Selection & Training of Test Event Directors for Advanced Unmanned Aircraft

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Definitions - What’s a TED?

- Test Event Director (TED)
- Engineer responsible for overall execution of test event
  - “Test mission commander”
  - Safety of test
  - Productivity of test
- May be known as “flight director”, “test director”, or “test conductor”
  - Not much standardization at present
  - Terms may also denote levels of responsibility
Why Have a TED?

• Historic trend
  – Started at NASA in 1960s for manned spaceflight
  – Expanded to air vehicle testing
  – Spreading to mission systems testing
• Increasing complexity of tests and test teams
  – 5-15 engineers instead of 1-3
  – Networked assets and TM rooms
  – Provides single focal point for test planning & execution
  – Makes best use of experience spread
• Increased safety and productivity of test events
• Becoming the new standard
  – Significant drive from flight test professional groups
TED Responsibilities

• Make test policy inputs to management
• Plans test mission
  – Inputs from aircrew, technical discipline engineers
• Prepares briefing materials & card deck
  – Inputs from aircrew, mission planners, engineers
• Briefs mission
  – Including ejecting non-participants
• Runs test mission
  – Safety
  – Test execution
  – Assists in emergencies
  – Bouncer
• Reporting
  – Immediate post-event report
Large UAV TED Challenges

- MQ-4C posed daunting TED challenges
- Extremely complex system

- Air vehicle
- Sensors
- Ground stations
  - 2 or more
- Telemetry monitoring stations
  - 1-3, often in different time zones
- Networks
- Satellites
- Targets
- Range
- Ground chase
- Flight chase

- Multi-shift operations
  - Very long work day for TEDs
- Multiple tests on single sortie
  - Transfers of test control

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Triton TED Solution

- Defined qualifications
- Extensive training
- Practical experience
- Formal approval process

- 4-8 months to fully qualify a TED for high-risk flights
Triton TED Structure

• 3 levels of TED
  – Test Director (CAT C/D)
    • High risk tests such as envelope expansion
    • Primary control of all flights for first ~2 years
  – Test Director (CAT A/B)
    • Low-risk flights
    • Secondary TM rooms for high-risk events
  – Test Conductor
    • Ground tests
    • Specific disciplines in flight

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Triton TED Training

• Aircraft familiarization
  – Full pilot or TACCO ground school
    • NATOPS open-book exam

• Policy review
  – Program Test & Evaluation Master Plan
  – Navy test planning & execution policies
  – Squadron, test team, and contractor operating procedures
  – Airspace
  – Control room ICS and displays

• About 80 hours to complete everything
Triton TED Experience

• Students operate under the instruction of an experienced TED
• Buildup of assignments
  – Ground tests
  – Secondary TM room in flight
  – Primary TM room in flight
• Student responsible for
  – Brief preparation
  – Briefing
  – Test conduct
  – Debrief
  – Reporting
• Student debriefed on performance

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Triton TED Experience

• 2-4 ground events under instruction
  – Test conductors can be sent to Board if successful
• 2-4 flight events under instruction
  – 2-4 flights/10-20 hours
  – Minimum 1 takeoff and 1 landing from primary SOF monitoring station
  – Can be sent to Board for CAT A/B Test Director
• CAT C/D Test Directors double the flight events
  – 4-8 flights/20-40 flight hours
  – 2 takeoffs, 2 landings from primary SOF station

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Triton TED Approval

• Test Director Board approves
  – Government & Contractor test team leadership
  – Technical area test leads
  – Pilot or TACCO
  – Senior Test Directors
  – Chief Test Engineer of VX-20 has final say

• ~50% of early applicants rejected on first attempt
  – Sent back for additional experience
  – Requirements adjusted as a result
Triton TED Results

• Very complex test missions flown
  – 2 ground stations
  – 3 control rooms
  – Flights of 12+ hours
  – Multi-disciplinary sorties
  – Multiple transfers of control
    • Of aircraft
    • Of primary SOT monitoring

