Nuts and Bolts of Implementing a UAS Operation

November 2, 2016

Brad Hayden – Robotic Skies (Moderator)
Captain Donald Bernier – FirstEnergy
Kevin Gould – Hawk Aerial
Todd Graetz – BNSF
Rick Marcus – Era Helicopter
Nuts and Bolts of UAS Implementation

Program Development: In-House vs. Out-Sourced UAS Services

November 2, 2016

Captain Donald Bernier
Flight Operations
FirstEnergy
About FirstEnergy

- Headquartered in Akron, Ohio
- 6 million customers served
- More than 15,800 employees
- $15 billion in annual revenues
- 10 electric utility operating companies in 6 states
- 65,000-square-mile service territory
- 24,200 miles of transmission lines and approximately 269,000 miles of distribution lines

All data as of Dec. 31, 2015
Potential Uses of UAS

- Site inspection
- Line inspection
- Storm damage assessment
- Project observation
- Incident response
- Equipment maintenance
UAS In-House vs. Outsourcing

- Director, Flight Operations: Responsible for the operational control and management of all aviation assets owned or operated by FirstEnergy
- Integrated operational management and oversight of UAS
- Immediate business need in developing industry
- Identifying industry best practices
- Flight Operations provides governance over FE Corporate UAS Policy
UAS In-House vs. Outsourcing

- Business Unit contacts FE Supply Chain for UAS needs
- UAS Corporate Policy coordinates Data Network Security Policy, Corporate Security
- Policy and Risk Management (insurance and legal) Requirements
- Approval and Notification Procedures
- Guidelines for UAS Operation
- 14 CFR 107 Impacts
- Future Hybrid Program of In-House and Outsourced UAS Services
Avionics in Commercial UAV’s:
What data is available to drone pilots?

Wednesday, November 2, 2016 | 3:00 p.m. – 4:30 p.m.

PRESENTED BY:
Kevin Gould, CEO of Hawk Aerial, LLC
Manual Flight

*Inspection, Documentation; individual stills & video*

E.g., DJI Matrice 100 + Controller + iPad with DJI GO app

Sources: author
DJI GO app

Preflight scan:

SYSTEMS CHECK
DJIGO app

Preflight scan:

SYSTEMS CHECK

- Flight Mode
- # of Satellites
- GPS signal
- Internal systems
- Controller signal
- Video downlink signal
- Battery level

Sources: author
DJI GO app

Inflight scan 1:

FLIGHT DATA

Sources: author
DJI GO app

Inflight scan 1:

**FLIGHT DATA**

- Heading NE
- Height ~50 m
- Horiz. dist. 64.2m
- Horiz. to pilot 68m
- Horiz. speed 11.3 m/s ~22 kts
- Vertical speed 0.0 (level flight)

Sources: author
DJI GO app

Inflight scan 2:

ENDURANCE

Sources: author
DJI GO app

Inflight scan 2:

**ENDURANCE**

- 8:21 Flight time remaining
- 69% Battery capacity

Sources: author
Inflight scan 3:

NAVIGATION
DJI GO app

Inflight scan 3:

NAVIGATION

- Path flown (white)
- Relative location (138 m ENE)
- Heading (SE)
- Return vector (green line)

Sources: author
Camera Control

RGB Optical

Infrared

Sources: author
DJI GO app

Camera Controls:

- Pitch up ~30° to see underside
- Pitch down 90° (nadir) for top view, landing spot
DJI GO app

Camera Controls:

• Focus: Auto or Manual
• Zoom
• Still or Video
• Shutter trigger

Sources: author
DJI GO app

Camera Controls:

Advanced camera settings:

- Auto
- Shutter priority
- Aperture priority
- Manual

Sources: author
DJI GO app

Auto Assist:

• Auto Takeoff & Land
• (Gimbal control)
• Return to Home
• Reset Home Point

Sources: author
Flight Stabilization

Hands off = stationary hover:

• 3 gyroscopes
• 3 accelerometers
• Barometer
• Magnetic compass
• GPS
• New: ultrasonic and monocular sensors for lateral stabilization w/o GPS

Sources: author, DJI Phantom 4 User Guide
Autonomous Flight

Agriculture, Mapping; precise overlapping images

E.g., SkySquirrel Technologies Aqweo/Quanta + Mission Planner PC App

Sources: author
Auto Flight

Step 1:

Draw border around area

Sources: author
Auto Flight

Step 2:

Autofill Grid & Waypoints

- Automatically calculates overlap, photo frequency & ground speed

Sources: author
Auto Flight

Step 3:

• Upload flight plan to drone
• Flip 3 switches
  – Arm: On
  – Auto: Takeoff
  – Mission: On
• Available: Auto Land

Sources: author
Info during autonomous flight:

- Artificial Horizon
- Heading
- Vertical Speed
- Altitude
- Ground Speed
- GPS status
- Flight tracker traces progress
- Selectable fields

Sources: author
Technologies under development

- Dynamic Collision avoidance/ADS-B (drones, manned aircraft)
- Precision AGL & Terrain avoidance (ground)
- Object avoidance/3D corridors (vertical structures)
- Live datalink:
  - Very remote piloting
  - Real time data upload

