



Future of VTOL Aviation

DARPA

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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

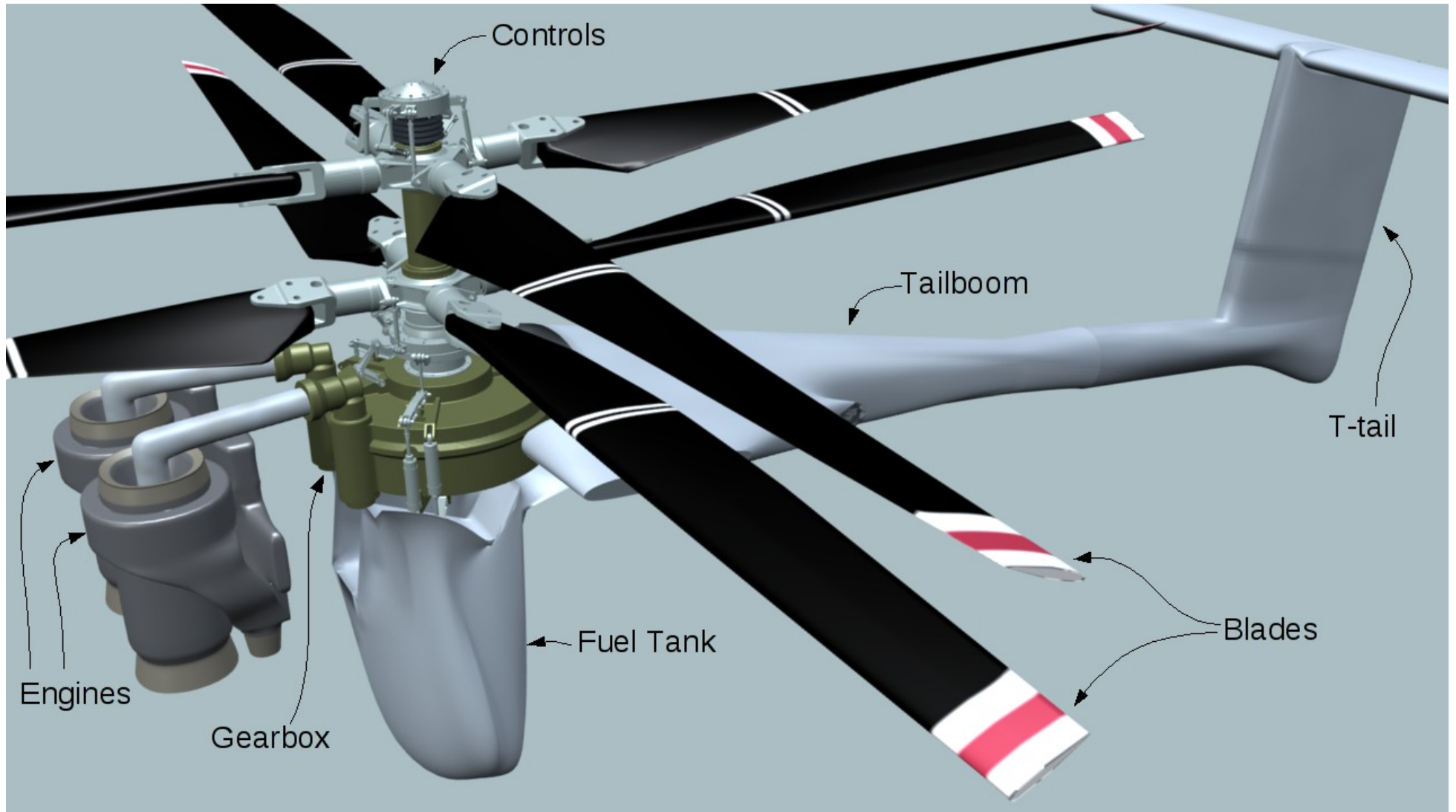


- Common drive system and tail assembly built from mature components & technologies
- Modular cargo pod
 - Joint Modular Intermodal Container
 - Pallet, cargo net, other...
- Modular, hinged, dry (no fuel) wing panels
 - Droop for maximum performance takeoff
 - Lock for cruise, for landing (, & for takeoff)

