Drones for Deliveries

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This work was created in an open classroom environment as part of a program within the Sutardja Center for Entrepreneurship & Technology and led by Prof. Ikhlac Sidhu at UC Berkeley. There should be no proprietary information contained in this work. No information contained in this work is intended to affect or influence public relations with any firm affiliated with any of the authors. The views represented are those of the authors alone.
Drones will handle last mile delivery of most lightweight packages
How will it work?

Order Online → Warehouse receives orders → Trucks with drones and packages deliver to fulfillment centers → Drones deliver the last leg
Market Analysis
Packages for delivery

Keeney, Tasha. "How can Amazon Charge $1 for Drone Delivery?" Ark Invest.
$500M savings per year for Amazon

Projected Cost per Drone Shipment

($ / shipment)

<table>
<thead>
<tr>
<th>Year</th>
<th>$50 Drone Price</th>
<th>$250 Drone Price</th>
<th>$125 Drone Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>$0.18</td>
<td>$0.09</td>
<td>$0.04</td>
</tr>
<tr>
<td>2017</td>
<td>$0.16</td>
<td>$0.08</td>
<td>$0.04</td>
</tr>
<tr>
<td>2018</td>
<td>$0.15</td>
<td>$0.07</td>
<td>$0.04</td>
</tr>
<tr>
<td>2019</td>
<td>$0.14</td>
<td>$0.07</td>
<td>$0.04</td>
</tr>
<tr>
<td>2020</td>
<td>$0.14</td>
<td>$0.07</td>
<td>$0.03</td>
</tr>
</tbody>
</table>

Notes: Only includes North American shipments. Assumes 17% of shipments are done by drone in 2016, rising to 85% by 2020. Assumes a 1.5% CAGR in packages shipped. Assumes Direct & Indirect drone OpEx to be 8% of drone prices, which declines at 5% per year.

Source: Prashob Menon

Menon, Prashob. Ivey Business Review.
Current Players

Drone Startups
- DJI
- 3DR
- Matternet
- CyPhy
- Flirtey
- HorseFly
- QuiQui

Logistics Companies
- FedEx
- UPS
- DHL

Retailers
- Amazon
- Google
- Walmart
- Pizza Hut

Sutardja Center for Entrepreneurship & Technology
Berkeley Engineering
Technology Analysis
## Technology Analysis of Drones

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Grade</th>
<th>Consumer</th>
<th>Enterprise</th>
<th>Military</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td></td>
<td>Carries cameras for pics and videos</td>
<td>Package delivery, farming, topology</td>
<td>Delivers weapons</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td>$500</td>
<td>$5,000-$10,000</td>
<td>$5,000,000</td>
</tr>
<tr>
<td>Package weight</td>
<td></td>
<td>1-2 pounds</td>
<td>5-7 pounds</td>
<td>200 pounds</td>
</tr>
<tr>
<td>Charging time</td>
<td></td>
<td>~120 min</td>
<td>~60 minutes</td>
<td>hydrogen fuel cell 10 minutes</td>
</tr>
<tr>
<td>Solar charging</td>
<td></td>
<td>n/a</td>
<td>Acquila 3 months</td>
<td>In development</td>
</tr>
<tr>
<td>Flight distance</td>
<td></td>
<td>~3 miles</td>
<td>2 lbs package for 12 miles</td>
<td>48 hours</td>
</tr>
<tr>
<td>Example</td>
<td></td>
<td>3D Robotics $500; 22 min flight time</td>
<td>MatternetOne $5K; range 12 miles</td>
<td>NG Global Hawk $223M, range 14,154mi</td>
</tr>
</tbody>
</table>
Technology Outlook

Integrated Flight Management
Asset Management
Flight Operation Logging and Reporting
FAA Approval of Pilot-less drones for package delivery
Automated regulatory compliance
Direct Drone Communications
Air traffic Controlled Delivery
Base to Drone communications
Accident Avoidance
2016
2017
2019
2020
Heavy Rain resilient
Societal Factors

- Societal issues (Privacy, Safety, Liability, etc.)
- Environmental factors (Noise, birds, etc.)
Regulations

• Commercial drones require FAA exemption
• New proposed FAA rules for commercial drones (2016)
  • Current FAA proposal has limits
    – Height limit of 500 feet
    – Speed limit of 100 miles per hour
    – Daylight & visual-line-of-sight
    – One operator per drone
    – Certified operator
• State laws (Florida SD766, Arkansas HB1349, etc.)
  – privacy protections
Opportunities

- Home delivery drone manufacturers
- Air traffic coordination (device/software)
- Drone charging stations & landing pads
- Drone Recovery & Safety
- Analytics for drone insurance
- Skilled Technicians for maintenance and support
Conclusions

• Drones will handle last mile delivery of most lightweight packages

• Key factors: Convenience, Cost

• Creation of an industry and a supporting ecosystem

• Innovators: Amazon, Walmart, Logistics companies