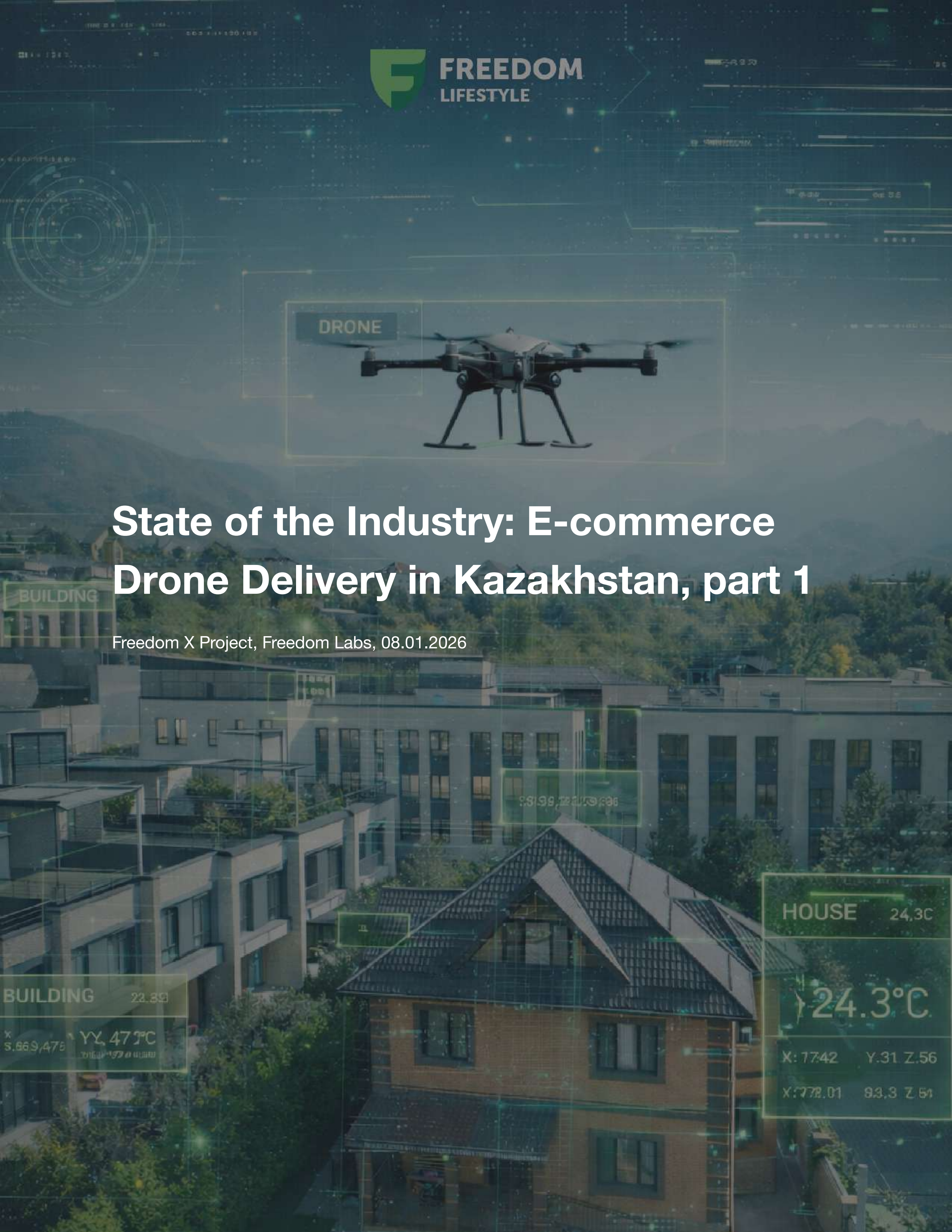
FREEDOM LIFESTYLE

State of the Industry: E-commerce Drone Delivery in Kazakhstan, part 1

Freedom X Project, Freedom Labs, 08.01.2026



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Abstract

E-commerce continues to reshape the market landscape: more than 100,000 restaurant food deliveries are made every day, along with tens of thousands of deliveries[1] from various online marketplaces and stores. The drone-delivery logistics industry in Kazakhstan has the potential to make a significant contribution to economic development by reducing the load from mopeds and scooters on the streets of Almaty and Astana, reducing emissions, lowering delivery costs and times for suburban areas.

