Drone Delivery: Deal or No Deal

Assessing Feasibility of the Delivery Drone

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Overview

- Background
- Methodology
- Result
  - Operational feasibility
  - Financial feasibility
- Discussion & conclusion
A history that started with a bang

- July 1849 – Austrians sent incendiary balloons to besiege Venice
June 1941 – Winston Churchill and others waiting to watch the launch of a de Havilland Queen Bee target drone
The Delivery Drone

- 2012 / 2013 – the delivery drone craze begins (medical, surveillance, inspection, small parcel, food delivery)
The Delivery Drone
Delivery drone challenges

- Weather
- Range
- Obstacles
- Batteries
- Cellular Network
- Airports
- Payload
- Noise
Methodology

Operational Feasibility

- Understand regulatory landscape for drone delivery
- Define feasible metrics for drone delivery
- Operational sensitivity analysis

Financial Feasibility

- Baseline financial model
- Cost sensitivity analysis
- Scenario analysis
Target Locations & Key Operational Metrics

Key Metrics selected for analysis:
- Maximum flying range
- Airport Proximity
- Payload
- Priority level
Operational Feasibility – Current Scenario

With the current capabilities and scenario, all of the cities analyzed had less than 1% of their current deliveries feasible for drone delivery.

- <1% of current deliveries are feasible for drone delivery.
- Payload is the primary constraint followed by airport proximity constraint.
Operational Sensitivity Analysis – Maximum Distance

>90% of customers (by number of orders) can be reached by drone when it can fly up to 55 miles round trip.
>80% of customers (by number of orders) can be reached by drone when it is allowed to fly 3 miles from airports.
In terms of delivery package size, 50 - 60% of orders are 1.2 cu. ft. in volume.
With favorable improvement in technology and relaxation in regulations in the next 5 years, 8% - 18% of deliveries would be feasible for drone delivery.

Current scenario

Likely scenario in 5 years
## Financial Feasibility – Current vs Future

Drone delivery is only feasible under optimistic scenario as a cost saver.

### NPV without premium charge (cost saver)

<table>
<thead>
<tr>
<th>City/Region</th>
<th>Current scenario</th>
<th>Future scenarios in 5 years</th>
<th>Pessimistic</th>
<th>Most likely</th>
<th>Optimistic</th>
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</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>(2,745)</td>
<td>(2,627)</td>
<td>(919)</td>
<td>560</td>
<td></td>
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<tr>
<td>San Diego</td>
<td>(1,377)</td>
<td>(1,355)</td>
<td>(558)</td>
<td>590</td>
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<tr>
<td>San Francisco</td>
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<td>(1,427)</td>
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<td>339</td>
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<tr>
<td>Houston</td>
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<td>(1,361)</td>
<td>(481)</td>
<td>(11)</td>
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<tr>
<td>Dallas</td>
<td>(1,421)</td>
<td>(1,464)</td>
<td>(734)</td>
<td>(669)</td>
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</tr>
</tbody>
</table>

### Cost metrics to be considered in all scenarios:

- **Initial investment & replacement costs**
- **Future benefits**
  - Fuel & maint. cost saving
  - Driver wage saving
- **Future costs**
  - Operating cost (batteries, maint.)
  - Drone specialist salary
Financial Feasibility – Cost Saver vs Profit Driver

Pairing some fees with most likely and optimistic scenarios show some potential for delivery drone investment.

<table>
<thead>
<tr>
<th>City/Region</th>
<th>NPV without premium charge (cost saver)</th>
<th>NPV with $20 premium per order (profit driver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current scenario</td>
<td>Future scenarios in 5 years</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Cost Sensitivity Analysis

Number of drone specialists required is the most sensitive factor for drone implementation.

- Driver wage rate, 47%
- Drone investment cost, 21%
- Gas price, 15%
- Drone operating cost, 15%

Level of sensitivity to NPV (Los Angeles)
Discussion & Conclusion

• Changes in regulations
  • Line of sight to autonomous
  • Flight over populated areas

• Technology
  • Advancement in batteries
  • Increase in payload
  • Increase in range
  • All weather capability

• Watch for momentum in drone medical deliveries

• Wait for the best means of drone delivery service to emerge
Discussion & Conclusion

• Understanding the complex nature of delivery drone operations
• Cost savings versus profit driving
Appendices
Cost Sensitivity Analysis

