



# JMR RFF Response



## ONE MISSION:

*Without Compromise*

Range  
&  
Speed  
&

*Without Tradeoff*

Vertical Agility

8-9 December 2010

Baldwin Technology Company, LLC

[www.baldwintechology.com](http://www.baldwintechology.com)



# Implications of JMR Size/Weight



Mono Tiltrotor design studies\* have concluded:

- Ultra has 80ft rotor and four AE1107 engines
- Small has 25ft rotor and two T800 engines
- Uses 100% COTS components/technologies
- Scalable design over the full JMR family
- MTR is lightest, most cost effective configuration

\* Conceptual Design Studies of a Mono Tiltrotor (MTR) Architecture, Contract Number: N00014-03-C-0531, 2004.

Mono Tiltrotor (MTR) Validation Activities, Contract No. W911W6-05-D-0004-0002, 2008

Assessment of the Mono Tiltrotor as a Sea-Based Resupply and Replenishment Unmanned Aerial Vehicle, Contract No. N00014-09-C-0575, 2009.



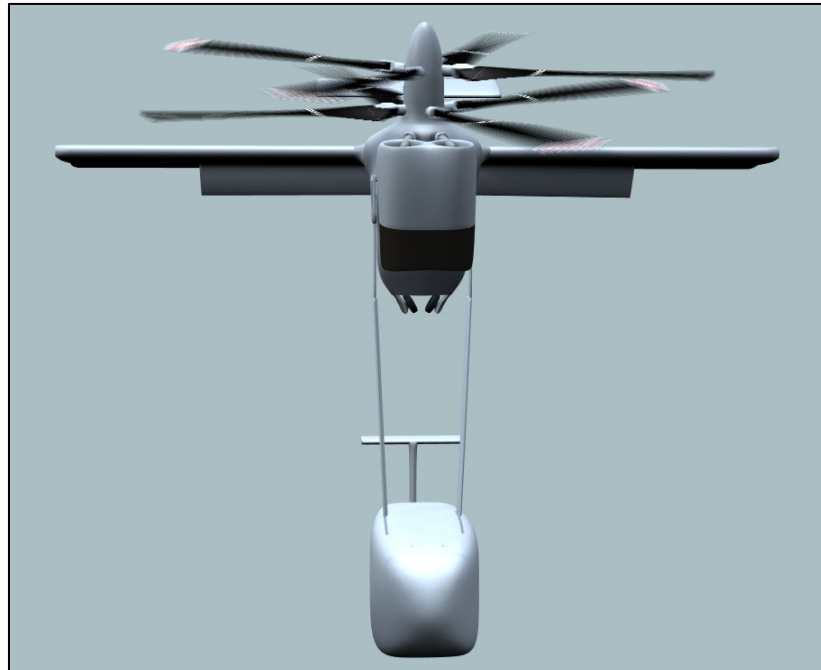
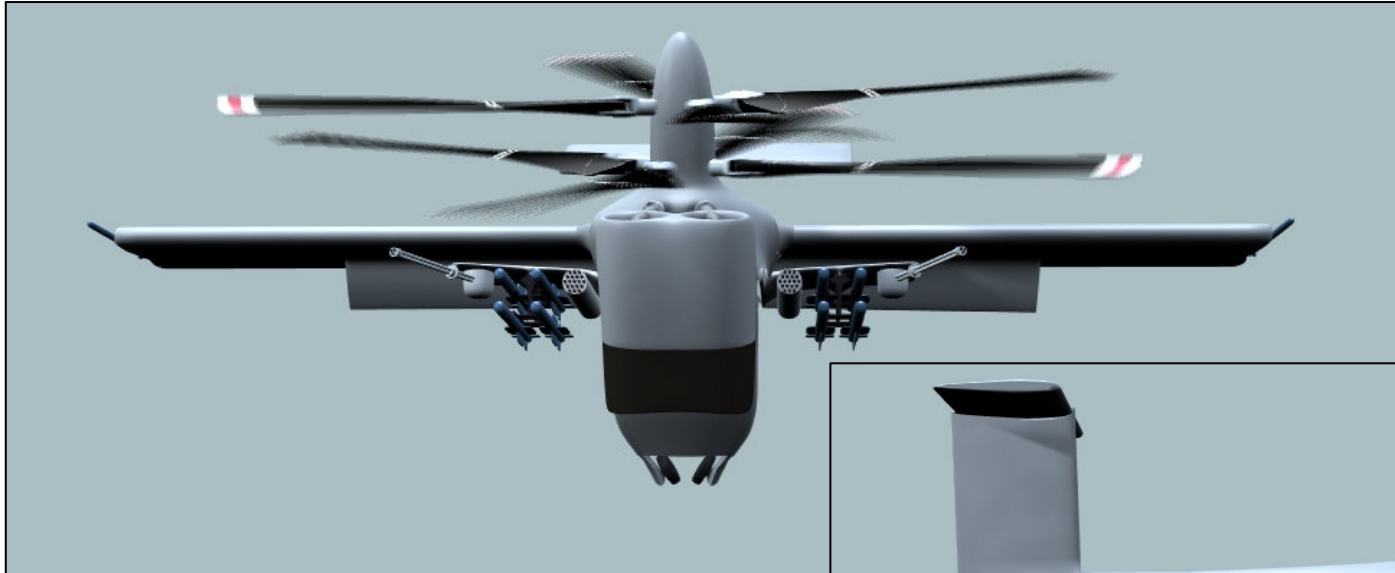
# Physical/Operational Characteristics



