

# 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

# 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

# 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



# 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

# 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

# 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:
  - (# of control rooms) x (# 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

# 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

# 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%





# 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?