Freedom Labs, the innovation arm of Freedom Holding Corp., is launching a series of publications on drone delivery, sharing insights gained from 11 months of research and implementation in real-world operations. We'll begin with the economics and briefly touch on the technological landscape.

Executive Summary

Drone delivery is quite feasible for commercial use today, using existing technologies for autonomous flight along a route, automatic unloading using a winch, and more precise positioning during takeoffs, landings, and unloading. Solutions for launching such a delivery service are available commercially.

Advantages of Logistics Drones

Logistics drones will make delivering goods to consumers cheaper and more widespread than traditional courier delivery. At the same time, the inherent disadvantages of traditional courier delivery can be overcome:

- delivery speed and reliability can be increased through direct air routes;
- delivery costs can be reduced by saving on manual labor;
- delivery coverage can be expanded to low-density areas and remote locations difficult to access by ground transportation.

Regulatory Framework

The regulatory framework in Kazakhstan already covers drone delivery[2]. To launch a delivery service according to regulatory requirements, in terms of the automotive industry, you need a

[1] Kazakhstan's Retail E-Commerce Market: A 12-Month Analysis to 2024 – Strategy& (2025, In Russian)
[2] Rules for the operation of unmanned aerial vehicles in the airspace of the Republic of Kazakhstan, approved on December 31, 2020 (in Russian)

registration certificate, a state registration plate, a driver's license, a license, and route approvals.

We haven't yet achieved full autonomy, eliminating humans entirely from the process. Furthermore, regulations don't yet permit autonomous delivery during nighttime, which would make the delivery process 24/7 and widespread.

Brief Forecast

We believe the logistics drone market will experience rapid growth in the near future. This growth will be similar to what has happened in the agricultural drone and aerial chemical services markets over the past two years (the market has grown exponentially). Robotics technologies, specifically "physical AI," and new types of lithium-ion batteries for electric vehicles will have the greatest impact on the global market over the next three years.

Recommendations

Today, when choosing solutions, it's important to be cautious about the **technical specifications** of drones advertised by manufacturers. In practice, flight range and time figures can be significantly shorter than stated.

Certain drone operations may require manual intervention, which can be expressed as the ratio of the number of drones performing flights to the number of operators monitoring them during flights. Manual intervention should be automated, or, in other words, the **level of autonomy** of the drones should be increased.

Technical specifications and the level of autonomy can critically impact the unit economics of drone delivery.

Unit Economics

The demand for courier delivery of goods will continue to grow. In 2024, the cost of one courier delivery in Kazakhstan on average increased by 20%. For example, in 2025 in Almaty, the average cost of one courier delivery within the city is about 2,500 tenge. We do not see macroeconomic factors that will prevent the price from rising. “Supply” does not keep pace with “demand”, especially during peak hours, which leads to higher labor costs.

At the same time, the reduction in cost of autonomous delivery technologies will lead to the fact that, first in individual cases, and then on a larger scale, autonomous delivery will become equal to the cost of courier delivery or become cheaper.

To understand when and how this will happen, we compiled a model of the unit economics of drone delivery at the initial stage, where we estimated the costs per delivery and calculated the throughput per drone. At subsequent stages of development, increasing the degree of autonomy of drones **will reduce delivery costs by 3.5 times**.

The assumptions and projections used in the unit economics calculations below range from pessimistic to realistic, and are based on our field trials and tests.

