



MARCH 8, 2024

DRONE DELIVERY

A rapidly innovating industry in need of public sector approval

Overview

The drone delivery industry seeks to be the best solution for last-mile delivery, which is when a product or good is delivered to the ultimate user. Not only are drone delivery services economically viable, they present numerous benefits to society, such as reduced delivery times and better servicing for difficult-to-access locations.

While it may seem far fetched to some, in 2024, the technology is not only feasible but is approaching the point of being readily accessible. Indeed, we've already seen drones used to deliver a wide range of products ranging from medicine to pizza.

Simultaneously, the industry is subject to enormous scrutiny and regulatory limitations due to the potential scope of its drawbacks in implementation. Unlike other delivery methods, such as bicycles and motor vehicles, drones present unique risks and edge cases. These issues compound due to the difficulty of implementing the technology into existing supply chains and a lack of mature safety protocols that meet the stringent standards set by organizations such as the United States Federal Aviation Administration (FAA).

According to David Carbon, lead of Amazon's Prime Air, the problem with the industry is not that drone delivery is difficult to implement. The problem is that it is difficult to "design, build, and certify an autonomous, safety-critical system that can operate over densely populated environments within the national airspace" (Tarasov, 2023). In particular, given the United State's history with aviation and that the nation already has the busiest airspace in the world, there is good reason for governing bodies to act ultra-conservatively regarding national safety concerns.

The concerns of these parties are not unfounded. Unfortunately, drones can be extremely dangerous. They have been used as objects of war to deliver lethal payloads or have acted as the payloads themselves. Drones are also used regularly for espionage. This raises privacy concerns, given that drones deliver goods to residential areas.

However, drones offer numerous advantages over alternative delivery methods in specific use cases. They are capable of using less energy to deliver small packages. However, there is a very narrow sweet spot in which drones operate. For example, Wing's latest drone can carry a payload that weighs up to 5 pounds (Hawkins, 2024). These weight limitations mean delivery drones likely will not be used for anything other than last mile services in the short run.

Key Players

Large companies with existing integrations and moats in delivery infrastructure initially dominated the current market for drone delivery. Theoretically, it was viable for them to implement drone delivery as part of their bigger-picture strategies, since they had the capacity to absorb the overhead needed for implementation.

These first players included Amazon, Alphabet, UPS, and Walmart. However, many of these early movers ran into regulation and implementation issues. Amazon, in particular, has had difficulty with the FAA being slow to give them the green light to operate in wider vicinities without needing operators keeping track of their drones (Palmer, 2023).

On the other hand, startups like Zipline, Matternet, DroneUp, and FlyTrex have disrupted the industry and are holding their own with innovation and diligence. For example, instead of using a drone to drop off packages directly, Zipline's new drone, the Platform 2, hovers above the delivery point and slowly lowers a droid carrying the package with a cable, ensuring a lesser risk of accidents (Bellan, 2023). In contrast, Matternet was the first company to receive the rigorous "Type Certification" for their M2 drone after extensively testing with the FAA. In other words, it was the first non-military unmanned aircraft system (UAS) considered "airworthy" or generally safe enough for commercial use (Business Wire, 2022).

Characteristics

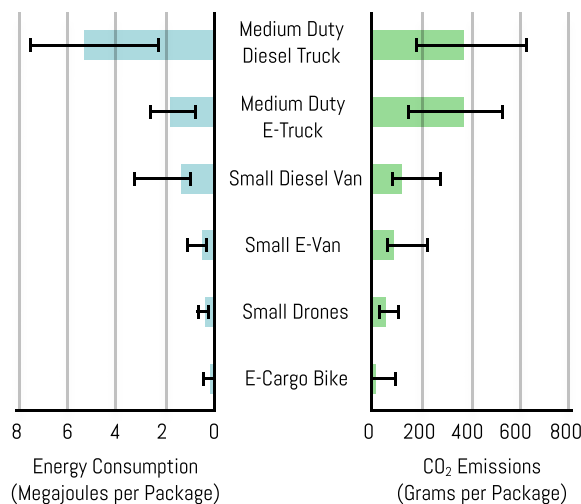
While overseas shipping and rail are highly efficient (but not necessarily fast) and have been relied upon for centuries, they are irrelevant regarding the drone discussion. Since drones are used for last-mile delivery, their main competitors by mode of transport are trucks and bikes. Compared to these alternatives, drones are more efficient across numerous dimensions.

