

Selection & Training of Test Event Directors for Advanced Unmanned Aircraft



Michael L. McDaniel
NAVAIR Associate Fellow
Lead Test Director, MQ-4C Triton Integrated Test Team

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?

