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Digital Technologies of Cargo Transport Terminals

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The transport terminal is a complex of buildings equipped with modern technological equipment that allows performing the full range of services related to the transportation and distribution processes [1].

Terminals are intricate systems, and digitalization is one of the ways to increase the efficiency of their operation.

Digital technologies used at cargo terminals are expected to support the basic infrastructure with the help of various intelligent sensors that are integrated into container platforms, roads, railways. These devices can transmit real-time data on the operating conditions of the infrastructure. The introduction of such sensors is part of the Internet of Things (IoT) technology. This technology provides data exchange between devices embedded in the network without human intervention and allows automating production and minimizing human participation in it.

Internet of Things technology is used to develop «smart» containers. A «smart» container is a container equipped with sensors for monitoring its condition and devices for exchanging data with other participants in the supply chain. Container sensors generate real-time data on the condition of the container and its location, and also allow you to change the temperature and humidity inside the container remotely, monitor the opening of doors and the presence of external damage. «Smart» containers are especially useful when transporting medicines and food products due to their sensitivity to environmental parameters.

Another step towards full automation is the creation of digital copies or digital twins of terminals. A digital twin is a virtual digital model (prototype) of a physical object or process, simulating internal processes, technical characteristics and behavior of a real object in the conditions of interference and environmental interaction [2]. The sphere of application of this technology is wide enough. For example, it is easier to detect weak points of the terminal on a digital copy, as well as to test various options for improving the efficiency of its functioning without prejudice to the production process. The combination of digital terminal technologies and the Internet of Things increases the accuracy of automated terminal equipment. As a result, the risk of damage to the cargo during transshipment and the time of overload and downtime are reduced.

The introduction of digital technologies on any object requires appropriate software. This software is TOS (Terminal Operating System), which enables the integrated management of production and logistics processes at the terminal. The TOS includes container terminal management systems – CTMS (Container Terminal Management System). They perform the functions of TOS already in relation to container transportation. TOS and CTMS work in real time and use Wi-Fi, Bluetooth, RFID technologies for getting and processing data and manage workflows. These systems can work with other smart systems, for example, WMS (Warehouse Management), CV (Container Terminal Vision), Gate Management System.

Implementation of TOS and CTMS enables to reduce costs and time of terminal cargo handling and to increase quality of terminal works and management. The most famous TOS are Navis N4, Navis Master Terminal, Navis Octopi, U&Terminal, SAAB Terminal Control, Oscar, Kalmar One Terminal [3].

Digital technologies give us the opportunity to fully automatize the work of the cargo transport terminal. Introduction of digital technologies on terminals facilitates the development of

the transport industry and integration of different types of transport. These actions help reduce the influence of the human factor on transport processes and improve the quality of transport service This is especially relevant in the context of the development of the digital economy.

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