Assessing Feasibility of the Delivery Drone

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Summary:

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KEY INSIGHTS

1. Constraints are a critical component to understand and consider when exploring delivery drones in a transportation network. Drone flight range, payload, and cost of operation are currently the most difficult constraints to address.

2. Applications in the medical industry constitute most of the current delivery drone applications. Major transportation companies like UPS, Amazon, and DHL have all shown active participation in delivery drone research.

3. While delivery drones do not always directly translate to cost savings, they have shown potential to drive profit initiatives in their speed of delivery.

Introduction

Delivery drones have been highly anticipated in worldwide transportation networks since Amazon announced their exploration of the field in 2013. A variety of questions surround the topic. They center around operational and financial feasibility, government regulations, and technological capabilities to name a few. Our project found that the sponsoring company currently has 0% of their current deliveries eligible for drone delivery with a future potential of up to 35%.

Background

Getting into the delivery drone industry requires careful alignment of business and strategy for a company. Examining the important aspects of the drone industry to align them with the company strategy is the first step.

Amazon, Boeing, UPS, FedEX, and DHL are just a few of the companies that have been experimenting with delivery drones. Most of the momentum in drones seems to be in the medical industry. There are also a number of emerging delivery drone companies such as Matternet and Flirtey.

Given the activity in the drone industry, it is important to understand their technological capabilities and limitations. These considerations come with many tradeoffs such as battery versus hybrid technology for example. Figure 1 gives just a few examples of delivery drones available on the market now. Note that payload, cruise speed, endurance, and weight are the performance metrics considered. These four factors are critical to the delivery drone market.

While high payload is attractive, it also comes with a higher overall weight. Increased weight becomes tricky when considering regulations placed drones. Our research focused on the United States where the Federal Aviation Administration has a 55-pound (approx. 25 kilogram) weight limitation.

The scope of our research was concerned on how many customers were reachable by drone technology, so endurance and speed were important specifications to consider for measuring effectiveness.

Product	Payload	Cruise Speed	Endurance	Weight
 Airborg H8 10K	4 kg (8.82 lbs) 10 kg (22.04 lbs)	55 kph (~34 mph)	2+ hour 1+ hour	33 kg (~73 lbs)
 Flytrex Sky	0.75 kg (1.65 lbs)	36 kph (~22 mph)	30 minutes	1.25 kg (~3 lbs)
 Prime Air	2.26 kg (5 lbs)	80.5 kph (50 mph)	30 minutes	25 kg (55 lbs)

Figure 1: Delivery Drone Specifications

For current technology, we settled upon a drone which was capable of 5 pounds payload, maximum range of 35 miles, average speed of 35 miles per hour, and endurance of 1 hour.

Once there is a feel for the technology, the external challenges of drones require some consideration. The challenges include weather, running a business with an aviation component, and insurance to name a few. To avoid the challenges of weather, we researched locations with fair climates where the impact would be minimal.

With an established foundation for entering the delivery drone industry, we conducted an operational and financial feasibility analysis for our sponsor company. The analysis showed 0% of current deliveries in San Diego, Los Angeles, San Francisco, Houston, or Dallas were feasible for delivery drones.

Methodology

Operational feasibility relies on finding constraints of delivery drones in a logical order. We determined the distance between customers and company facilities. Next, we used those distances to determine if a drone could make a trip from the business to the customer then back to the business. If so, the delivery passed the first constraint of range.

Next, payload was considered. For current feasibility, a 5-pound limitation was applied. The next constraint was airport proximity. While drones are not necessarily prohibited from flying near busy airports, they do present additional challenges. The consideration filters out customers who are within 6 miles of a major airport.

Security and prioritization of deliveries were considered important factors. We built filters for the company to apply future analysis in these areas, but we chose not to use them for our analysis.

The operational metrics were later run through sensitivity analysis to give insight to how advances in technology and regulations could improve drone deliveries. For instance, 93% of San Diego customers would be reachable by drone if the drone could handle a 40-mile range (20-mile distance between customer and business location).

With an operational foundation established, financial feasibility was considered next. The desire of the sponsor company was to analyze how drones could reduce costs in the transportation network. To achieve this goal, we considered investment costs, future costs, and future benefits.

While many different costs were considered (and some like costs of data plans for drones were omitted), we ran sensitivity analysis on the financial analysis to determine the most significant costs.

The costs for employees who can manage a delivery drone network were the most significant margin. In general, the costs of employees and how many drones they are capable of handling was a make or break factor in financial feasibility. Professional truck and van driver wages, total drone investment cost, gas price, drone price, and drone operating costs were the other significant cost considerations.

With the operational and financial analysis, we examined future scenarios. The scenarios examined were three 5-year forecasts with pessimistic, likely, and optimistic features for the critical metrics. To take a quick look at drones as a profit driver instead of a cost saver, we also analyzed drones with a $20 premium applied.

Results

With the current capabilities of the delivery drone and our sponsor company, all of the cities analyzed had less than 1% of their current deliveries feasible for drone delivery. In 5 years, it looks likely that most cities will have about 10% of their deliveries eligible.

San Diego was one of the best potential candidates for delivery drones. In Figure 2, the most likely 5-year scenario is depicted in our wedding cake operational feasibility model. The model shows 18.1% of all deliveries are eligible considering a 50-mile range, 20-pund payload, and a minimum of 3 miles between a customer and major airport.