See videos and illustrations

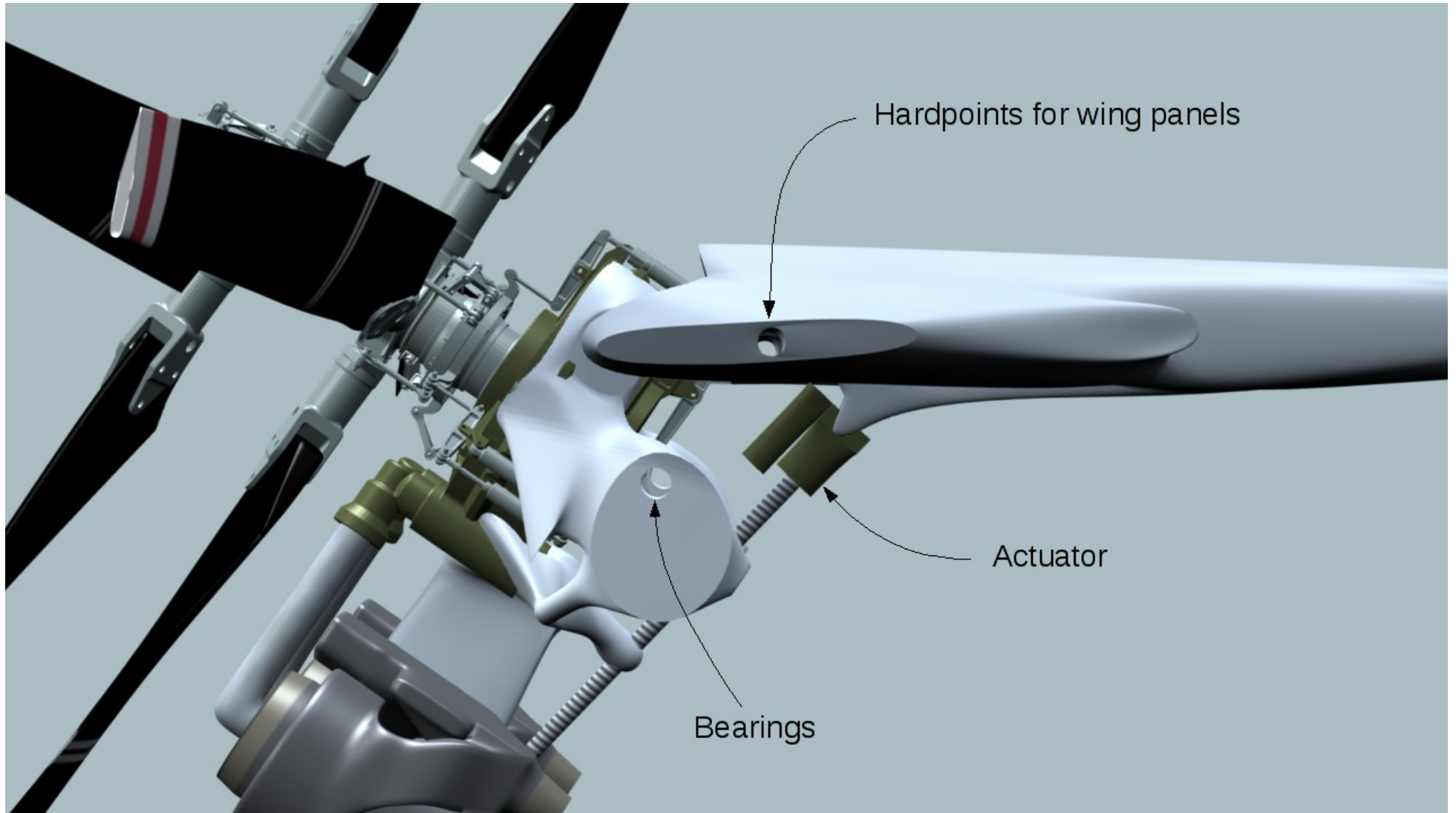


MTR Common Features



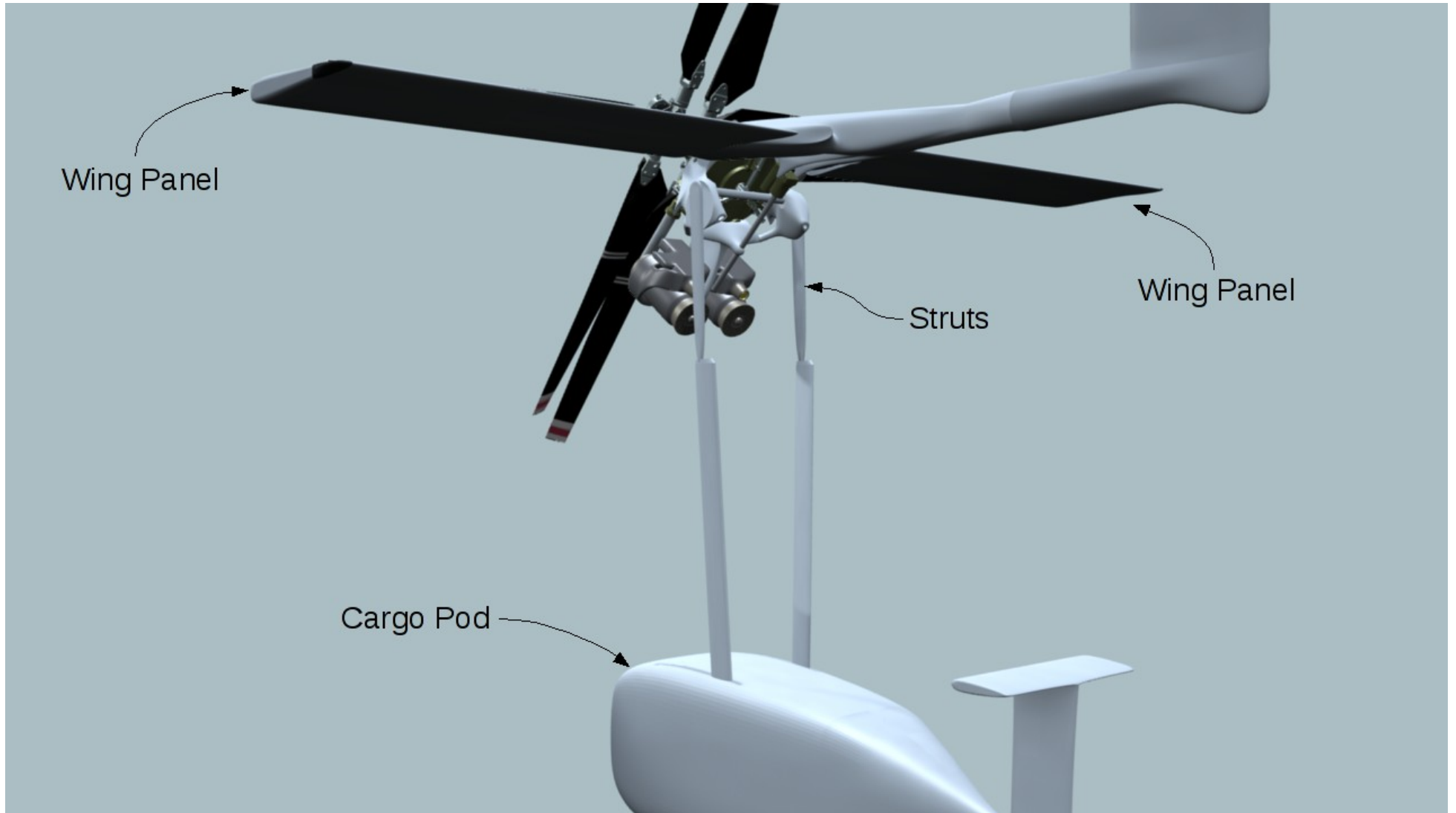


MTR Unique Features





