Electrification of Air Transportation

Keizai Silicon Valley
May 2021

Fred Borda
Aerial Innovation
About Aerial Innovation

Deep Understanding of the Global Ecosystem

- OEMs
- Regulators
- Test Sites
- Standards Organizations
- Services Providers
- Research Community

Deep Capabilities in Drone and Air Mobility Corporate Strategy

- New Entrants
- New Business Models

Deep Understanding of Japan and International Markets

- Regulatory Environment
- UAS and AAM Industry
- New Business Models
Ryoji Koike (小池良次)
Co-founder and C.E.O.

Ryoji Koike is a respected journalist, analyst and thought leader in Japan’s IT, telecommunications and commercial drone sectors.

Based in the U.S. for over 28 years, he has covered Silicon Valley for most of that time, bringing insight and context to the rise of the Internet, cloud computing, new business models, and a host of other pivotal developments. He writes frequently for Japan’s Nikkei Shimbun and other leading business publications and has authored a number of books on key trends. As a consultant, top management at Japan’s industry leaders seek out Ryoji’s advice on what’s next and how it will affect their businesses.

Ryoji holds appointments as part-time lecturer at Waseda University, visiting researcher at Waseda University’s Research Institute of IT & Management, fellow at International University of Japan’s Center for Global Communications (GLOCOM), and senior researcher at InfoCom Research. He is the convener of the Communications and Information Network Association of Japan’s (CIAJ) seminar series on U.S. Information and Communications Technology.

Select Publications (Japanese)
Electronic Retail Management Strategy, Impress
Second Generation B2B, Impress
The Cloud, Impress
Managing Development in the Network Era, Impress
The Future of the Cloud, Kodansha

Fred Borda (フレッド・ボーダ)
Co-founder and C.O.O.

Fred has been working with Japan’s technology sector for over 20 years, advising large telecommunications and IT R&D organizations on technology and strategy. He started the Japan practice for a Silicon Valley technology trend research and consulting firm and led it for over 15 years. He has also led and grown businesses in operating roles. Fred began his career at a prominent Japanese marketing research and strategy consulting firm in Tokyo.

Fred’s work has covered all facets of the IT and telecom ecosystem, from network core to cloud infrastructure, to applications and devices. He co-founded Aerial Innovation to help realize the future where commercial drones and new air mobility will unlock tremendous value for enterprises at the intersection of robotics and automation, aviation, IoT, sensors, and AI.

Fred currently serves on work groups and committees in global standards organizations including the Global UTM Association and ASTM International. He speaks at commercial drone air mobility events in the U.S. and Japan.
Overview

• When will the future get here?

• About the ground infrastructure for electric aircraft

• About the business models electric aircraft enable
## When will the future get here?

<table>
<thead>
<tr>
<th></th>
<th>Single Motor</th>
<th>Total Power</th>
<th>Seating Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UAM/AAM eVTOL</strong></td>
<td>80-100kW</td>
<td>0.5-1.5MW</td>
<td>2-5 seats Battery electric</td>
</tr>
<tr>
<td><strong>Small Prop Aircraft</strong></td>
<td>200-260kW</td>
<td>0.8-1MW</td>
<td>5-19 seats Battery electric (incl. retrofit) 5-19 seats Hybrid electric 40-60 seats Hydrogen fuel cell electric retrofit</td>
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<tr>
<td><strong>Large Turbofan Aircraft</strong></td>
<td>1MW+</td>
<td>10MW+</td>
<td>50-100 seats Hybrid turbo-electric 50-80 seats Battery or hydrogen fuel cell electric</td>
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</table>

**Timeframes:**

- **2020-2025**
- **2025-2030**
- **2030-2035**
- **2035-2040**
- **2040-2045**

*Archer Aviation, magniX, Eviation, Wright Electric, Universal Hydrogen*
UAM/AAM Ground Infrastructure