There are many limitations that cars and bikes face in the built environment that drones can bypass. For example, traffic means that motor vehicles often spend time idling or accelerating and decelerating, causing energy loss and excess pollution. Since cars and bikes are much heavier than drones, they have more inertia to overcome, meaning it takes more energy for them to reach full speed as opposed to drones. Cars and trucks have complicated internal mechanisms, meaning they lose relatively more energy by simply operating, particularly if they have old gasoline or diesel engines with a lot of internal friction.

Under ideal conditions, using drones is a way to avoid much of this energy loss. Using energy use as a proxy for operating expenditures, we anticipate that the operating costs of drones scale much slower than those of cars or bikes. Theoretically, you also need very few operators per drone (ideally close to none), further decreasing variable costs with scale.

Research seems to support this notion as well. Electric cargo bikes and drones are the most efficient and environmentally friendly delivery methods when considering the number of packages delivered with respect to energy use (Carroll, 2023). However, when cargo bikes carry smaller loads, this advantage is diminished. In other words, drones are still the undisputed king for delivering small payloads across short distances. They are even more attractive for dire situations, where speed and specificity trumps all.

Energy Efficiency and Emissions Across Modes of Delivery



by Carnegie Mellon University

Delivery with drones is not without caveats. As mentioned earlier, their advantages fully manifest only under ideal conditions. Unfortunately, drones perform abysmally in inclement weather. First, drones are very light and thus susceptible to wind. According to the Argonne National Laboratory (2023), when wind speeds are greater than 10 miles per hour, drones burn more energy than electric vehicles (EVs). And when speeds are greater than 20 miles per hour, drones burn more energy than diesel trucks.

Second, drones must employ complex sensing systems to ensure they do not crash into other objects. Often, these systems are expensive and do not work well in inclement weather, as precipitation introduces noise into the sensing environment. However, companies like Wing are steadily investing in R&D and extensive field testing to ensure that their drones can eventually perform well in all weather conditions.

Drone delivery systems are relatively new and have yet to be stress-tested by high volumes and scaling. Another difficulty with the drone delivery industry is that its health will always be tied to the regulatory landscape, meaning that even if drone delivery turns out to be massively profitable and efficient, the FAA could destroy this profitability by rescinding certain exemptions. For example, while the “Type Certification” is a seal of approval given to specific aircraft makes and models in a formal process, exemptions are generally fast and loose, subject to their ultimate authority.

For example, the FAA generally prohibits drone use Beyond the Visual Line of Sight (BVLoS) of operators. Without a BVLoS exemption, there needs to be one operator per drone. This arrangement is costly, and erases one of the main advantages of delivering with drones in the first place. Such restrictions serve as the tipping point for the viability of drone delivery as an industry, because the primary way the industry can experience economies of scale is by increasing the number of drones per operator. Whether or not companies are exempt from these regulations is the difference between innovating and growing or simply biding time, trying to appease the FAA.

The economics of the drone delivery industry are such that it will occupy a unique niche in the transportation and shipping sectors. Because the benefits the model provides are highly specific, the industry will not affect highly traditional channels with long business cycles like maritime shipping.

Instead, regulations permitting, the industry will succeed in fast paced, hyper-specific verticals. One major use case already mentioned is consumer facing last mile deliveries. Drones perform well here because the alternatives are so bad. Logically, there is very little economic sense in having a 2-ton motor vehicle deliver a Happy Meal to a single customer deep in the suburbs, especially if that vehicle is fuel inefficient and pushes other externalities onto society. Indeed, McKinsey consultants estimate that once operators can handle 20 drones each, the per package cost of drone delivery will dip below that of food delivery platforms like Uber Eats, DoorDash, and GrubHub (Cornell et al., 2023).

Drones also perform well in rural areas or locations with strict geographical constraints. For example, in Rwanda, which is very mountainous, Zipline was contracted by the local government to deliver blood to healthcare facilities (Levy, 2022). Zipline decreased delivery times and reduced the need for hospitals to overstock on blood, reducing emissions and waste. Since drones are the quickest, most precise delivery method, they excel in similar situations where price inelasticity and urgency are high.

Changes

Although the drone delivery industry is subject to regulatory changes, recent shifts have favored a few specific players within the industry. Many companies have overcome the tallest hurdle - they are now exempt from line of sight regulations.