Throughput

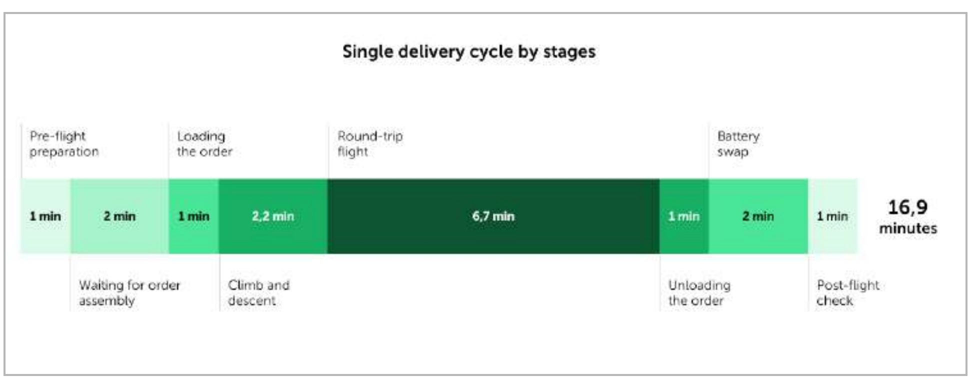
How many deliveries can a drone complete per hour?

Let's break down a single delivery cycle into its stages and insert the approximate average times observed during our trials and tests:

- Pre-flight preparation: 1 min
- Waiting for order assembly: 2 min
- Loading the order: 1 min
- Climb and descent: 2.2 min[3]
- Round-trip flight: 6.7 min[4]
- Unloading the order: 1 min
- Battery swap: 2 min
- Post-flight check: 1 min

Thus, the average total time required to complete one delivery is the sum of all stages, giving us **16.9 minutes.** With continuous operation, a single drone can perform **3.6 deliveries per hour** (throughput).

Chart: Timing of a Single Delivery Cycle by Stages



[3] Flight altitude – 100 m, climb and descent speed – 3 m/s (see appendix "Calculation of time for climb and descent")
[4] Delivery radius – 2000 m, speed – 10 m/s (see appendix "Calculation of time for flight in both directions")

The main factors affecting throughput are the **delivery radius** and the **average speed** of "horizontal" flight. For example:

- doubling the delivery radius from 2 km to 4 km increases delivery time by 39% and reduces throughput by 28%;
- increasing the flight speed by 1.5 times, from 10 m/s to 15 m/s, reduces delivery time by 13% and increases throughput by 15%.

When planning, it is important to take into account the actual technical specifications of the drones, the terrain, and the meteorological conditions in the area throughout the year. In our opinion, these factors have the strongest impact on delivery radius and average flight speed.

Cost per Delivery

How much does a single successful drone delivery cost at the distance of 2 km?

Main cost components:

- operator payroll wages;
- drone depreciation;
- maintenance costs;
- electricity costs for battery charging;
- insurance costs.

The cost of a single delivery largely depends on the number of deliveries a drone completes in one day.

Let's calculate the cost of one delivery using the formula:

$$Delivery\ cost = (Daily\ fixed\ costs + Daily\ variable\ costs) \div Deliveries\ per\ day$$

where:

- *Delivery cost*—the cost of a single successful delivery;
- *Daily fixed costs*—daily fixed expenses, consisting mainly of the operators' payroll wages;
- *Daily variable costs*—daily variable expenses, consisting of:
  - daily depreciation of batteries, lifetime—1 year or 240 flight days (~20 days/month);
  - daily depreciation of drones, lifetime—5 years, 240 flight days per year;
  - monthly subscription fees for 4G connectivity for drones, internet at the base location, and, in the future, fees for using a regional UTM system.

- *Deliveries per day*—the number of successful deliveries per day, calculated as the "target deliveries per day" multiplied by the success rate, which depends on weather and other factors affecting flights.

Unit economics calculations were made based on the following **starting conditions**:

- 20 flight days per month;
- 100 deliveries per day;
- 6 hours of work per day;
- 17 deliveries per hour in total;
- 3.6 deliveries per hour per 1 drone (average throughput);
- 0.5 drones per 1 operator (low level of autonomy);
- **9 operators**;
- **4.7 drones**.