Cost sensitivity for Los Angeles

- Salary for drone specialists: 100%
- Driver Wage ($/hr): 47%
- Total Investment cost: -21%
- Gas price ($/Gallon): -16%
- Drone Cost per unit: 15%
- Drone operating cost: 15%

Cost sensitivity for San Francisco

- Salary for drone specialists: 72%
- Driver Wage ($/hr): 31%
- Total Investment cost: 20%
- Gas price ($/Gallon): -11%
- Drone Cost per unit: -12%
- Drone operating cost: 6%

Cost sensitivity for San Diego

- Salary for drone specialists: 110%
- Driver Wage ($/hr): 60%
- Total Investment cost: -20%
- Gas price ($/Gallon): -21%
- Drone Cost per unit: 14%
- Drone operating cost: 14%

Cost sensitivity for Dallas

- Salary for drone specialists: 42%
- Driver Wage ($/hr): 1%
- Total Investment cost: 10%
- Gas price ($/Gallon): 0%
- Drone Cost per unit: 5%
- Drone operating cost: 0%

Cost sensitivity for Houston

- Salary for drone specialists: 64%
- Driver Wage ($/hr): 20%
- Total Investment cost: -12%
- Gas price ($/Gallon): -7%
- Drone Cost per unit: 6%
- Drone operating cost: 6%
Key Assumptions

**Drone capability assumptions:**
- Speed: 35 mph
- Flight time: 1 hour

**Initial investment cost assumptions:**
- Drone price = $10,000 per unit
- Container price = $100 per unit, 3 cargo containers per drone
- Drone station price = $10,000 per location (one location per depot)
- Implementation, system integration, and other administration cost = $40,000
- The useful life of drones and containers is 5 years

**Drone operating cost assumptions:**
- Annual salary for drone specialist = $60,000 per person.
- Drone maintenance cost (including battery, repairs, etc.) = $0.10 per mile

**Vehicle cost saving assumptions:**
- Gas price = $3.50 per gallon
- Energy consumption = 10 mile per gallon
- Average distance traveled per hour = 25 miles per hour
Weight Distribution for Package Size of 1.2 cu.ft.

Weight distribution for package size of 1.2 cu.ft.
## Scenario Analysis – 3 possible future scenarios to be considered for financial analysis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Current</th>
<th>Future Scenario 1</th>
<th>Future Scenario 2</th>
<th>Future Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base case</td>
<td>Pessimistics Scenario</td>
<td>Most likely Scenario</td>
<td>Optimists Scenario</td>
</tr>
<tr>
<td>Max Flying distance</td>
<td>17.5 miles</td>
<td>20 miles</td>
<td>25 miles</td>
<td>30 miles</td>
</tr>
<tr>
<td>Payload</td>
<td>5 lb</td>
<td>10 lb</td>
<td>15 lb</td>
<td>20 lb</td>
</tr>
<tr>
<td>Distance from airports</td>
<td>6 miles</td>
<td>4 miles</td>
<td>3 miles</td>
<td>2 miles</td>
</tr>
<tr>
<td>No. of drone specialists required</td>
<td>1 person handles 2 drones</td>
<td>1 person handles 2 drones</td>
<td>1 person handles 5 drones</td>
<td>1 person handles 10 drones</td>
</tr>
<tr>
<td>Total Investment cost</td>
<td>base case estimates based on regions</td>
<td>25% increase</td>
<td>25% reduction</td>
<td>25% reduction</td>
</tr>
<tr>
<td>Drone operating cost</td>
<td>base case estimates based on regions</td>
<td>25% increase</td>
<td>Same as base case</td>
<td>25% reduction</td>
</tr>
<tr>
<td>Gas price ($/Gallon)</td>
<td>3.5</td>
<td>25% reduction</td>
<td>Same as base case</td>
<td>25% increase</td>
</tr>
<tr>
<td>Driver Wage ($/hr)</td>
<td>20</td>
<td>Base case</td>
<td>25% increase</td>
<td>50% increase</td>
</tr>
</tbody>
</table>
References

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Historical references for Slide 3:
The Future of Drone Use: Opportunities and Threats from Ethical and Legal Perspectives, Asser Press – Springer, chapter by Alan McKenna, page 355

Image credit for Slide 4:
https://en.wikipedia.org/wiki/Target_drone#/media/File:Winston_Churchill_and_the_Secretary_of_State_for_War_waiting_to_see_the_launch_of_a_de_Havilland_Queen_Bee_radio-controlled_target_drone,_6_June_1941._H10307.jpg

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