In September 2023, uAvionix, Flight Forward, and Zipline were granted BVLoS exemptions from the FAA (FAA, 2023). Notably, uAvionix's request was in conjunction with Vantis, who are trying to standardize BVLoS safety protocols and create infrastructure for the industry as a whole through their communications and radar network. Matternet, who produces the M2 drone used by Flight Forward, also received approval from the Luftfahrt-Bundesamt (Germany's FAA equivalent) for BVLoS in the heart of Berlin, which is significant because large cities are more complicated to navigate safely, signifying a high degree of confidence in Matternet by German authorities (Business Wire, 2023). DroneUp received FAA approval in January 2024, allowing them to operate at Riverside Health system facilities, eventually preparing for "broader BVLoS rollout at additional locations throughout the country with existing and new customers" (DroneUp, 2024).

Interestingly, many of these companies welcome this new slew of approvals that outwardly signal intense competition. However, for those within the industry, this seems to be a sign of hope, confirming that their business models are indeed viable.

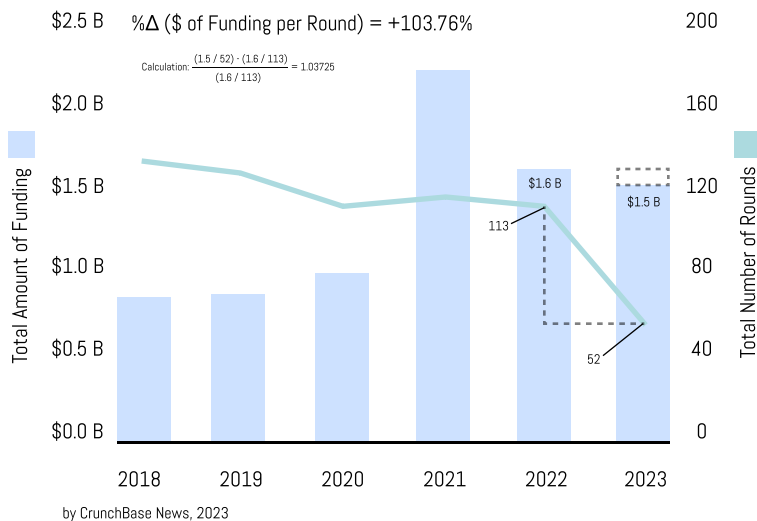
"I wish everyone else in the space the best luck because I want the space to exist" - Adam Woodworth, CEO of Wing, speaking to CNBC

Indeed, there is also an economic component to this. Tom Walker, CEO of DroneUp, believes that as startups continue to grow and become more established, supply chains will mature in response so that "high quality products for better prices" become more accessible, making "last-mile delivery actually profitable rather than just cost effective" (Tarasov, 2023).

Future

The drone delivery industry seems poised for strong growth. Despite the drastic downturn in VC funding volume in a low liquidity, high interest rate environment, appetite for drone related funding has remained exceptionally stable. This situation is quite unique, and speaks to the fact that expectations for the sector are unusually high amongst investors.

Drone and Drone Delivery Startup Equity Funding



With the United States IPO market anticipated to return to normal at some point in the latter half of 2024 (Schwartz & Gerring, 2024) and an increasingly favorable regulatory environment for drone delivery companies (Muller, 2024), there is good reason to believe in high levels of activity within the industry in terms of funding and continued innovation. Given that drone delivery companies currently operate in limited geographic vicinities, it would not be surprising seeing eventual M&A activity as well, particularly amongst market leaders attempting to expand their reach.

Conclusion

In the near future, we likely will not see drones dominate large swaths of commercial delivery nor become a de-facto method of transporting goods and services. However, as supply chains adjust to fit the drone industry, safety protocols and sensing technologies improve, and the regulatory environments softens, drones will occupy a more prominent role in sub-sectors where their implementation is economically beneficial.

Delivery drones have the capacity to improve the quality of life for many stakeholders while also making a profit. They will make things more convenient for those living in suburban and rural areas, decreasing the need for wasteful deliveries made by polluting, inefficient vehicles. Simultaneously, they will also aid us in times of crisis and assist in serving the disadvantaged, delivering crucial medicines and supplies where they are needed most.

References

Argonne National Laboratory. (2023, March 1). Argonne Drops Data on the Question of Efficient Drone Use for E-commerce Deliveries.

<https://www.anl.gov/article/argonne-drops-data-on-the-question-of-efficient-drone-use-for-ecommerce-deliveries>

Bellan, R. (2023, March 15). Zipline unveils cute little droid to make drone delivery more accurate. TechCrunch.

<https://techcrunch.com/2023/03/15/zipline-unveils-cute-little-droid-to-make-drone-delivery-more-accurate/>

Business Wire. (2022, November 30). Matternet Receives FAA Production Certificate for its M2 Drone Delivery System. Business Wire.