An example calculation of the cost per delivery in tenge is as follows:

$$Delivery\ cost = (341\,623 + 213\,733) \div 100 = 5554$$

Thus, a single drone delivery at the minimal initial load of 100 deliveries per day costs **5,554 tenge**.

Fixed costs—341,623 tenge—mainly consist of the **wage fund for drone operators** and administrative personnel with taxes and deductions, as well as administrative expenses for these activities.

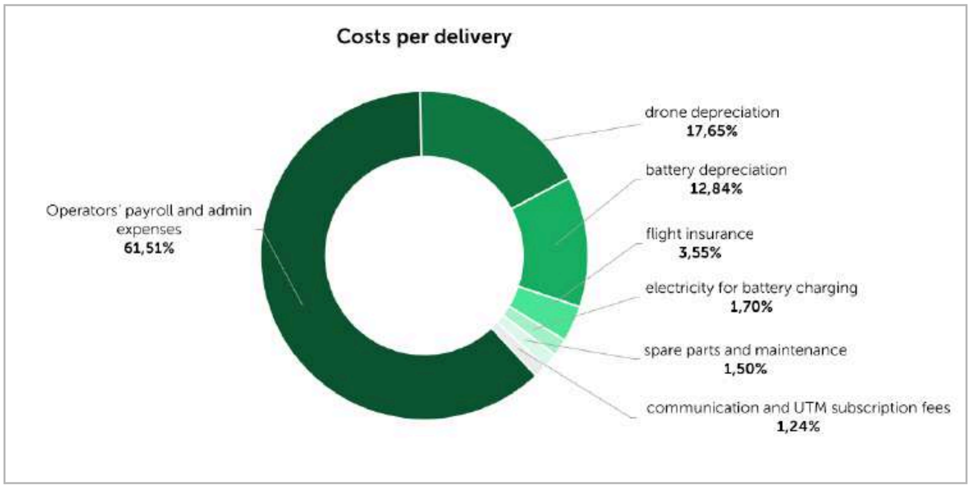
The payroll fund for operators at the start of the project is calculated based on the ratio of "**2 operators per 1 drone**".

It is important to note that our calculation does not include facility rent and other potential expenses.

Variable costs per delivery (at 100 deliveries per day, totaling 2,137 ₸) include the following:

- electricity for battery charging: 94.54 ₸
- spare parts and maintenance: 83.33 ₸
- battery depreciation: 713.20 ₸
- drone depreciation: 980.38 ₸
- communication and UTM subscription fees: 68.70 ₸
- flight insurance: 197.18 ₸

Chart: Cost Structure per a Delivery



The depreciation amounts include **starting conditions**: an average of 3 batteries per drone and 4.7 drones per 100 deliveries per day.

The cost of drones and batteries, the number of batteries per drone, and the service life of both components have the greatest impact on the cost per delivery.

It is also important not to underestimate the **technological sophistication of drones and batteries**. Higher autonomy and smarter onboard systems may allow a shift from the "2 operators per 1 drone" ratio toward fewer operators managing more drones simultaneously—directly reducing fixed costs.

Unit Economics Analysis

With a throughput of 3.6 deliveries per hour per drone, an average of 4.7 drones and 9 operators would be required to complete 17 deliveries per hour (100 deliveries per day with a 6-hour flight period). The cost per delivery is 5,554 tenge.

How will the cost per delivery change as the number of deliveries increases?