MTR Cargo Features





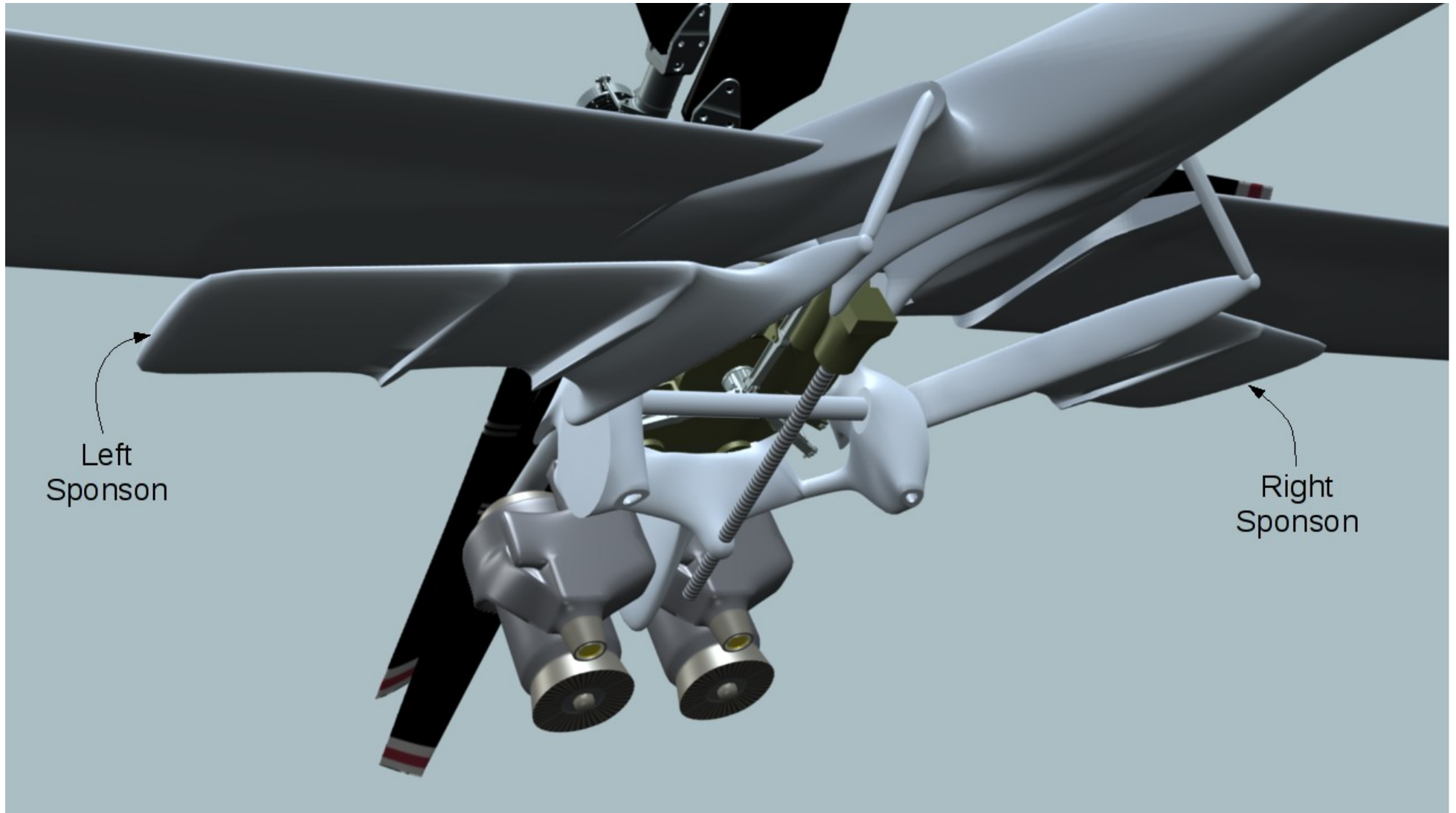
MTR Attack Features

- 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