Table 1 shows a perspective of financial feasibility if customers were willing to incur a $20 surcharge for drone delivery. Pairing the fee with most likely and optimistic scenarios in cities with good weather and a strong customer base show some potential for delivery drone investment.

Discussion

The delivery drone has caught momentum in medical applications. Many of the companies that were launched to deliver goods have found themselves involved in medical delivery and applications. The waivers for operation seem to favor the exploration of medical applications. Considering the current activity, drones will likely need to prove themselves in medical applications before they expand to delivering products. The critical nature of medical equipment and supplies also fit the operational and financial implications of the analysis. Unlike parcel deliveries, most drone delivered medical supplies are going to remote areas within the range of drones where cost is virtually not a factor with someone's life on the line.

The sponsor company is a master at customer service. While consumer preference for drone delivery is outside the scope of this analysis, the sponsor company's care and consideration of the customer are paramount. As previously mentioned, the technology of drones delivering to vans would be a good starting point for future analysis. Although there are complications in network modeling for this solution, there are undeniable benefits. The safety of

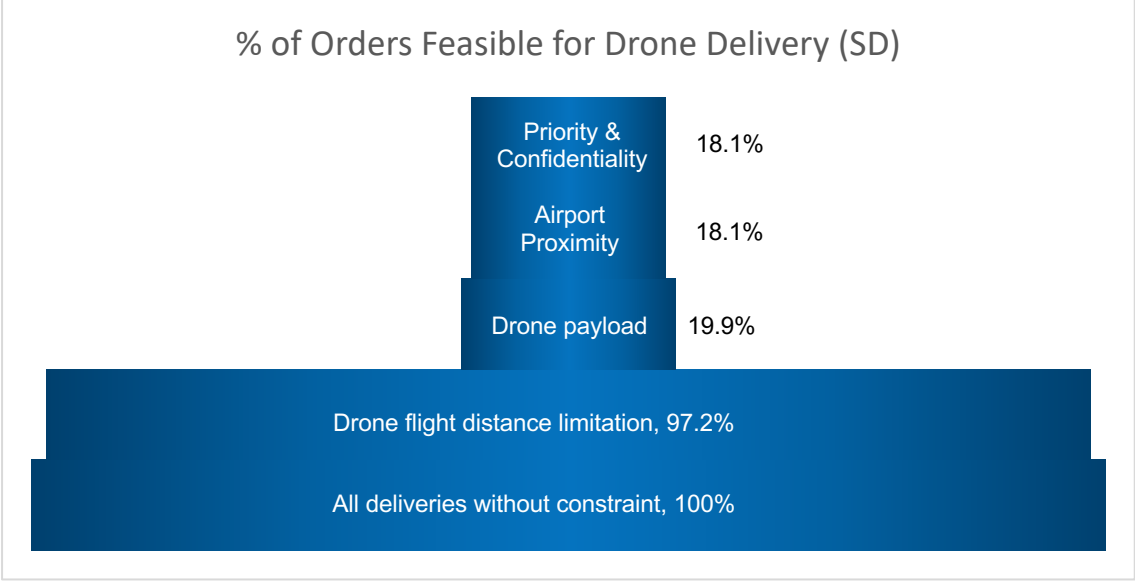

Figure 2: Operational Feasibility for San Diego, California Adjusted for Average Weight Distribution of 1.2 Cubic Feet or less Cargo ≤ 20 pounds

City/Region	Current		In 5 years		
	Base case		Future Scenario 1	Future Scenario 2	Future Scenario 3
	Rush & half day order only	All orders	Pessimistic	Most likely	Optimistic
Los Angeles	$ (2,788)	$ (2,623)	$ (2,022)	$ 1,220	$ 6,037
San Diego	$ (1,381)	$ (1,361)	$ (1,238)	$ 582	$ 2,808
San Francisco	$ (1,445)	$ (1,405)	$ (1,263)	$ 53	$ 1,494
Houston	$ (1,377)	$ (1,338)	$ (1,184)	$ (1)	$ 1,072
Dallas	$ (1,412)	$ (1,411)	$ (1,402)	$ (565)	$ (298)

Table 1: NPV for Drone Delivery Implementation at the Sponsor Company given all Drone Deliveries come with a $20 Surcharge

the product and the customer satisfaction of a person delivering their product are still ensured. It also provides the advantage of decreasing delivery times. This presents an opportunity for future profit growth. Rather than looking at drones as a cost saving technology, they should be viewed as a profit driver.

Technology improvement will likely favor a wider range of climates in the future. Regulations will come and go as well as relax and constrain with time. Every time a drone makes the headlines because of an accident, the potential for overreaction occurs. This may present future risk and considerations for elevated insurance in the future. Given the silence from initial investors like Amazon and UPS, there are likely some other challenges are likely being considered before investing further.

Conclusion

The delivery drone comes with opportunity and risk. Drone delivery has limitations that will likely restrict it to certain areas and applications for some time. There is also risk that a newer technology will end the drone craze. Given the required alignment of favorable conditions, ambitious assumptions, and operation in restricted areas with favorable weather and business conditions, the outlook for cost reduction looks hindered. Although cost reduction does not seem significant, delivery drones have the potential to drive profit. The research conducted at MIT and in industry is measuring drone performance in terms of time and not cost. The sponsor company may have some opportunity to revisit this inquiry from a profit driving consideration versus a cost reduction. While the future is unclear, the technology does seem to be holding on. For the right applications, drones will continue to make headlines for the foreseeable future.