A Proof-Of-Concept For Drone Inspections

KLM's Journey

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Royal Dutch Airlines

AIRFRANCE KLM

Our Dream / Our Ambition

The MRO Lab
Adaptive Innovations

- Use drones for the inspection of aircraft:
  - Hail damage
  - Lightning strikes
  - Exterior conditions (e.g. paint / stickers)

- Quicker result (time) – More efficient (money) – More details (quality)
- Quicker response
- Less downtime (MONEY)

- Standard service – Ready-to-use

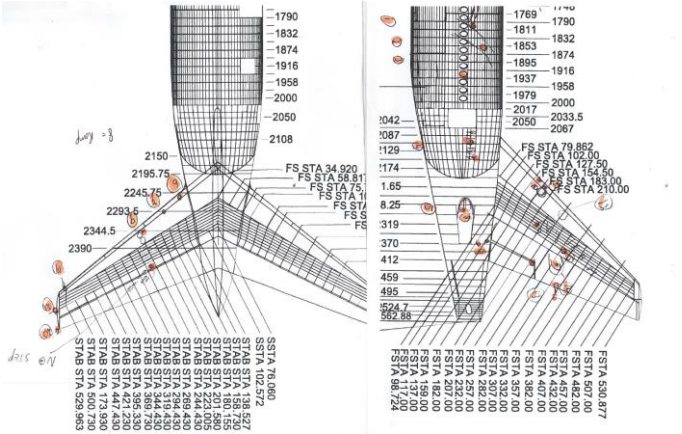
Our Journey

1. Get the **basics** right
   - Risk assessment
   - Contractual conditions
   - Insurance issues
   - Procedures / Manuals
2. We have **lift-off**
   - Controlled indoor conditions
   - Lessons learned
   - Adjusted procedures / manuals
3. What's my **position**?
   - Actual position
   - Position relative to aircraft, SLAM technology
   - Automatic patterns
4. Proof of the **pudding**
   - Aircraft preparation
   - Drone inspection
   - Manual inspection
   - Compare the results
5. Share the **results**
   - Drone operator
   - Aircraft manufacturer
   - Authorities
   - Accepted method
6. Drone inspection as **service**
   - Commercially available solution

Travelling Time: appr. 1,5 year

First POC – Hangar 14 – 4 November 2016

- Aircraft type: 777-300
  Aircraft registration: PH-BVD
  SkyTeam Livery
- Aircraft preparation: 21 markers
  6 mm diameter
  Creaform
  45 minutes
- Inspection by drone: MainBlades
  Inspect & Detect
- Manual inspection: KLM Constr. Specialist
  Inspect & Detect
  Remove markers



-MainBlades-

Aerial filming, photography & inspections

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Comparison Drone vs. Manual

Parameter	Drone	Manual	Remarks
# Of Detected Markers	21	21	All markers detected; additional paint damage observed
# Of Detected Locations	21	21	All locations detected; drone location automatically recorded
# Of Operators / Inspectors	4	2	Drone ambition = 2 + 1 Manual minimum is 1
Equipment	Various	* Cherry picker * Flashlight	Drone: specialized equipment Manual: standard equipment
Elapsed Time [mn] a. Set Up b. Preparation c. Inspection d. Reporting	 a. 25 b. 15 c. 95 d. 15	 a. 30 b. 5 c. 45 d. 15	 Set Up: "setting the stage" Preparation: instructions Inspection: looking ("visual") Reporting: administer results
Elapsed Time TOTAL	**150**	**95**	

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Video Impression of H14 POC

Qualitative Observations / Lessons Learned

- Drone set up must be quick and easy
- Light is crucial for quick detection
- Expect the unexpected; surprises happen
- Fixed flying pattern will save time; autonomous
- Snap shots and immediate assessment
- Quality of camera images must improve

Future Considerations

- Remember: the drone is just the platform!
  It must carry high quality camera, pattern recognition, localisers, …

- This POC will not convince the Manufacturers and Authorities (precision, open-air application)
  Further analysis must done

- Eventually, it will be a standard service. Quick set-up is essential

- If can save aircraft downtime ("airlines gold")

Thank You