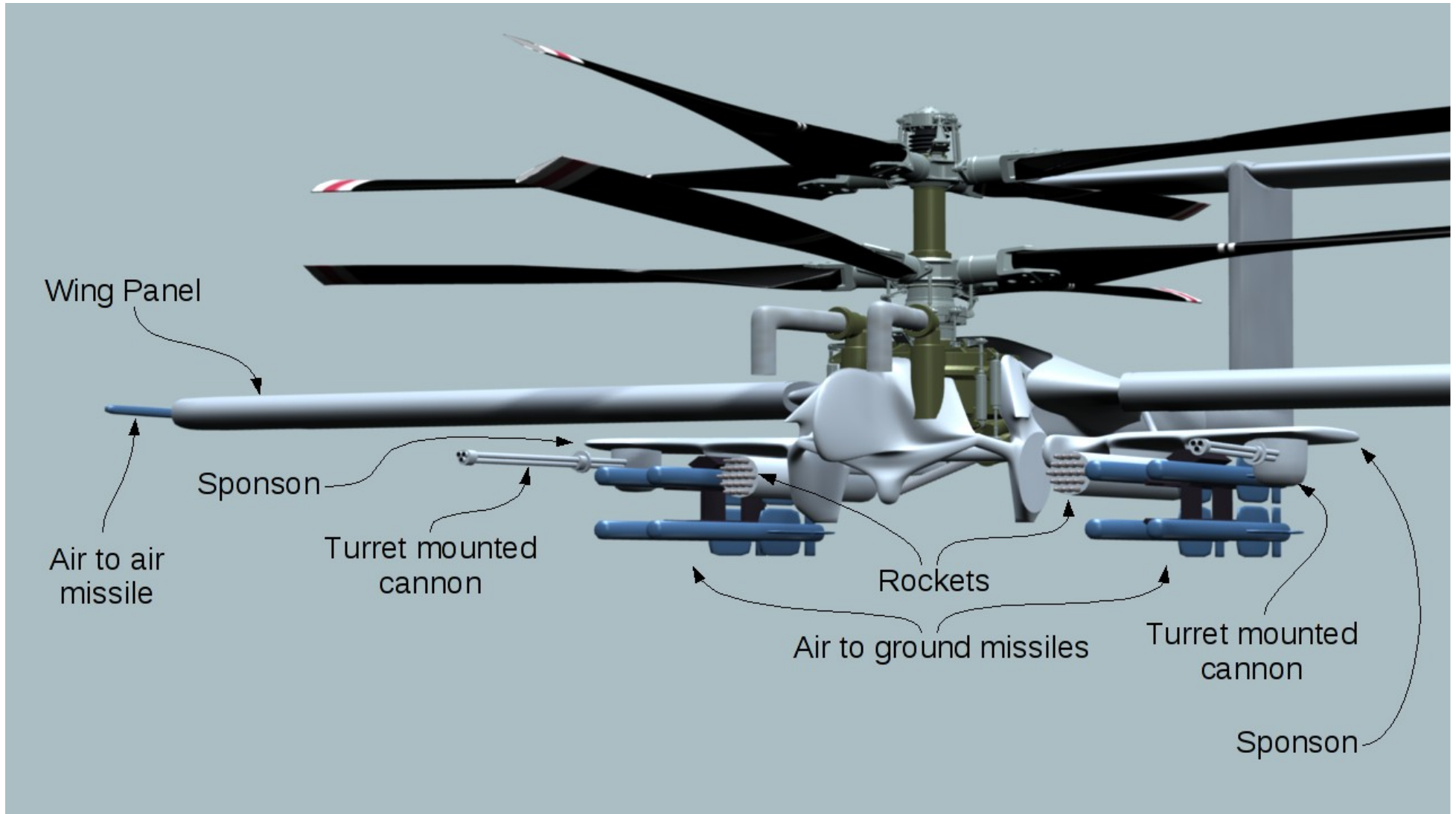


MTR Attack Features





MTR Armaments





MTR Advantages

- In comparison to legacy helicopters for long range (750nm to 1000nm) cargo missions:
 - 1/3rd of the baseline structural weight
 - 1/3rd of the fuel burn
 - 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