Sources: author
NBAA BACE

BUSINESS AVIATION CONVENTION & EXHIBITION

NOVEMBER 1–3, 2016
ORLANDO, FL
UAS Operations at BNSF

PRESENTED BY:
Todd Graetz, Director, Technology Services/Infrastructure
The BNSF / FAA Partnership

• A focus on community and employee safety
  • Supplemental safety inspections of track and structures
  • Reduced track occupancy
  • Opportunity to diminish derailment risk
  • Foundational for multi-modal transportation inspections

• Safe integration of UAS into The NAS
  • Full BNSF and FAA executive commitment
  • BNSF and The FAA are focused on risk elimination
  • BNSF flights utilize known, well-managed flight corridors
  • Existing infrastructure supports ‘C2’, ATC communications, SUA de-confliction and sense/avoid capabilities

The BNSF / FAA Partnership
Safe integration of aircraft..

• The FAA and BNSF’s risk reduction approach to enable flight and flight area safety
BNSF’s Airworthiness Certifications
**FAA/BNSF Proof of Performance Tests**

- Pilots and electronic systems equivalence tests
  - 100+ flights
    - Double blind testing, unpredictable timing
    - Aircraft of all sizes and speeds
    - Video, time and location based monitoring
Flight Patterns
Expirimental Radar
Experimental ADSB
900 MHz “C2” (Command/Control)
Clovis Subdivision (New Mexico)
BNSF’s Clovis Subdivision Cockpit
BNSF’s Clovis Subdivision Cockpit (2)
Flight 09 Encounter 99:

Range when PIC ‘detected’ the Intruder Range at CPA

RTCA: 4k ft and 35 sec

Minimum Range
@ 19:30:34
Range: 3386 ft

Intruder Spotted by PIC
@ 19:30:24
Range: 4200 ft
Track Integrity Sensor Image
UAS Integration for Aviation Operators

Wednesday, November 2\textsuperscript{nd}, 2016| 3:00pm – 4:30pm

PRESENTED BY:
Richard Marcus, Director of Business Development – Era Helicopters, LLC
Era Helicopters, LLC

- Founded in 1948 in Alaska by aviation pioneer Carl Brady
- NYSE: (ERA) – 2015 Revenues of $281mm
- Era operates 140+ Leonardo, Airbus, Sikorsky and Bell Helicopters in the United States, Brazil, Colombia and Suriname
- Co-founders of JV in Dart Aerospace with 700+ rotorcraft STCs for all OEMs

Five Year Totals
- 1.4 million passengers served
- 558,000 flights
- Equal to 1,309 trips around the world
Era’s Service Offerings

- Oil and Gas
- Search and Rescue
- Air Medical
- Leasing
- Utility / Firefighting
- Humanitarian
- Flight Seeing
- UAS
Why UAS?

• Our customers are asking for it – UAS can be safer and more cost effective
• Cross selling opportunities for core offerings into new geographies and clients
• Rapid technology transfer to rotorcraft: sensors, OPVs, safety enhancements
• Mission profiles can enhance our core product line…SAR, linear infrastructure
• Our complimentary partnership with Total Safety U.S. adds global reach

“Every success story is a tale of constant adaption, revision and change.” – Sir Richard Branson
UAS Integration: Flying is just the beginning

- A data collection business which happens to incorporate aviation
  - Sensors, software, data security, and UAS platforms are moving forward at light speed
  - Customer expectations change just as rapidly – think flip phone to IPhone
- Your Op-Specs, SMS, and auditing processes are an integral part of your value proposition- it’s no different that adding any other fleet variant to your portfolio
- Your company understands FAA, you have a robust safety culture, many won’t
- As Military hardware migrates to the commercial side it will displace certain FW and RW missions- aviation operators already understand how to introduce technologies safely and effectively to the marketplace in concert with FAA
Other Operational Considerations

- There is a deep pool of talent rotating out of the military and subcontractor deployments, but you will be surprised by the market rate compensation packages being offered to these coveted people.
- ERAU, UND and other programs are offering robust training programs.
- Lots of capital has poured in, there will be consolidation, and many will lose.
- Substantial regulatory and technological hurdles exist domestically due to the complexity of the National Airspace System (i.e., home package delivery).
- The low end of the spectrum has almost no barrier to entry - what differentiates your offering? Aviation Pedigree.
- Staying on top of the software and sensory advancements is a full time job.
# Last Thoughts - Where are we headed?

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<thead>
<tr>
<th>Existing False Perceptions</th>
<th>Current Market Migration</th>
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<tbody>
<tr>
<td>The perception amongst many aviation professionals: “These things are toys.”</td>
<td>Representatives of the electronic news gathering and aerial cinematography businesses would say otherwise as UAS take share rapidly in those segments</td>
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<th>On the Horizon</th>
<th>The Mid-Term and Beyond</th>
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<td>Many fixed wing and rotor wing OEMs are now fully engaged in the race to develop both optionally piloted and autonomous aircraft</td>
<td>The cultural acceptance progression from UAS carrying sensors, to freight, to people is less of a hurdle the younger you go on the curve</td>
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Audience Q & A