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ROBOT IN WAREHOUSES: AUTOMATION OF WAREHOUSE WORK

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A robotic warehouse, in contrast to a conventional one, allows to reduce the Operator's participation at various stages of cargo processing. In practice, warehouse robots can cope with any action 3-4 times faster than a person. In addition, they do not get tired, withstand significant loads, and do not reduce productivity. Automatic assistants make it possible to optimize the movement of goods and warehouse stock management, to use space more rationally, and to eliminate errors caused by the human factor.

Modern works used to automate warehouse processes are divided into two groups: industrial and collaborative.

Industrial robots are programmable machines that replace manual labor for complex repetitive actions. Such equipment is equipped with real-time data recording sensors. In warehouses, this type is represented by lifting mechanisms and automatic conveyors.

Collaborative robots (cobots) represent the cooperation of man and machine. These devices perform certain actions together with a person. One of the advantages of cobots is the possibility of programming so that the equipment can work autonomously or under human control. In the warehouse sector, cobots are represented by manipulators for moving goods and packaging machines.

Robots in warehouses are used to automate the following processes: maintenance of racks, transportation of goods (conveyors), completion of orders. Reduction of

personnel costs, speed and accuracy of operations, reduction of human burden are the main arguments in favor of robotization of warehouses. As the experience of strong market players shows, automated systems will gradually completely replace human labor. The following are the most interesting examples of robotic warehouses, where the participation of the operator was minimized [1].

Warehouse work at Amazon:

Amazon's robotic warehouse uses systems to automatically transport goods. Goods are moved around the warehouse using human-operated conveyors and loaders. Goods are stored on portable shelves. After the product is entered into the database, the system directs an unmanned robot to it. The robot picks up the shelf with the product and transports it to the operator, who selects the desired product. Warehouse workers move around the complex, following the QR codes on the floor. Sensors prevent robots from colliding with each other. Robots are able to charge themselves.

A robot at Cainiao warehouses:

Maneuvering robots are able to rotate 360 ° and move loads weighing up to 500 kg. A built-in laser system allows you to avoid a collision. Communication with the operator and receiving tasks is carried out via Wi-Fi. If the battery is running low, the robot can replenish energy reserves automatically. According to the company, unmanned warehouse operations allowed to reduce personnel labor by 70%.

Robotization of Ocado warehouses:

The peculiarity of the automatic system is that the robots move on rails over cells with goods along a special marking in the form of a grid. Their movement is regulated by a traffic control system based on 4G, which allows you to avoid collisions. Robots develop a speed of 4 m/s. Batteries are charged automatically in special compartments. Robots bring boxes of products to sorting stations, where a robot or a human later forms the order. Empty work cells are filled with new products.

Sagawa X-Frontier robotic warehouse:

With the help of an army of robots and artificial intelligence systems, the company manages warehouse stocks, organizes space in warehouses, transports goods

between buildings and even brings orders directly to employees working in the warehouse.

DHL warehouse work:

Robots are able to move independently, find necessary goods and deliver them to employees. In this way, the company reduces the time it takes to perform repetitive or physically difficult tasks [2].

Table 1 – Results

Company	Warehouse location	Process automation	Features of the system
Amazon	Branches all over the world	Transportation of goods	Unmanned robots deliver goods to operators. Traffic control using QR codes on the floor.
Cainiao	Hoiyang, China	Transportation of goods	Mobile robots-suppliers of goods. Management via Wi-Fi.
Ocado	Andover, Great Britain	Transportation of goods, order fulfillment	Move around the grid. 4G traffic control technology. The goods are delivered to the operator. Add goods in cells.
Sagawa X-Frontier	Tokyo, Japan	Transportation of goods, order fulfillment	Unmanned robots, traffic is regulated using QR codes on the floor.
DHL	North America	Transportation of goods, order fulfillment	Robots deliver goods to employees, who later enter them into the system using QR codes.

Robotization of warehouses has a number of significant advantages. This is a reduction in personnel costs, an increase in the efficiency and speed of tasks performed by robots, and the ability to optimize warehouse space. Companies that already use warehouse robotics were able to appreciate the benefits of automating warehouse processes during the coronavirus epidemic. It was at this time that the ability to solve many tasks with minimal use of human resources became of primary importance.

Until now, fully robotic work in warehouses is impossible without the participation of an operator. But the experience of such large companies as Amazon,

Cainiao, Ocado, Sagawa X-Frontier, DHL demonstrates that even today it is possible to make people and equipment work more efficiently. The process of robotization is only gaining momentum, and managing all complex processes without human intervention in the future is a very real prospect.

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ABOUT WAREHOUSE SHARING

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Nowadays, it is difficult to imagine a world without trade in the form it currently exists. It is the engine of progress. The further in time - the greater the needs of consumers, this is reflected in everything. And the more needs there are, the more services that can satisfy these needs. Due to the pandemic-related quarantine of 2019-2022, online trade has gained incomprehensible momentum, and all trading companies are working on the problem of lack of space for storing goods. On the other hand, there are many people who do not trade, but they have premises that can be used as a warehouse. Many large companies have their own department stores, but most smaller companies will generally find it more cost-effective to take advantage of a multi-user/customer warehouse. This method of goods logistics can be especially advantageous for start-up companies that need a warehouse. Also, most small and start-up companies do not have the resources to implement automated inventory and logistics, which is a big time-consuming problem in our digital age.

Warehouse sharing involves turning idle and excess space into profit by offering that space to other parties. Although warehouse sharing is considered an innovative approach to overcoming existing warehousing inefficiencies, it is still not a common practice.

Warehousing has always been an important factor in the development of globalized production networks. The warehouse is the interface area for production lines, the market, customers, suppliers, and the business environment in general. Traditionally, warehouses are owned by a single logistics service provider with warehousing and inventory management knowledge/skills. From the warehouse's total