The process is repeated until the entire order picking is completed. Then the operator prints a shipping label. The system verifies that the printed label is correct and determines a location to place the pallet.

Fig. 5 Pick-by-Voice [7]

Fig. 6 Scheme of a Pick-by-Voice system [13]

Pick-by-Point [12, 14]

The innovative Pick-by-Point technology complements the Pick-by-Light and Pick-by-Voice systems. The biggest advantages include its extraordinary flexibility and low installation costs.

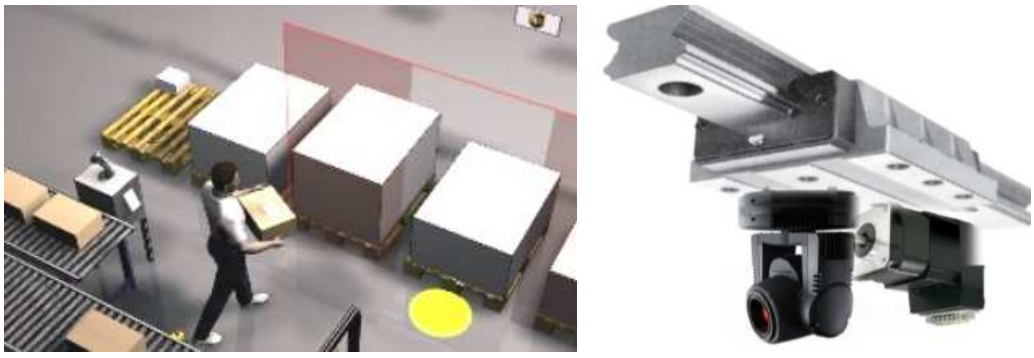

Fig. 7 Pick-by-Point [14]

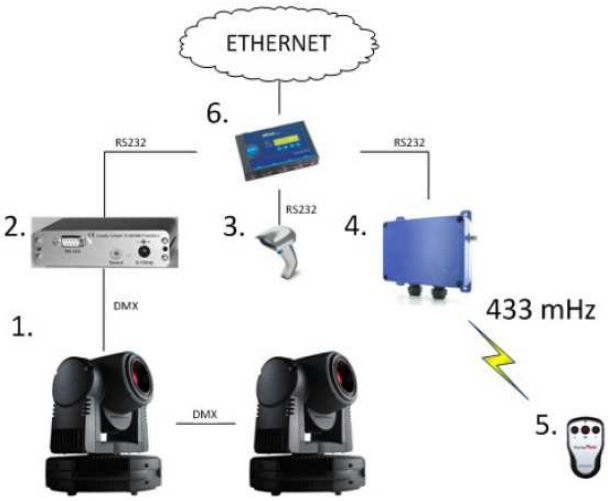

Fig. 8 Control scheme of a Pick-by-Point system [12]

Pick Term Sentinel [4]

In this method each selected storage section is equipped with a device for monitoring the picking process. A sensor of this monitoring system is located directly above the warehouse section and is assigned to a specific display on a shelf or rack.

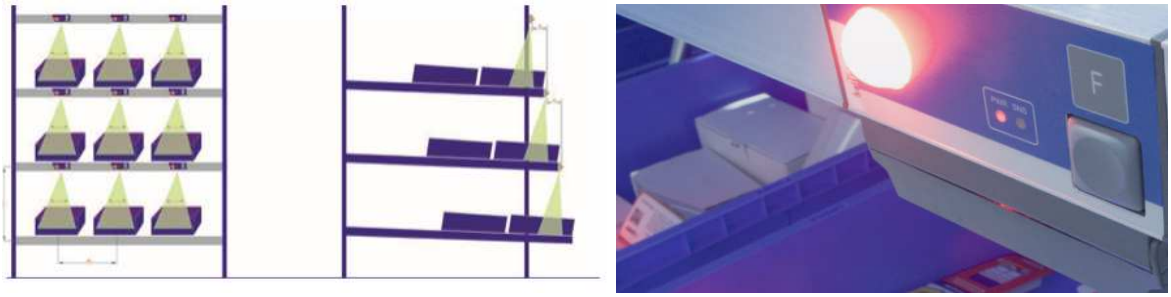

Fig. 9 Pick Term Sentinel [4]

Pick-by-Frame [20]

This technology uses a frame mounted on a truck. The central display shows a barcode which is scanned with a barcode scanner to load information about the required order.

The operator confirms the order by pressing ENTER and starts the picking process. After finding the appropriate item, the operator scans its code or the storage location code. The slots in which the items should be put are indicated by lighting side displays.

Fig. 10 Pick-by-Frame [20]

Pick-by-Vision [3]

This method works in combination with smartglasses which show an arrow indicating the direction (see Figure 11 on the right).

Fig. 11 Picking by means of smartglasses [3]

ProGlove (smart glove) [3]

Fig. 12 Smart glove [3]

It is an electronic glove with a built-in scanner which allows the operator to scan items quickly and conveniently. Recording data or inventory check reflects the natural movements

of human hands. Codes can be scanned both vertically and horizontally. The codes are confirmed with a button on the index finger.

3 AUTONOMOUS VEHICLES

Automated guided vehicles (AGV, FTS) have been replacing conventional vehicles such as forklift trucks, hand pallet trucks, and other means of transport in almost all industries. Navigation methods vary from wire systems through laser guidance to magnetic tapes which appear to be the simplest solution.

Automated tuggers move along magnetic lines towing multiple trailers with material picked from the stock. They run in sequences required by the assembly line. A risk of collision is identified by sensors mounted on the vehicles which monitor the routes and their two meter surroundings. If necessary, AGVs can stop virtually immediately, but to avoid undesired frequent stops, they play music to be easily spotted.

Fig. 13 Automated tugger guided by a magnetic tape [18]

Fig. 14 Fleet of automated tuggers [18]

Fig. 15 Assembly line supply [18]

Fig. 16 Scheme of an intelligent assembly line [2]

4 PACKAGING AND SHIPPING [2, 18]

The basic categorization of packaging is based on the weight of packaged products:

- up to 15 kg:
  - universal
  - special
- over 15 kg
  - universal
  - special

Fig. 17 Universal KLT containers [18]

Fig. 18 Special packaging for components
of a single type [18]

Fig. 19 Large universal containers [18]

Fig. 20 Assembly of large special containers [18]

Fig. 21 Wooden transport frame for car bodies [18]

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