Drones In Logistics

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Outline

• Introduction – The Nature of Drones
• Drone Characteristics and Challenges
  – Technical
  – Regulatory
  – Operational
• Drone Applications in Logistics
• Case Study: Aircraft Assembly
• Conclusions
INTRODUCTION
The Nature of Drones

• Unmanned Aerial Vehicles/System (UAVs/UAS), Remotely Piloted Aircraft (RPAs)
• Range of sizes and configurations
  – Fixed wing, rotocraft (inc. multirotor), Tilt wing/rotor
Drone Enabling Technologies

- Improved microprocessors
- Advances in flight control software and autonomy
- Improved materials and manufacturing
  - Rapid prototyping, composites
- Developments in sense-and-avoid technology
  - Sensors, artificial intelligence
- Networking and communication protocols
Current Drone Landscape

- As of the end of 2016, 40,000+ FAA registrations for commercial drone use
  - BNSF
  - Sempra Energy
  - Amazon.com
  - Disney
  - Intel
- Current global market of commercial applications: >$2B
- 2020 Projection: $127B
DRONE CHARACTERISTICS AND CHALLENGES
General Objective: Move payload from place to place
Technical Capabilities For Logistics

• Movement Strategies (point to point or follow trajectory)
  – Remote control
  – Autonomous flight

• Variety of payloads
  – Cameras (EO/IR)
  – Other sensing equipment (LIDAR, RFID, etc)
  – Network nodes
  – Objects (depending on platform and weight)
Payload Capacity

• Related to design factors
  – Engine/Motor selection
  – Flight mode (e.g. VTOL less efficient than winged flight)

• Payload inextricably related to flight time/duration
Other Technical Factors

- Communications and flight sensors
  - Dropout
- Sense and Avoid
- Battery Technology
- Cybersecurity
Regulatory Considerations

- Outdoor flight regulated by Federal Aviation Administration (FAA)
- Part 107 regulations (June 2016)
  - Line of Sight (LoS) operations
  - Single vehicle per operator
  - Daylight operations only
  - Cannot fly over persons not participating
  - Max 400ft
  - Max 100mph
  - Class G airspace without approval (B,C,D,E need ATC approval)
  - Less than 55lbs, including payload
  - Remote pilot airman certification
  - Drone must be registered
- Most of these are possible to modify with a waiver
- Section 333 exemption
Drone Operations

• Drone-Operator ratio
• Central vs Distributed control
• Personnel and Training
  – Pilots/Operators
  – Maintenance team
  – Other personnel that will interact with UAS
• Safety and emergency operations
DRONE APPLICATIONS IN LOGISTICS
Point To Point Delivery

- External – customer is end point
- Internal – inter/intra facility
- Payload capacity key factor
- Regulatory approval is a challenge (BLOS, populous areas, interaction with manned aircraft)
Asset/Inventory Tracking

• Utilize high mobility of drones to track assets or resources
  • Example: Mining
  • Use drone to obtain birds-eye view of mine equipment and layout
  • Scan and monitor stockpiles
• Scan and track inventory in vertical warehouses ( Eyesee, Dronescan )
• Typically operates in or over company property, which reduces regulatory burdens
Inspection

• Drones can allow for faster, less expensive inspections of infrastructure or large equipment
  – Example: Railway inspection (BNSF)
  – Aerial imagery of wide ranges of rail lines can be captured in a single UAS mission
• Requires inspection team with both drone and subject matter expertise to design flight paths and interpret results
• Drone range/flight time can be an important limitation
CASE STUDY: AIRCRAFT ASSEMBLY
Scenario

- Commercial aircraft assembly line
- Static and dynamic elements to environment
- Current movement of parts/tools via motorized carts along designated paths
Problem

• Size of facility, path restrictions, and height of assembly work reduces efficiency of ground delivery
• Can drones be used as a warehouse delivery option?
• What are the major constraints or concerns in the implementation of such a system?
• Key Requirements: productivity, reliability, safety
Vehicle Selection

- VTOL multi-rotor
  - Advantages
    - Low speed, higher maneuverability, hover capability
    - Low requirement for takeoff/landing area
    - Multi-rotor relatively robust to failures
  - Disadvantages
    - Small payload capacity (<5-10kg)
    - Frequent recharging needed (10-20 min flight time)
Operations

• Delivery directly to personnel difficult to implement and dangerous
• Autonomous flight between stations, based upon mobile device request
• Onboard camera allows for basic obstacle detection
• Single command desk to monitor system (minimal personnel requirement)
Challenges

• Safety to personnel and equipment a major concern
  – Possible to isolate “highways” along the ceiling, but this requires significant infrastructure expense
• Personnel to insert/remove items at drone stations
• Limited payload reduces the usefulness of such a system across all delivery needs
Resolution

• Ultimately, drones represent a tool in the logistics toolbox that has important capabilities and weaknesses
• In this case, there is insufficient justification for the investment in drone tech
• Each situation must be carefully evaluated and planned to ensure appropriate strategic decisions
CONCLUSION
Summary

• Drones are a rapidly growing market that provide multiple opportunities in logistics, manufacturing and supply chain settings

• Drone systems vary considerably in capabilities, requirements, and operational and regulatory considerations

• An appropriate systems engineering plan including CONOPS should be developed as part of the acquisition of drone technology
SOLVE FOR X.

Data Science

- Concept of Operations
- Deploy
- Design
- Test and Evaluate
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