

ROBOTS DELIVERY APPLICATION IN BELARUSSIAN BUSINESS

Post's and courier companies today face a number of serious challenges that directly impact the efficiency and sustainability of their businesses. Primarily, these are constantly rising operating costs: a significant portion of the budget is spent on courier salaries, fuel, and regular fleet maintenance. Customers, expecting the fastest yet most affordable delivery, are creating additional pressure, leading to lower rates and, consequently, a decline in profits. The so-called «last mile» – the final stage of delivery, considered the most costly and organizationally complex remains particularly pressing. Added to this is the labor shortage: with the growing volume of online orders, companies are experiencing a severe shortage of couriers, especially during periods of peak demand. Against this backdrop, interest in autonomous delivery robots is rapidly growing. Today, they are viewed not only as an impressive technological innovation but also as a real tool capable of offloading some of the burden and offering effective solutions to the industry's key business challenges [1].

Today, more and more logistics companies are considering implementing robotic couriers, and they are faced with the question of choosing the optimal business model. Several options exist, each with its own advantages and limitations.

The first option is a direct purchase. In this case, the company purchases the robots with its own funds and gains full control over the equipment. The robot becomes a company asset, which can be considered a long-term investment. However, this approach requires a significant initial investment, and all risks associated with breakdowns and obsolescence are borne by the organization itself. This option is most suitable for large market players that are financially stable and willing to invest in innovation, such as national postal operators. To reduce the risks associated with purchasing autonomous courier robots, it is best to create a leasing platform. A large company in the telecommunications or logistics sector, such as a national postal operator, can benefit from becoming the operator and owner of a fleet of robots. This will help transform large initial costs into investments that will be recouped through the «robot-as-a-service» service for many small and medium-sized companies. This approach will not only accelerate the return on investment for the technology but also create a flexible and efficient delivery system in cities.

The second option is leasing, or rent-to-own. Companies can use robots over a long period, gradually paying off their purchase price, and eventually gain full ownership of the equipment. This approach reduces start-up costs and offers the opportunity to test the technology without major investments. However, in the long run, the total cost is often higher than with an outright purchase. This option is often chosen by organizations seeking to innovate on a limited budget.

Finally, there's the most flexible approach: the «robot-as-a-service» model [2]. In this case, the company doesn't purchase equipment, but pays a subscription or is paid for each successful delivery. This model doesn't require large initial investments, and the service provider handles all repairs, software updates, and equipment replacements. An additional advantage is easy scalability: the number of robots can be quickly increased during peak demand periods and reduced during quiet periods. The main drawback is less control and dependence on an external partner. However, this model is currently considered the most versatile and is particularly popular among young companies and mid-sized businesses that need to quickly adapt to changing market conditions.

In today's economy, personnel costs remain one of the most significant expense items for courier and logistics companies. Looking at the situation in Belarus, the following data emerges. The average salary for a walking courier is approximately 1,000-2,000 rubles per month, for a bicycle courier 1,500-3,000 rubles, and for a car courier 2,000-5,000 rubles and higher [3]. For a company that requires a staff of 15 couriers, the total monthly labor costs alone will range from 15,000 rubles (for walking couriers) to over 75,000 rubles (for car couriers). This is a significant sum, to which must be added the costs of organizing the workflow, staff turnover, and seasonal fluctuations in workload.

The robotic delivery model is built on a completely different principle. Instead of 15 people, 15 autonomous robot couriers can be used, controlled by just one operator. Their salary would be approximately 2,000 rubles. Maintenance costs and electricity consumption are also factored in, adding another 2,000-3,000 rubles per month. Therefore, the total cost of a fleet of 15 robots would be approximately 4,000-5,000 rubles. This is several times lower than traditional personnel costs.

Therefore, in the Belarusian market, delivery robots are not just a technological innovation, but a tool for increasing economic efficiency. They significantly reduce operating costs, optimize staffing, and ensure the sustainability of business processes even during periods of rapid demand growth.

Despite its obvious advantages, the introduction of delivery robots

has its own potential risks and barriers. First and foremost are regulatory restrictions. Belarus currently lacks a clear legal framework governing the movement of autonomous vehicles on sidewalks and public roads. The issue of their liability in the event of road accidents or other incidents has also not been resolved, creating uncertainty for companies and potentially hindering the widespread adoption of the technology.

Therefore, in addition to the technical equipment, it is essential to focus on developing an application that will serve as the central link of the entire system.

The app will be designed to connect all key elements of the process – from the customer placing an order to the delivery robot. The primary goal of this system is to ensure transparency and convenience for users, reduce the workload for operators, and make the delivery process as efficient as possible. The app will include functions for placing an order, tracking its status in real time, receiving notifications about the robot's arrival, and tools for operators to monitor and manage their fleet of autonomous devices. For implementation, you can use the Python programming language with Flask for the backend, integrating Starship Delivery API for creating delivery tasks and Google Maps API for navigation, with a React frontend Native for real-time mobile order tracking.

The development period for a minimum viable product (MVP) of such an application is estimated at approximately three months, and the minimum costs for the application will be approximately 100-120 thousand Belarusian rubles. This time is sufficient to create basic functionality that will allow testing the system in real-world conditions and collecting user feedback before scaling the project.

In conclusion, the most promising and flexible model for the rapid implementation of robotic delivery is the «robot-as-a-service» model. This model allows companies to minimize start-up costs and pay only for the actual volume of deliveries completed. Large state-owned operators with stable funding may consider purchasing robots directly, but only after a successful pilot project confirming their effectiveness in real-world conditions.

LITERATURE

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