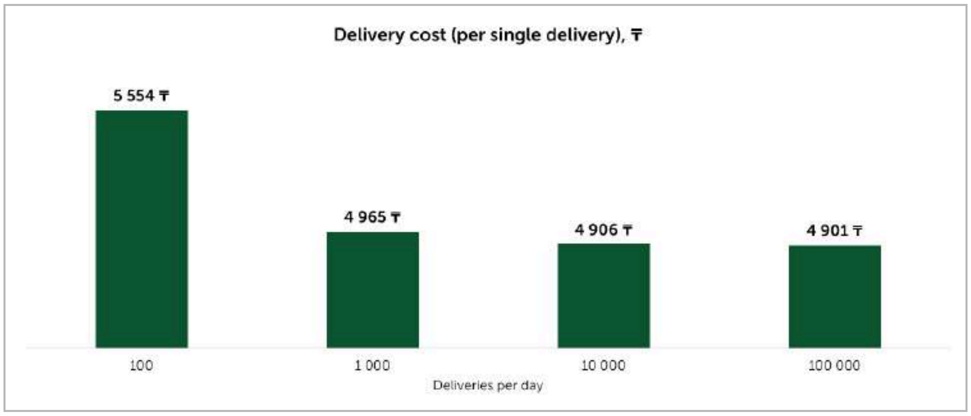
Table: Dependence of Delivery Cost on the Number of Daily Deliveries

Deliveries per day	Delivery cost
100	**5,554 ₸**
1,000	4,965 ₸
10,000	4,906 ₸

100,000	4,901 ₸

As the volume increases from 100 to 1,000 deliveries per day, the cost per delivery decreases faster due to the scale effect in unit economics than as the volume increases from 1,000 to 10,000 deliveries per day. It's clear that the reduction in delivery costs by increasing the number of deliveries alone reaches a certain limit, in this case ~4,900 tenge.

Chart: Relationship Between Delivery Cost and Number of Deliveries



What factors most influence the possibility of reducing the cost of one delivery?

Table: Dependence of Delivery Cost on Key Factors

Flight days per month	Deliveries per day	Daily operating hours	Drones per operator	Cost per delivery
20	100	6 h	0.5	5,554 ₸
20	100	6 h	**1**	**3,998 ₸**
20	100	6 h	**5**	**2,753 ₸**
30	**1000**	**8 h**	**5**	**1,576 ₸**
30	**1000**	**8 h**	**20**	**1,459 ₸**

Our calculations, supported by research[5] from previous years, show that the key factor affecting delivery cost is the ratio of drones performing flights to the number of operators

[5] Drone Deliveries: Taking Retail and Logistics to New Heights - PwC (2024), Drones take to the sky, potentially disrupting last-mile delivery — McKinsey (2023)

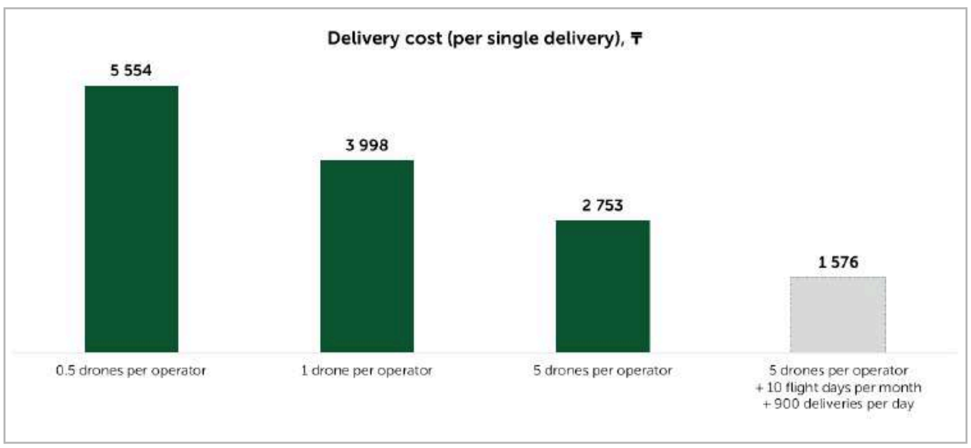
controlling them during flights. The more drones a single operator can manage, the lower the cost per delivery. The expenses for training and operating the operators are moving from being variable costs (as with couriers) to fixed costs.

For example, increasing the ratio from 0.5 to 5 drones per operator almost halves the cost per delivery—from 5,554 ₸ to **2,753 ₸**.