- I. A Coaxial proprotor
- II. Drooped wing panels
- III. Pitch axis suspended...
  - Pod and/or
  - Sponsons

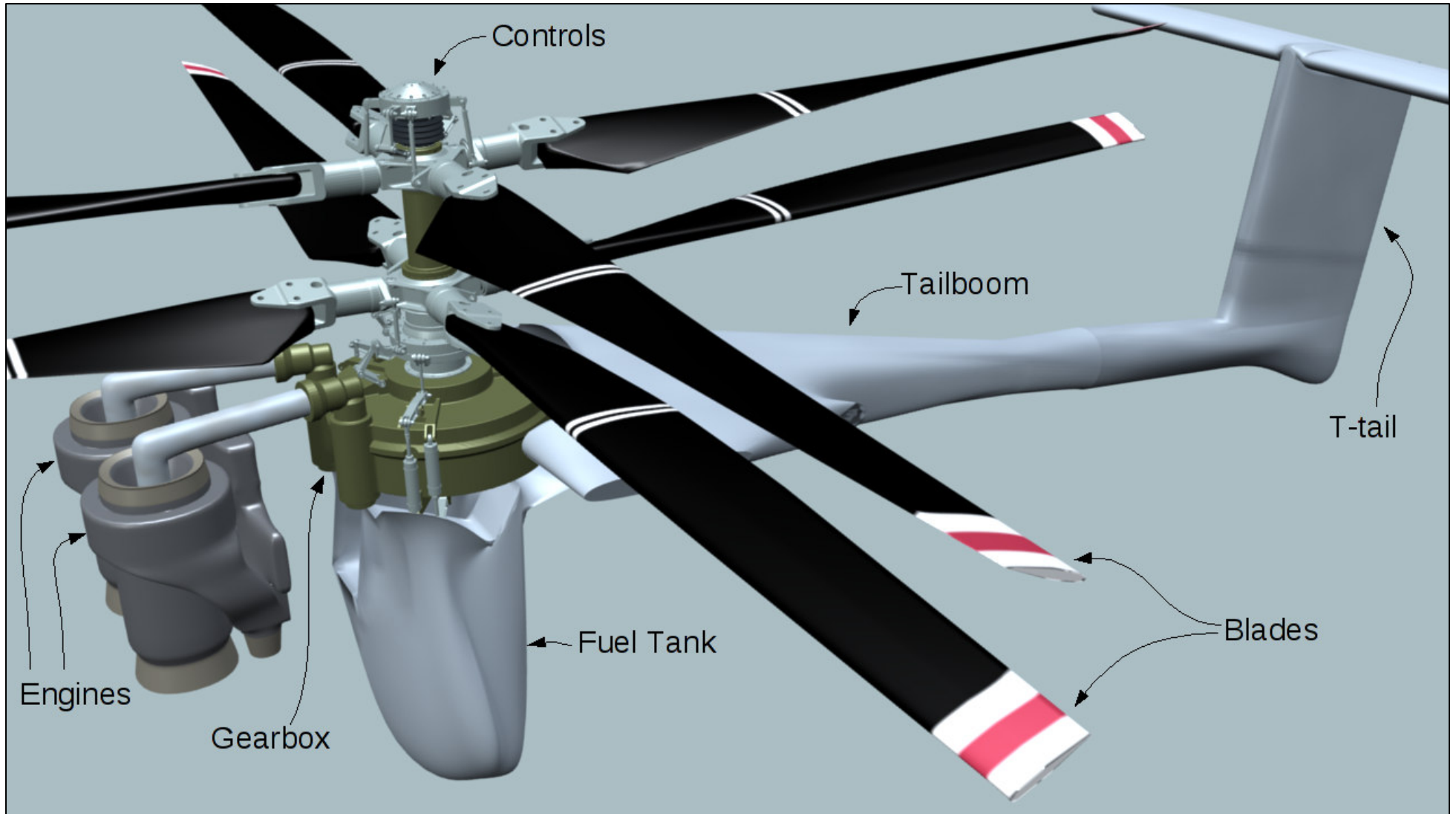


# Watch JMR Concept Video



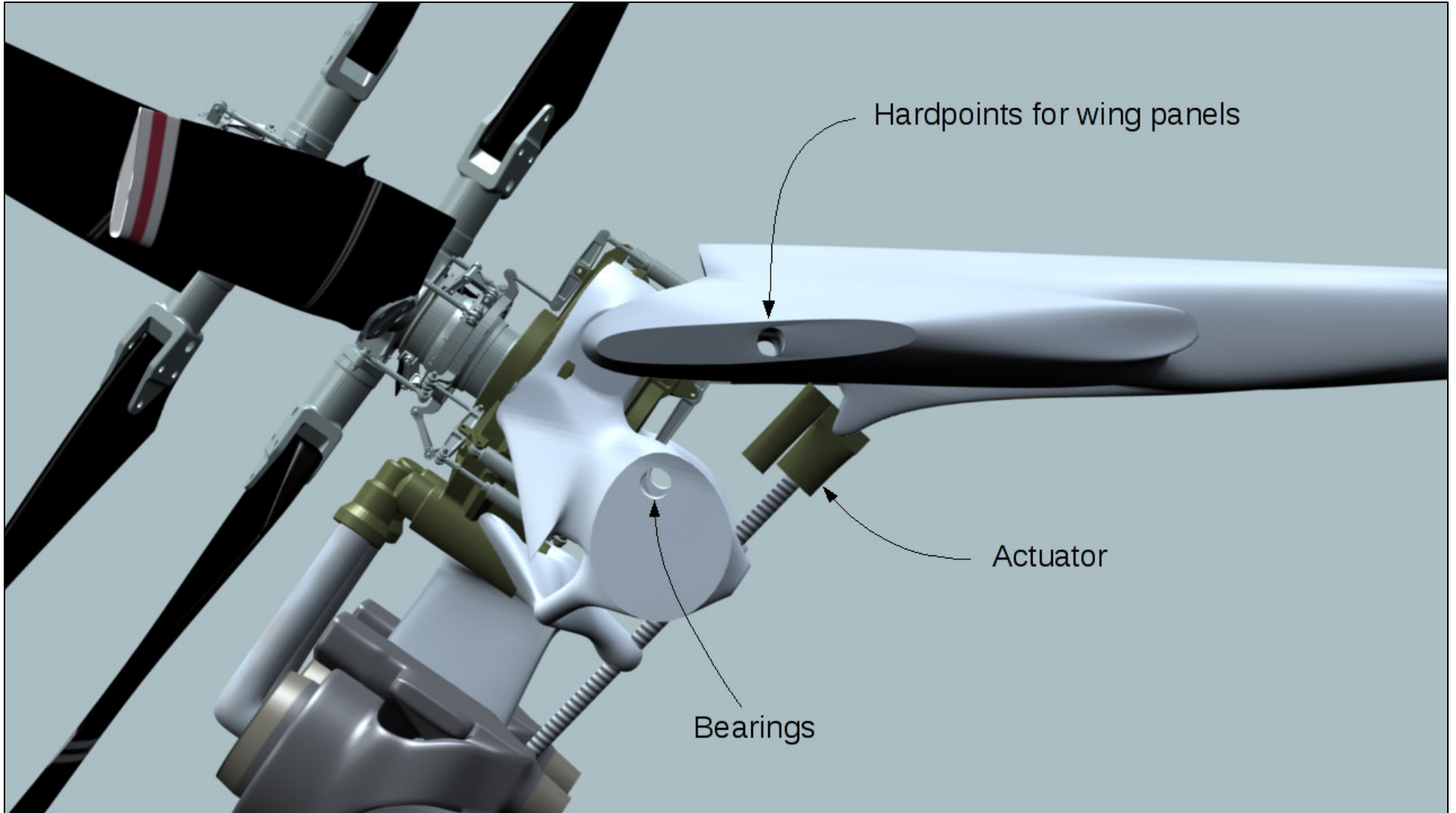


# Conventional helicopter features



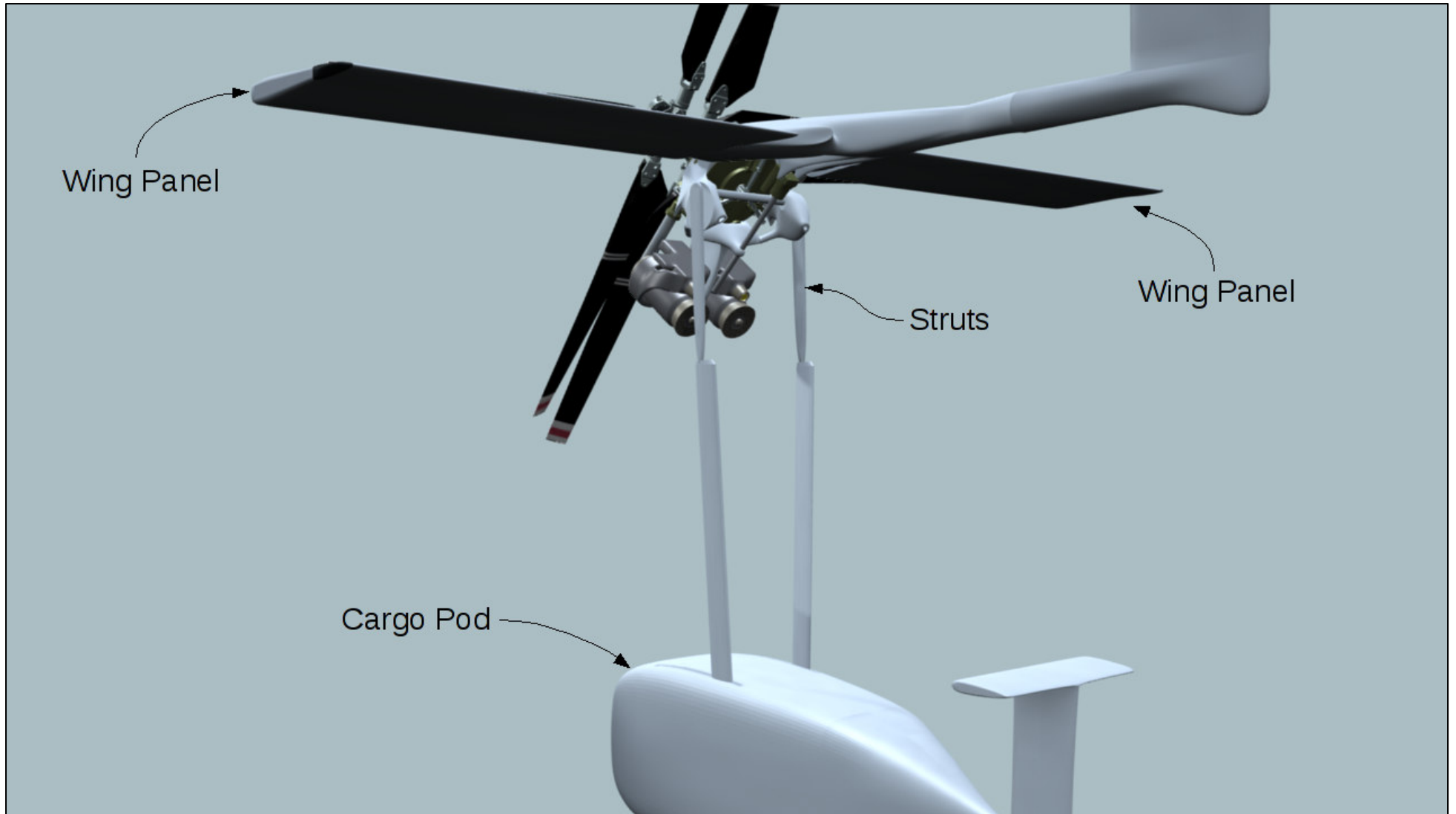


# Features that set it apart





# Cargo features

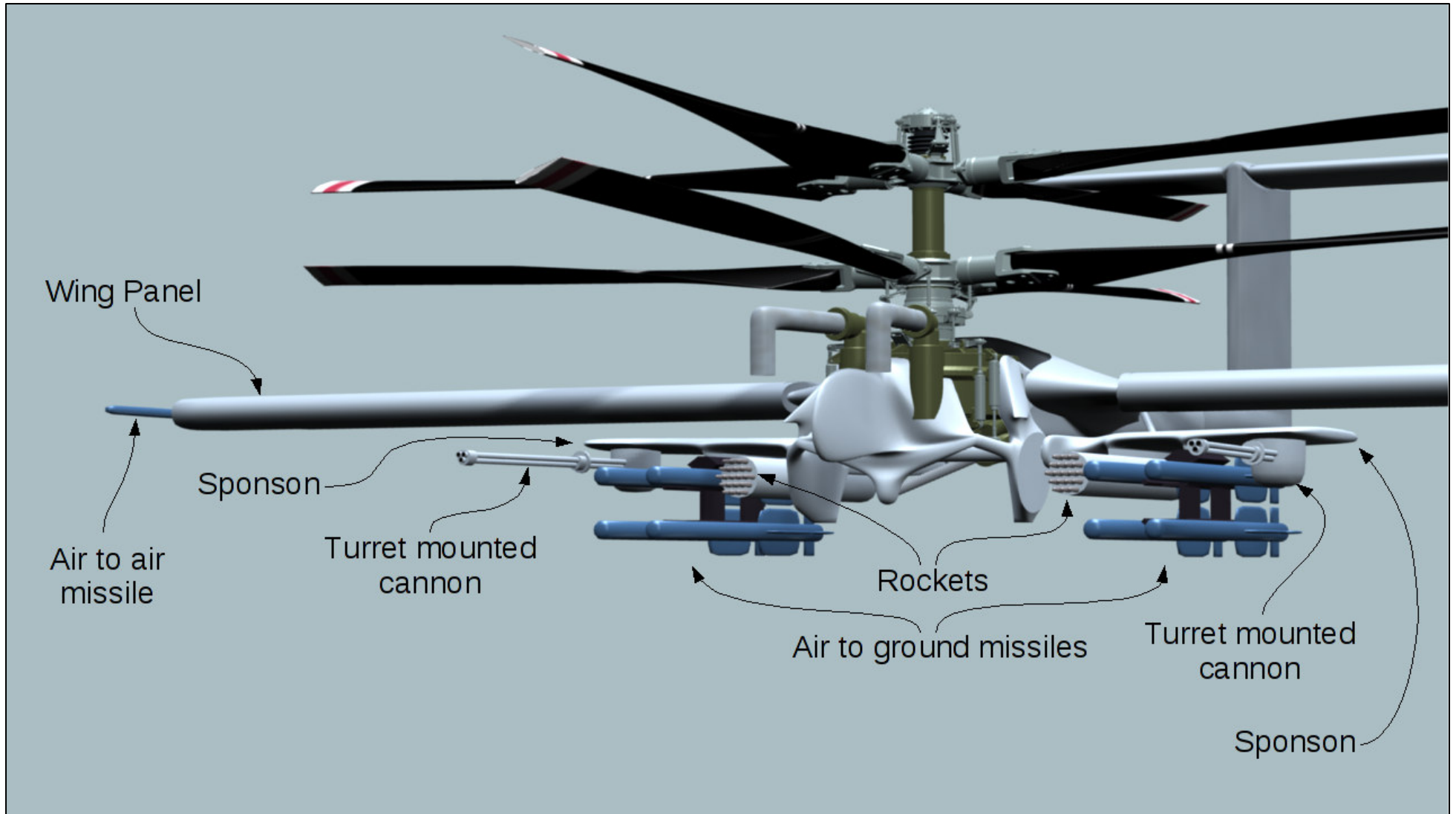




