



## Generation Drone – Utility T&D Innovations

SEAoT 10.20.16 Annual Conference Austin, TX  
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## Agenda

- Commercial UAV market overview
- Regulatory environment
- Drone technology (current and future states)
- Drone applications
- Final thoughts
- Q/A





## A Rapidly Growing Market


### DRONE INDUSTRY




Commercial drone industry will hit **\$82 billion** by 2025



**80%** public support for domestic use




**80%** of the commercial market for drones will eventually be for farming purposes



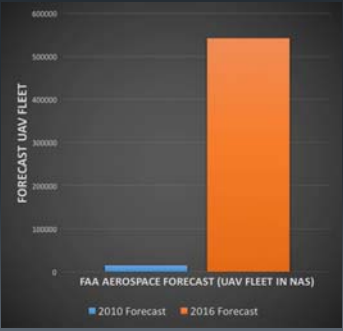
Venture Financing for drones doubled in 2014 to **\$108 million**

Sources: Association for unmanned vehicle systems International, AUVSI, CHBC, Aerospace Industries Association




## A Rapidly Growing Market

- 2010 Forecast – 15,000 civilian drones
- 2016 Forecast – 540,000 civilian drones



FAA AEROSPACE FORECAST (UAV FLEET IN NAS)

Legend: 2010 Forecast (blue), 2016 Forecast (orange)



## Regulatory Environment

- 2007 FAA bans ALL commercial UAV operations
- 2014
- 2016



## Regulatory Environment

- 2007 FAA introduces Section 333 exemption
  - Pathway for legal commercial flight under 55 lbs
  - Very strict operational restrictions
    - Under 200ft AGL
    - Pilot's License
    - Visual Line of Site (VLOS)
    - Daytime Operations
    - Visual Observer
    - NOTAMS
- 2014
- 2016



## Regulatory Environment

- 2007 FAA releases Part 107 rules for small UAS
  - Relaxed operational restrictions
  - STILL NO BEYOND VISUAL LINE OF SITE (BVLOS) operations (WHY???)
- 2014
- 2016



IT'S a START.....



## Drone Technology - Origins

MQ9 Reaper Hunter/Killer UAV

- Original application - MILITARY
- Responsible for today's innovation
- Not indicative of mainstream commercial equipment



## Drone Technology – Current State

- SMALL – Under 55lbs
- GPS assisted flight
- Autonomous capability
- Emergency procedures
- Real time video feed
- 3-5 km range
- 10-60 minute flight times
- Versatile payload options
- Robust weather conditions

Small Unmanned Aerial Systems (sUAS)



## Drone Technology – Coming Soon

### FAA Requirement for BVLOS

- Full Autonomy
- Sense and Avoid
- Collision Avoidance



### Technology Solutions

- Computer Vision
- Lidar
- Flight path algorithms

Sense and avoid for BVLOS operations  
 Feature recognition for automatic damage detection  
 Real time data processing



## Drone Technology – Collision Avoidance



## Applications in Industry

- What is the commercial value in using drones?
  - Safer
  - Less expensive
  - Acquire Better Data



## Applications in Industry

- What industries are using drones? *Parcel Delivery*



## Applications in Industry

- What industries are using drones? *Film Industry*



## Applications in Industry

- What industries are using drones? *Search and Rescue*



## Applications in Industry

- What industries are using drones? *Beer Delivery!!!!*



## Applications in Industry

- What industries are using drones? Infrastructure Inspection



## Drones in the Utility O&M Space

- Routine inspection
- Storm damage assessment
- Line patrol – Security
- Line Patrol – Vegetation management
- Survey and mapping
- Forensic failure analysis



## Routine Inspection

- Regular preventative inspections
- Missing/damaged hardware
- Conductor/insulator damage
- Structural Connections
- Foundations
- Right of Way



## Routine Inspection

- Drones push probability of detection up close to 90%

### EPRI Line Patrol Research

Steel Tower Line-% Of Defects Reported	
Aerial Patrol	0.4%
Ground Patrol	17.1%
Climbing Patrol	29.3%
Detailed Aerial	47.6%

Wood Pole H-Frame-% Of Defects Reported	
Aerial Patrol	1.7%
Ground Patrol	12.8%
Climbing Patrol	15.6%
Detailed Aerial	36.3%

Project included 100 lattice towers and 100 wood pole h frames



## Storm Damage Assessment

- Winter storm Goliath
- Major ice and wind event
- Laminated wood poles
- 40 downed structures
- Assessed damage and ROW access
- Responded on Jan 1 holiday



## Common Defects

- Insulator Damage



## Common Defects

- Grounding Connections



## Common Defects

- Cracked Weld – Fatigue due to Wind Induced Vibration



## Common Defects

- Cracked Weld – Fatigue due to Wind Induced Vibration



## Common Defects

- Corrosion



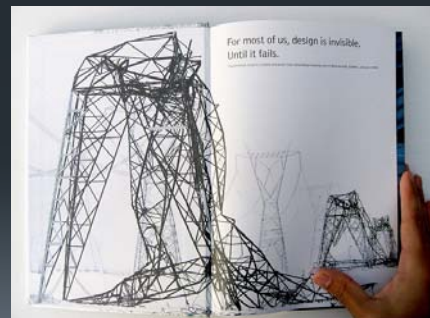
## Common Defects

- Missing Hardware



## Why Details Matter

- Failures happen when details are ignored
- US Infrastructure is aging and in need of repair
- Reliability of public infrastructure is paramount





## Why Details Matter



- Failed dead end structure
- Cracked seam weld caused failure



## Why Details Matter

- Pulled down 3 adjacent structures
- Tripped out crossing 138kv line



## Why Details Matter

- Punctured underground gas line



## Why Details Matter

- Base plate failure





## Why Details Matter

- Base plate failure



## Why Details Matter

- Base plate failure
- Fell in 6mph winds
- Girls soccer team was in stadium at time of failure



## Why Details Matter

- Cracked arm vang
- Poor welding
- Fatigue from wind induced vibration



## Final Thoughts



## Final Thoughts

- Regulations and drone innovation are converging rapidly
- UAS capabilities are perfect for infrastructure inspection
- Aging US infrastructure needs more thorough inspection
- The technology is becoming easier and easier to use
- It's a no brainer!!!



## Questions?