With extensive measures to increase quantitative factors and scale up deliveries, the cost will decrease even further—from 2,753 ₸ to **1,576 ₸**, or 3.5 times compared to 5,554 ₸ at the initial stage.

By 2030, according to research forecasts, the drone-to-operator ratio should increase to 20 drones per operator. Then, delivery costs will decrease from 1,576 ₸ to **1,459 ₸**.

Chart: Impact of Various Factors on Delivery Cost



Considering that fixed costs have a lesser impact on the cost of a single delivery with increasing scale, and that costs can also decrease in absolute terms with technological advances, the cost of a single delivery can decrease further.

Increase of the number of drones per operator will be enabled by technological advancements aimed at improving the **autonomy of drones**.

Technological Landscape

We believe that, regardless of the design type of drones, the drone autonomy is most significantly impacted by:

- commercially available batteries, their energy capacity, and chemical composition;
- autopilot or the currently hyped "physical AI";

- sensors and communications.

Let's briefly review the current state of each technology group and the technical requirements.

Batteries

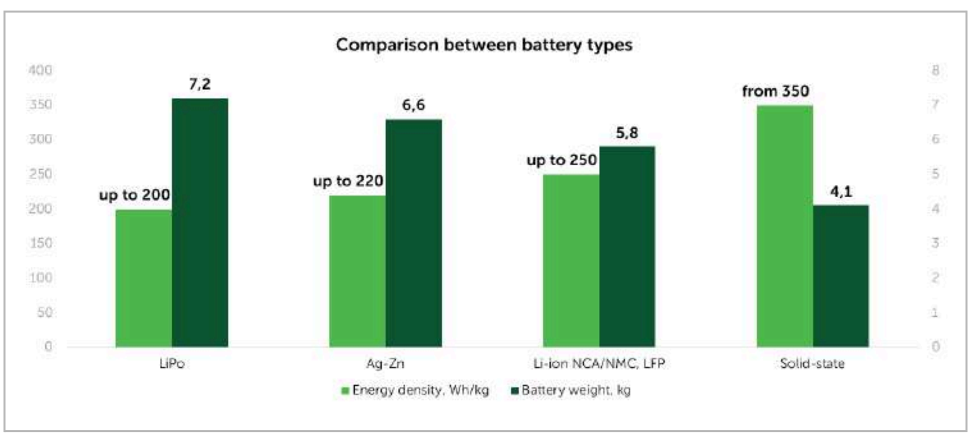
The delivery radius and load capacity are determined by the energy capacity of the batteries, which mainly depends on their chemical composition.

Table: Common Battery Chemistries for Drones

Designation	Description	Energy density, Wh/kg	Battery weight[6], kg
LiPo	lithium-polymer	up to 200	~7.2
Ag-Zn	silver-zinc	up to 220	~6.6
Li-ion NCA/NMC, LFP	lithium-ion	up to 250	~5.8
Solid-state	solid-state lithium-ion	from 350	~4.1

Lithium-polymer and silver-zinc batteries are not suitable for use in modern drone delivery solutions due to their high weight in the first case and high cost in the second.

Chart: Comparison Between Battery Types



[6] Approximate weight, calculated for 48 V and 30 Ah capacity (1.44 kWh)

The most suitable batteries today are lithium-ion batteries, with nickel and cobalt in the cathode materials.

The most promising batteries in the coming years are solid-state lithium-ion batteries. Drones equipped with such batteries will be able to deliver orders significantly farther. Faster charging will reduce capital expenditures.

Several companies, such as CATL, Factorial, Ilika, ProLogium, QuantumScape, and Solid Power, are conducting research on the mass production of these batteries. According to our forecast, from 2026 to 2030, the mass production and adoption of this type of battery will bring significant changes to the markets for vehicles, autonomous mobility, and robotics.

Physical AI

Battery energy can be used not only to increase delivery range and payload capacity but also to enhance drone autonomy by installing specialized AI computers. These computers and technologies in the field of Physical AI will allow drones to operate with a **higher level of autonomy**, increasing the ratio of drones per operator to 5:1, 20:1, and beyond.