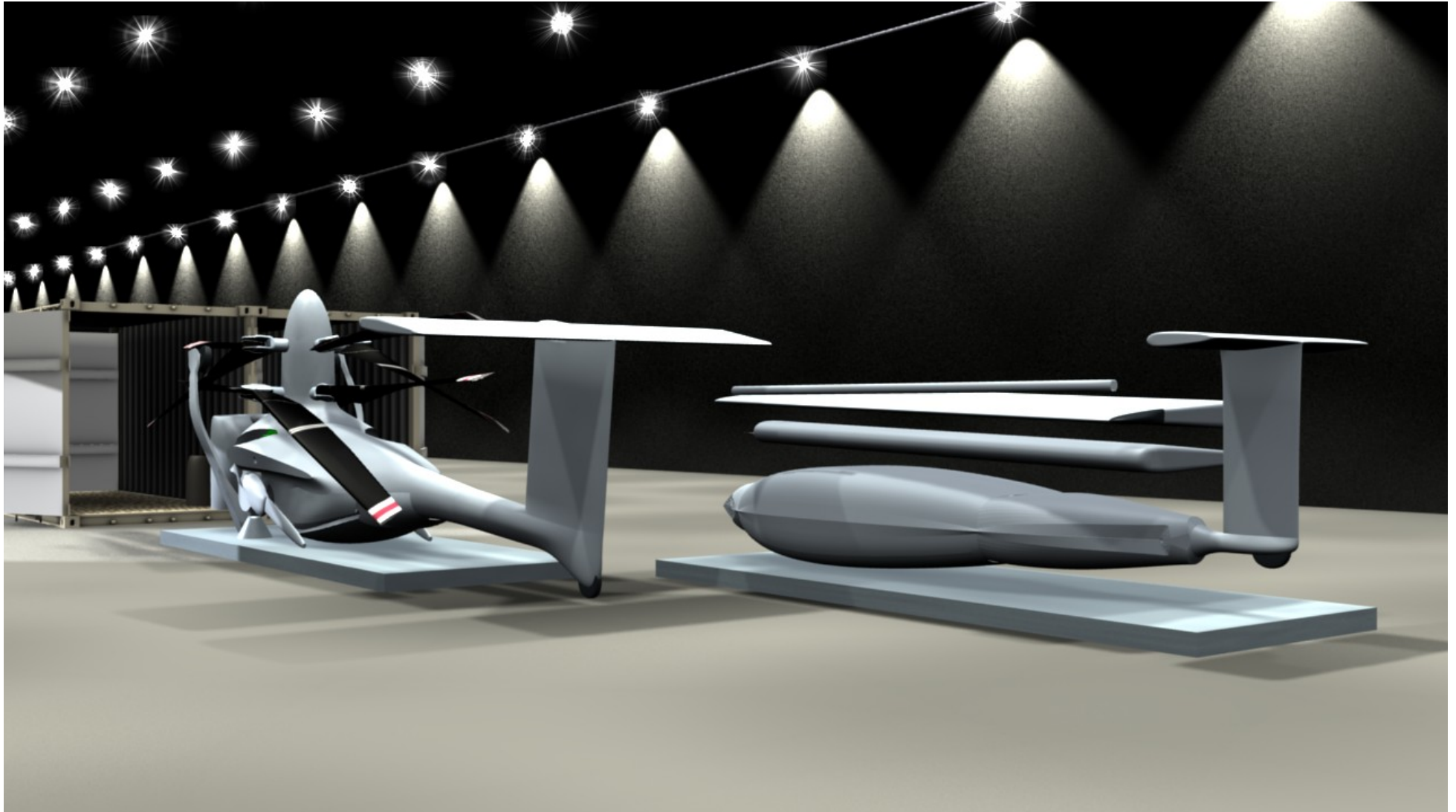
MTR Advantages (cont. 2)



- 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.



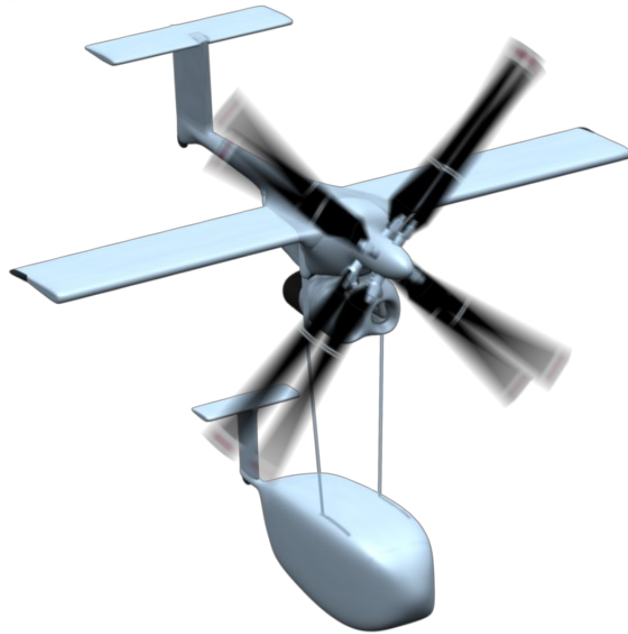
MTR R&D Timeline



- 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)



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

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

Research Contracts

Amounts (\$K)	FY04	FY05	FY06	FY09	Total
ONR	277			690	967
AATD		810	819		1629

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



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