- Vertiport Design
- Weather Information
- Traffic Management
- Charging

Lilium
UAM/AAM Vertiport Design

- Existing heliports may not be suitable for air taxi eVTOLs
  - Landing/take-off areas
  - Approach/departure paths
  - Charging/fueling
  - Passenger operations
  - Crew operations
  - Maintenance & repair
  - Fire protection

- New transportation models → new types of landing sites
  - Urban
  - Building-tops
  - Integration with parking and ground transit
UAM/AAM Weather Information

- Low altitude (under 1000 ft) weather sensing infrastructure very sparse
- Particularly localized wind conditions and in urban areas
- Smaller aircraft are more susceptible to winds
- Not only safety: operational efficiency and route optimization issues for operators
- New aviation weather paradigm emerging:
  - New class of weather sensors
  - New weather data providers
  - New weather decision support tools
UAM/AAM Traffic Management

- Based on concepts of UAS (drone) Traffic Management (UTM)
  - Uncontrolled airspace: Minimize impact on existing air traffic management
  - Operators exchange data – between each other and with ATC
  - Airspace “corridors” or “operating environment”
Charging

- Electrical grid impact
  - MW-level power demand at each charging site
  - Grid upgrades: New feeders (over 5MW), new substation transformers & capacity upgrades (over 10MW), new substations (over 20MW)
- UAM/AAM eVTOLs will have to fast-charge
  - 3C charging
  - Local power storage at charging sites to smooth demand peaks
- Charging equipment
  - Existing heliports would require upgrades
  - Rooftop vertiports require building upgrades
  - Size and weight a challenge
  - Thermal management a challenge
Hydrogen

- The most weight efficiency of any energy
- Power fuel cells or burn directly
- Storage technologies
- New ground infrastructure
- New aircraft power trains
- Progress from retrofit to new integrated designs
## Business Models: UAM/AAM

- **UAM/AAM Air Metro/Air Taxi**
  - Intra-city
  - 5-15 min. flights
  - New electric aircraft (eVTOL)
    - Joby Aviation
    - Archer Aviation
    - Wisk
    - Beta (& 300 more...)
  - New infrastructure
  - Network model
    - Scheduled service (Air Metro)
    - On demand (Air Taxi)
  - Multimodal coordination
  - Very high throughput increases passenger load, reduces price, induces demand

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<tr>
<th>Mode</th>
<th>Zero Emissions</th>
<th>Passenger Price</th>
<th>Total Time</th>
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<td>Personal Vehicle</td>
<td>No</td>
<td>Operating cost</td>
<td>60 min</td>
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<tr>
<td>Uber X</td>
<td>No</td>
<td>$76</td>
<td>70 min</td>
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<tr>
<td>Uber Pool</td>
<td>No</td>
<td>$59</td>
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<tr>
<td>Helicopter</td>
<td>No</td>
<td>$1,175</td>
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<td>UAM Service</td>
<td>Yes</td>
<td>$50</td>
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*Note: Archer Aviation*
# Business Models: UAM/AAM

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<tr>
<th>Value Chain Functions</th>
<th>OEM</th>
<th>Operator</th>
<th>MRO</th>
<th>Vertiport Operator</th>
<th>MaaS App Provider</th>
<th>Fully Integrated Player</th>
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<tbody>
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</table>
Business Models: Thin Haul

• Short haul/thin haul transport
  • Hub-and-spoke air travel constrained resources: airspace and gates
  • Over 5,000 public-use airports in the U.S.
    • Long tail of sub-200 mi. routes
  • Players like Cape Air, Surf Air, Mokulele Airlines already active
  • Constraints on growth today
    • Dispersed demand
    • High operating costs
  • One solution
    • Demand aggregation networks
      • On demand or scheduled service
      • Multimodal service coordination
    • Dramatically lower costs of eCTOL/eSTOL aircraft (est. 80%+ energy cost reduction, reductions in maintenance, etc.)
  • Lower per-seat prices induce more demand
Thank you
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