# Attack features



# Example armaments





# Manned assault (strawman)



- Pilot forward of engines in helo mode
- Use both the sponsons for armaments and a pod for troops
- Pod has ballistic protection
- Pod is detachable for persistent ballistic protection after aircraft departs
- Pod deploys a separation recovery parachute in the event the aircraft is disabled under fire



# Watch Conversion Flight Video





# Mission/CONOPS Strengths



- Range & Speed & Vertical Agility all-in-one mission
- Low vulnerability trajectory with cruise at 20,000 feet; and steep descent/assent
- Mission pod unconstrained by the fuselage size
- Rapid reconfiguration with mission pods
- One level deep maintenance actions
- Airplane-like levels of cruise vibration



# Performance Estimates



Class	Light	Medium	Ultra
Best Cruise Speed *	200 kts	220 kts	260 kts
Combat Radius	695 km	787 km	926 km
Payload	3000 lbs	12,000 lbs	40,000 lbs
Passengers	6	24	-
Self Deploy	6100km	6100km	6100km
Engines	2 x T800	2 x AE1107	4 x AE1107
Rotor Diameter	25 ft	50 ft	80 ft
Gross Weight	9400 lbs	36,000 lbs	120,000 lbs

\* - with 30-minute reserve fuel, after 5-minute hover on takeoff at 4k/95 and a best cruise at 20,000 feet ISA.



# Best Lift-to-Drag Effective



3

5

7

**Directly proportional to range**  
(for same vertical lift fraction and turbine efficiency)



# Best Lift-to-Drag Effective



Legacy  
Rotorcraft

X2

MTR  
SR/C

3

5

7+

Directly proportional to range  
(for same vertical lift fraction and turbine efficiency)



# Watch Suspended Pod Video





# Risk and Uncertainty



- Dynamic scalability of pod subsystem
- Engine installation
  - Installation drag
  - Infrared signature
  - Heat soak on ground
- Conversion structure preliminary design

A new technology physical demonstration effort is needed to address the first one of these three risk areas.