• High productivity
  – ~40% concurrency of test points
  – <20% refly rate

• No mishaps
Lessons Learned

General

• Big investment = Big payoffs
  – Quality TEDs greatly enhance test efficiency
  – Quality TEDs require a lot of training

• Multiple locations requires a hierarchy of TEDs
  – Mission lead TED
  – TED with test conn at the moment
  – Positive transfer of test conn
  – Essential if controlling test from multiple sites
    • Expect more of this in the future

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Lessons Learned
TED Recruiting

- Personality
  - Calm in crisis
  - Tenacious in mission execution
  - Pressure-proof

- Experience
  - TED experience on other programs best
  - Flight test experience excellent
  - Military aviation OK
  - Quality more than quantity

- Quality candidates are scarce
  - Triton program has had to train our own

- Recommendations:
  - Recruit early
  - Recruit carefully
  - Expect to train some in house
Lessons Learned
TED Demand

- Easy to underestimate number of TEDs needed
- One shift of TEDs can
  - Plan/brief/fly ~2 x 6-8 hour missions/month
  - Support ~2 other events if someone else plans/briefs
- Shortages snowball
  - Overworked TEDs leave
  - TEDs not easily or quickly produced
  - TEDs highly qualified for other jobs
- Recommendations:
  - (Number of control rooms) x (Number of shifts) x (Flights per month/2) = **MINIMUM** # of TEDs required
    - More required for sustained test operations
  - Keep TED training pipeline full
  - Stay ahead of demand

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Lessons Learned
TED Retention

• Retaining TEDs can be a challenge
  – After 2 years of testing, 8 of 13 Triton Test Directors have left

• Causes
  – Other opportunities
    • In demand for other programs as TEDs
    • Highly qualified for other jobs
  – Quality of life
    • Extremely unpredictable schedule
    • 100+ days/year travel
    • 12-14 hour days when flying
  – Permanent movement of aircraft between test sites
Lessons Learned
TED Retention

• Recommendations:
  – Start with enough TEDs for the workload
    • Exhausted TEDs = Exodus of TEDs
    • Retention problems snowball
  – If using Contractor TEDs, number & qualifications must be specified in contract
    • TEDs in training can’t count
  – TEDs need to have bright future
    • “Scars earn stars”
    • Specific term of duty to earn benefits
Lessons Learned
TED Training

• Leverage existing training where possible
  – Aircrew ground school courses
    • Have a senior TED qualified to teach ground school courses for backfill
  – Range safety
  – Test planning

• Administrative courses must be completed prior to TED training
  – Conflicts with flight events

• Flight schedule will drive timeline
  – Can’t get experience without flying

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Lessons Learned
Mission Systems TEDs

• Air vehicle community has accepted TED concept
• Mission systems community is resisting
  – Attitude like air vehicle around 1960
  – Smaller test teams
  – Consider aircrew responsible for safety of flight
• Recommendations:
  – For large UAV testing, TEDs are a must
    • Complexity of systems
    • Complexity of test environment
    • Volume of work involved in TED duties
    • Concurrent testing
Unsolved Issues
TED Standardization

• Few standards for TEDs
  – Requirements
  – Terminology

• Little transferability
  – Increases requalification time/resources when TEDs transfer between programs

• Recommendations:
  – Set standards within test organizations
  – Harmonize standards between test organizations
    • Will be a long-term effort
  – Establish transferability of qualifications
    • Won’t be 100%, but should be > 0%

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Conclusion

• Quality TEDs are worth the investment
  – Safety
  – Productivity

• TEDs for large UAV programs require careful selection, thorough training
  – Large UAVs are extremely complex systems
  – Test missions are very challenging

• Take good care of your TEDs
  – TEDs are long-lead-time personnel
    • You can’t afford to lose them
  – Recruit early
  – Have enough for the job
  – Work to keep
Questions?