<https://www.businesswire.com/news/home/20221130005322/en/Matternet-Receives-FAA-Production-Certificate-for-its-M2-Drone-Delivery-System>

Business Wire. (2023, December 12). Matternet Receives Authorization from the German Aviation Office to Launch BVLOS Drone Delivery Operations in Berlin. Business Wire.

<https://www.businesswire.com/news/home/20231212271453/en/Matternet-Receives-Authorization-from-the-German-Aviation-Office-to-Launch-BVLOS-Drone-Delivery-Operations-in-Berlin>

Carroll, D. (n.d.). Research Suggests Drones More Efficient for Last-mile Deliveries. College of Engineering at Carnegie Mellon University.

<https://engineering.cmu.edu/news-events/news/2022/09/16-last-mile-drones.html>

Cornell, A., Kloss, B., Presser, D., & Riedel, R. (2023, January 3). Drones take to the sky, potentially disrupting last-mile delivery. McKinsey & Company.

<https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/future-air-mobility-blog/drones-take-to-the-sky-potentially-disrupting-last-mile-delivery>

DroneUp. (2024, January 18). Droneup awarded landmark FAA approval for Beyond Visual Line of sight (BVLOS) in the U.S. DroneUp.

<https://www.droneup.com/droneup-awarded-bvlos>

Federal Aviation Administration. (2023, September 6). The FAA Authorizes UPS Flight Forward and uAvionix to Operate Drones Beyond Visual Line of Sight. The FAA Authorizes UPS Flight Forward and uAvionix to Operate Drones Beyond Visual Line of Sight | Federal Aviation Administration.

<https://www.faa.gov/newsroom/faa-authorizes-ups-uavionix>

Gerring, R., & Schwartz, M. (2024, January 18). Q4 2023 IPO market trends. EY.

https://www.ey.com/en_us/ipo/trends/q4-2023-ipo-market-trends#:~:text=2024%20outlook%20for%20the%20IPO,to%20access%20the%20public%20markets.

Glasner, J. (2023, October 25). Funding for Drone Delivery Startups Still Flying High Amid VC Downturn. Crunchbase News.

<https://news.crunchbase.com/retail/drone-delivery-startups-raising-funding-zipline/>

Hawkins, A. J. (2024, January 17). Alphabet's wing unveils larger drones for heavier packages. The Verge.

<https://www.theverge.com/2024/1/17/24040030/wing-delivery-larger-drone-payload-capacity-alphabet>

Kramer, H. (2023, September 6). FAA Approves uAvionix Beyond Visual Line of Sight (BVLOS) Exemption with Vantis Network. uAvionix.

<https://uavionix.com/faa-approves-uavionix-beyond-visual-line-of-sight-bvlos-exemption-with-vantis-network/>

Levy, M. G. (2022, April 21). Drones have transformed blood delivery in Rwanda. Wired.

<https://www.wired.com/story/drones-have-transformed-blood-delivery-in-rwanda/>

Loftus, K. (2018). Low angle photo of drone near trees photo – Free Tree Image on Unsplash. Unsplash. Kal Visuals. Retrieved March 8, 2024, from

<https://unsplash.com/photos/low-angle-photo-of-drone-near-trees-Ve7iqUNkGsA>.

References

Muller, J. (2024, January 2). 2024 will be a breakout year for delivery drones. Axios.

<https://www.axios.com/2024/01/02/delivery-drones-2024-amazon-zipline-wing>

Palmer, A. (2023, August 9). Amazon Prime Air loses two key operations leaders, as drone delivery struggles continue. CNBC.

<https://www.cnbc.com/2023/08/09/amazon-drone-delivery-unit-prime-air-loses-two-key-operations-leaders.html#:~:text=The%20drone%20unit%20has%20been,target%20of%2010%2C000%20this%20year.>

Tarasov, K. (2023, May 18). Why Walmart and Alphabet are Beating Amazon in Drone Delivery. YouTube. <https://www.youtube.com/watch?v=yMqbj4Kj-z0>

Team Zipline. (2023, September 18). FAA Clears Way for Autonomous Aviation in the U.S.; Unlocks Major Drone Delivery Expansion with Zipline Decision.

Zipline. <https://www.flyzipline.com/newsroom/news/announcements/faa-authorizes-zipline-to-fly-bvlos>

Team Zipline. (n.d.). Ghana Used Instant Delivery to Build a Better Supply Chain. How Will it Change Public Health?. Zipline.

<https://www.flyzipline.com/newsroom/stories/articles/ghana-instant-delivery-supply-chain>