Future of VTOL Aviation

DARPA

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Standard Form 298 (Rev. 8-98)  
Prepared by ANSI Std Z39-18
Outline of presentation

- 2025 & 2035 scenarios / needs
- Mono Tiltrotor (MTR) features
  - Cargo/Utility
  - Attack
- Mono Tiltrotor advantages & benefits
- BTC business model
- Timeline
- Next steps
- References
Future VTOL Scenarios

- 2025: Fielded and battle tested capability
  - Precise discrete autonomous cargo moves
    - 4x400lbs/200kts/750nm/20k ft
    - 4x1000lbs/220kts/850nm/20k ft
  - Deliver and retrograde w/o MHE
  - From land or seabased distribution node

- 2035: Fielded capability
  - Capacity-based cargo moves
    - 1x20tn/260kts/1000nm/20k ft
    - ...or larger w/new engine program
Joint Multi-Role (JMR) Needs

- Increased capabilities across the board
  - Expand all VTOL missions
- Lower costs
  - Robust, common air machine
  - Modular interface to mission packages
- Maintain/enhance industrial base
  - Advance subsystem technologies (off-ramp)
  - Vendor competition over full JMR life-cycle
MTR Cargo/Utility Features

- Common drive system and tail assembly built from mature components & technologies
- Modular cargo pod
  - Joint Modular Intermodal Container
  - Pallet, cargo net, other...
- Modular, hinged, dry (no fuel) wing panels
  - Droop for maximum performance takeoff
  - Lock for cruise, for landing (, & for takeoff)

See videos and illustrations
MTR Common Features
MTR Unique Features

- Hardpoints for wing panels
- Actuator
- Bearings
MTR Cargo Features

- Wing Panel
- Struts
- Cargo Pod
MTR Attack Features

- Common drive system and tail assembly built from mature components & technologies
- Fixed, wet (fuel) wing with tip mounted AAM
- Eliminate cargo pod assembly
- Armaments supported by strut hardpoints
  - AGM
  - Cannons
  - Rockets

See videos and illustrations
MTR Attack Features
MTR Advantages

- In comparison to legacy helicopters for long range (750nm to 1000nm) cargo missions:
  - $\frac{1}{3}$rd of the baseline structural weight
  - $\frac{1}{3}$rd of the fuel burn
  - $\frac{1}{2}$ of the size (i.e. rotor diameter)
  - Nearly twice the speed

- Performance advantage due to system level architecture [not due to subsystem advances]
  - Large disk with minimal download in hover
  - Optimal wing and small frontal area in cruise
MTR Advantages (cont.)

- Common drive system and common hinged tail assembly for all missions and configurations...
  - Engines and gearbox
  - Hubs, blades, and controls
  - Tailboom, stabilizers, and control surfaces
  - Conversion actuator
- No reconfiguration of drive/tail assembly to re-missionize between cargo and attack roles
MTR Advantages (cont. 2)

- Mission packages are external to airframe
  - Relaxed cube constraints
  - Simple mechanical interface
  - Decouple from airframe program

- Modular airframe architecture
  - Disassembles for stowage and transport
  - Highly accessible components and sub-assemblies for maintenance actions
MTR Disassembly
MTR Benefits

- Breakthrough range/speed/payload using COTS components and technologies
- Reduced acquisition costs (weight of airframe)
- Reduced O&S costs (weight of fuel; modular)
- Reduced component S&T costs (COTS)
- Rapid reconfiguration between roles
  - Connect cables for cargo
  - Mount armaments for attack
BTC Business Model

- Licensee of MTR patents for MTR research
- Funded by US Government R&D contracts
  - All deliverable data licensed to US Gov't
  - Preference to publish all reports
- Ad hoc, world-class R&D teams for each SOW
- Primary focus is on MTR technical bona fides
- Responsive to Government needs while advancing the understanding of the MTR
- Positioned for future teaming arrangement(s)

Extreme Development speeds time to market.
MTR R&D Timeline

- 2004: MTR Concept Study (ONR)
  ➔ Breakthrough performance possible
- '05/06: 3000lbs payload design (AATD)
  ➔ Point design created
- '07/08: Demonstration and Validation (AATD)
  ➔ Function demonstrated on RC flight models
  ➔ Point design independently validated
- '09/10: Cargo UAS Operations Study (ONR)
  - Contract awards to Bell Helicopter & to BTC
Mono Tiltrotor (MTR)

Participants
➢ Army AATD – Ft Eustis; ONR
➢ Baldwin Technology Company (BTC) w/ Bell, GT, UMd, ARL, Eagle Aviation

Status and Plans
➢ ONR Conceptual Design Study – FY04
➢ AATD Concept/Prelim Design – FY05-06
➢ AATD Validation Activities – FY07-08
➢ ONR Operations Study - FY09-10

Technology [TRL 4]
➢ Pitch axis suspended load air vehicle
➢ Efficient hover and cruise connector
➢ Sustain battlefield from sea or ashore

Design
➢ 3000lbs load, 750nm, 200kts, UAS
➢ 2xT800, 52% struct. eff., Cruise L/D=10
➢ 25ft rotor, 30ft span
➢ Sized for MILVAN transportability
➢ Sized to transport JMIC
➢ Reconfigures into an attack aircraft

Research Contracts

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Benefits
➢ Breakthrough in vertical sustainment speed, range, and payload using COTS components and technologies
➢ 1/3 of structural weight & fuel compared to conventional helicopter at same range
MTR Next Steps

• For the first time in its development lifecycle, the MTR is becoming resource constrained
  – Very little funding was needed to answer basic questions regarding merit and value
  – MTR fundamentals are now understood, and commitment is needed to show operational potential to user community

• Will need Government support for TRL-5 demonstrations of suspended cargo pod and aerodynamic wing deployment using a medium lift UAS helicopter as a flying testbed
Selected References


- Mavriplis, D. J., Computational Drag Study for the Mono Tiltrotor Scaled Demonstrator (MTR-SD), March 2008.


Selected References(2)


Selected References (3)