Capabilities required to enhance drone delivery safety and autonomy via AI:

- Real-time detection of static and moving objects to automate the selection of unloading spots, safe takeoff and landing, and obstacle avoidance;
- Visual navigation for flight control in case of communication loss, decision-making for landing, and selection of safe emergency landing sites;
- Drone health monitoring and self-diagnostics;
- Intelligent winch control for dynamic adjustment of rope length.

Sensors and Communications

Modern delivery drones should be equipped with the following hardware capabilities:

- GNSS[7] connectivity with RTK[8] technology for centimeter-level navigation accuracy;
- Winch system capable of lifting and lowering cargo, with safeguards to prevent drops if the rope gets caught;
- Efficient fast charging and quick battery replacement;
- Integration with UTM[9] (Unmanned Traffic Management) systems;

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[7] GNSS—a general term for global navigation sattellite systems such as GPS, GLONASS, BeiDou, Galileo, etc.

[8] RTK—real-time kinematic, a technology that allows for the correction of positioning errors inherent in GNSS and reduces the positioning accuracy error from 3-4 meters to 3-4 centimeters, approximately.

[9] UTM—unmanned aircraft systems traffic management system, a class of information systems that enable automated dispatching of unmanned aircraft systems, and in a broader sense—an ecosystem for the joint work of air traffic participants at low altitudes.

- Body ingress protection of at least IP55, operation at temperatures from –20°C to +45°C, and operation in light rain or snow;
- Internet modem with a backup communication channel;
- Onboard inertial measurement unit: accelerometer for high G-loads, highly sensitive barometer, gyroscope;
- Stereo camera for computer vision.

The Ideal Drone

Today, the ideal autonomous delivery drone, from a technological perspective, is a lightweight, energy-efficient platform powered by solid-state batteries, equipped with physical AI for autonomous visual navigation, in-flight self-diagnostics, and safe unloading management.

The drone should also be equipped with an aviation-grade sensor suite for inertial navigation, as well as a redundant set of communications capabilities for communication with control systems, UTM systems, and RTK services.

Such a drone will provide high throughput thanks to its **high level of autonomy**.

Conclusion

In future publications, we'll delve deeper into drone design, regulation, and IT solutions for the drone delivery market (UTM).

We'll also take a closer look at the potential impact logistics drones may have on the e-commerce market in Kazakhstan. We'll also provide our forecast for the development of the autonomous delivery market over the next five years.

Appendices

Calculation of time for climb and descent

The climb and descent time in minutes is calculated using the following formula:

$$Time_{climb\ \&\ descent} = (Altitude \times 4) \div Speed_{climb\ \&\ descent} \div 60$$

where:

- $Time_{climb\ \&\ descent}$—the time for takeoff and landing;

- *Altitude*—the flight altitude, which in our case averages **100 meters**;
- $Speed_{climb\ \&\ descent}$—the average speed of climb and descent, which in our case averages **3 meters per second**.

The calculation using this formula looks like this:

$$Time_{climb\ \&\ descent} = (100 \times 4) \div 3 \div 60 \approx 2,2$$

Thus, takeoff and landing will take approximately **2.2 minutes.**

Calculation of time for flight in both directions

Let's calculate the time for a round-trip flight using a similar formula:

$$Time_{horizontal\ flight} = (Distance \times 2) \div Speed_{horizontal\ flight} \div 60$$

where:

- $Time_{horizontal\ flight}$—the time of "horizontal" flight;
- *Distance*—the average delivery distance (delivery radius), which in our calculations is 2,000 meters;
- $Speed_{horizontal\ flight}$—the average speed of "horizontal" flight, which in our case is 10 meters per second.

The calculation using this formula looks like this:

$$Time_{horizontal\ flight} = (2000 \times 2) \div 10 \div 60 \approx 6,7$$

Thus, a round-trip flight over the distance will take approximately **6.7 minutes.**

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