# Commonality Potential



- Within each class...
  - Airframe is common, to include all major mechanical systems
  - Pods and sponsons are unique to each mission variant
- Across classes...
  - Pods and sponsons from smaller classes may be fitted to larger classes

**BOTTOM LINE:** Bulk of financial investment is preserved, even after airframe is fielded and new variants are subsequently developed.



# Technology Development



## PARTNERS:

ARL –Army Research Labs

BHTI –Bell Helicopter Textron

CDI –Continuum Dynamics Inc.

EATI –Eagle Aviation Tech. Inc.

GT –Georgia Tech

NIA –Nat'l Institute of Aerospace

PIM –Polytech. Inst. of Milan

SS –Scientific Simulations

UCB –U. of Cal. at Berkeley

UMd –University of Maryland

## COLOR KEY for next chart:

Conceptual Design - YELLOW

Preliminary Design - ORANGE

Wind Tunnel Test - GREEN

Flight Demonstration - BLUE



# Technology Development Timeline



	'02	'04	'06	'08	'10
Pitch axis suspended load	BTC	{ UMd-BTC }		GT	{ BTC }
Drooped wing panels		{ UMd-BTC }		GT	
Tilting proprotor			ARL	GT	
Proprotor subsystem		UMd	EATI-ARL	BHTI	
Parasitic drag		UMd	BTC-SS	BHTI	
Component weights		UMd	EATI-UMd	BHTI	
Performance		UMd	UMd-ARL	BHTI	
Stability analysis	BTC		BTC-ARL	BHTI	
Multibody analysis			BTC-NIA-PIM-CDI		
Autonomous control				BTC-UCB	
Shipboard suitability				BTC	BTC
Cargo UAS design				BTC	BTC
Contracts (\$K):		277	810	819	690



# TRL-4 ==>>> TRL-6

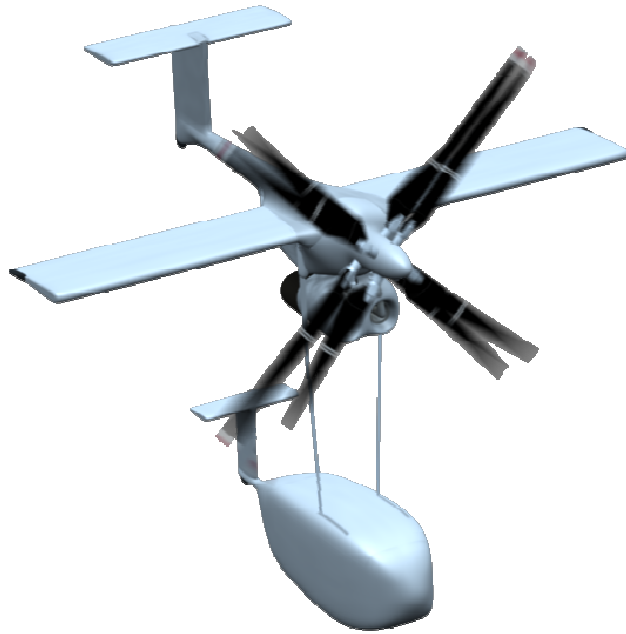


- Fast track the demonstration and analysis of a suspended pod at 1:1 scale on GFE
- Leverage the current 1:10 scale MTR-FD flight demonstrator to calibrate...
  - The multibody analysis tool
  - The autonomous control method
- Repeat demonstrations and analysis at 1:5, 1:3, 1:2, and 1:1 scale.

Requires funded Government action: \$10-15M.  
NT contractors, by definition, do not enjoy  
traditional Government funded IR&D.



# 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

<u>Amounts (\$K)</u>	<u>FY04</u>	<u>FY05</u>	<u>FY06</u>	<u>FY09</u>	<u>Total</u>
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



# Selected References



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