Smart Structures

Technology Applications Group

MultiDisciplinary Technologies Center

Air Vehicles Directorate

Air Force Research Laboratory
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MD Technology Applications Group

Develop Air Vehicle Technologies & Processes that Exploit and Maximize the Benefits of Previously Unused Technology Interactions

BUT HOW ?

1. Establish Project Teams, including External Partners

2. Define Realistic Mission Requirements

3. Identify Technical Challenges & Required Detailed Analyses

4. Perform Analyses/Design Trade-Offs & Technology Assessments

5. Quantify Benefits of VA Technologies in a System Context

6. Strive for Complete System Integration

7. Support Technology Development for an Optimal System Design

MD Technology Applications Group Technology Assessment Projects

Product: Support to Air Vehicles Directorate.
Detailed Technology Assessment/Recommendations
for Required Investment, i.e. Technology Programs.
Focus: Technology Enabling a Vehicle for an Advanced Mission

Customer:
VA's ICLs for Technology Investment Guidance

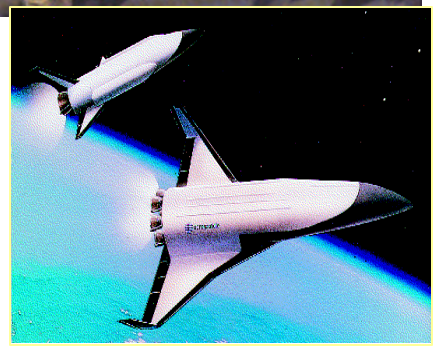
Why This Group ???
Industry wants to build and sell systems, technology as required.
ASC performs mission assessments, system benefits
This group will do generic technology assessment in a design context

MD Technology Applications Group Technology Assessment Projects

UAV for ISR Mission, “Sensor Craft”
- 360 degree Antenna Coverage
- High altitude (>65kft), long endurance

SuperSTOL Theater Transport.
- 60,000lb Payload into & out of 750ft.
- New capability, vs C-130 fleet costs

Transatmospheric Vehicle
- Hypersonic speeds, Propulsion integration
- Structures/high temperature, Aircraft-like operations



Technology Assessment in a Design Context

UAV/ISR Technology Assessment

Starting Point

Assumption:

Team would attempt 100% solution to meet SN requirements

Design Drivers:

Antenna size & coverage required defines wing/fuselage layout
Antenna power vs engine availability/technology
Configuration lift/drag for loiter at 65kft altitude
Distribution of power required and heat produced
Flexible structure vs antenna orientation
Controls integration in wing without antenna interference

Need: More detailed analyses, concept refinement

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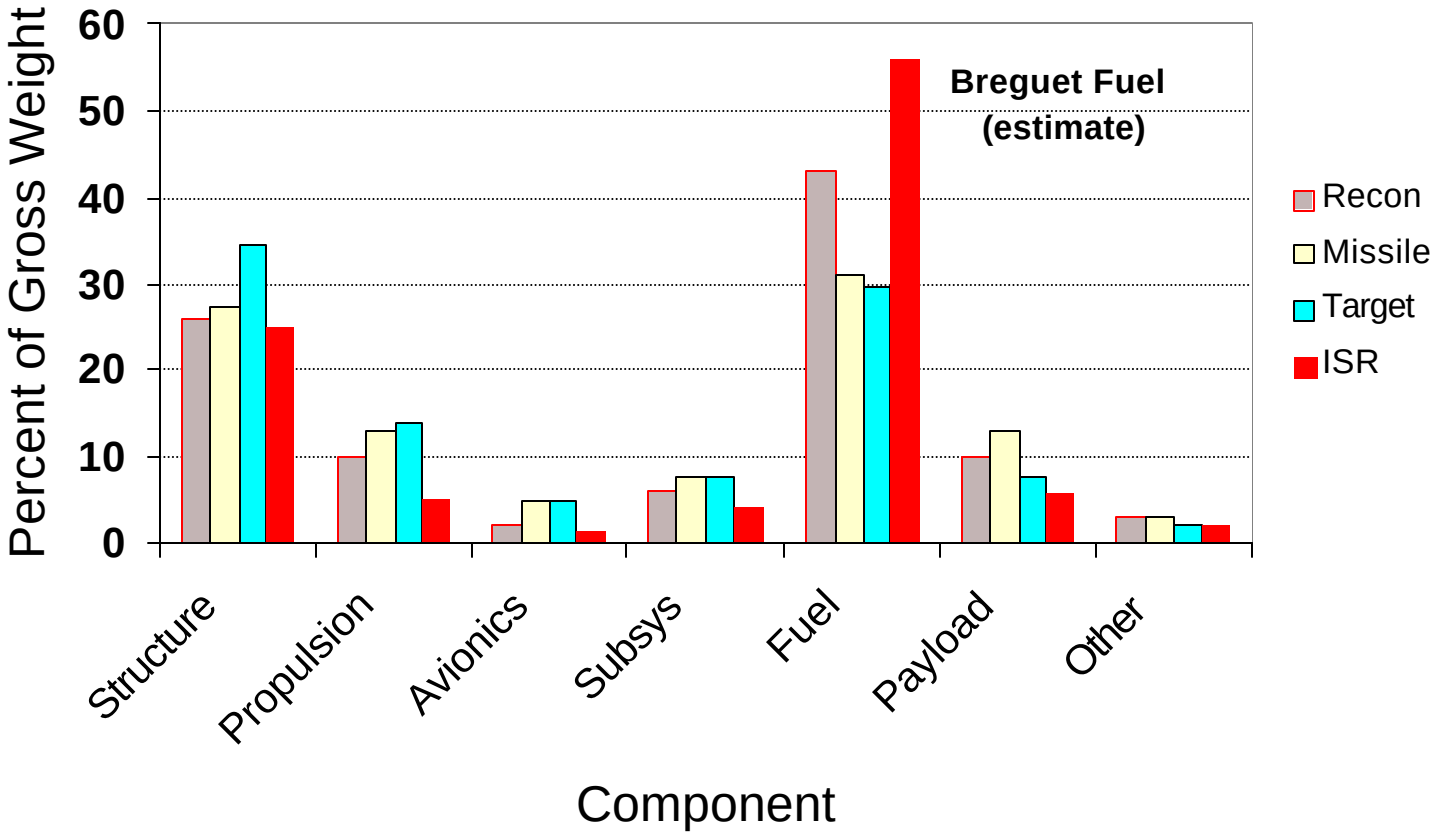
UAV/ISR Technology Assessment

Historic UAV Weight Distributions
30 Vehicles



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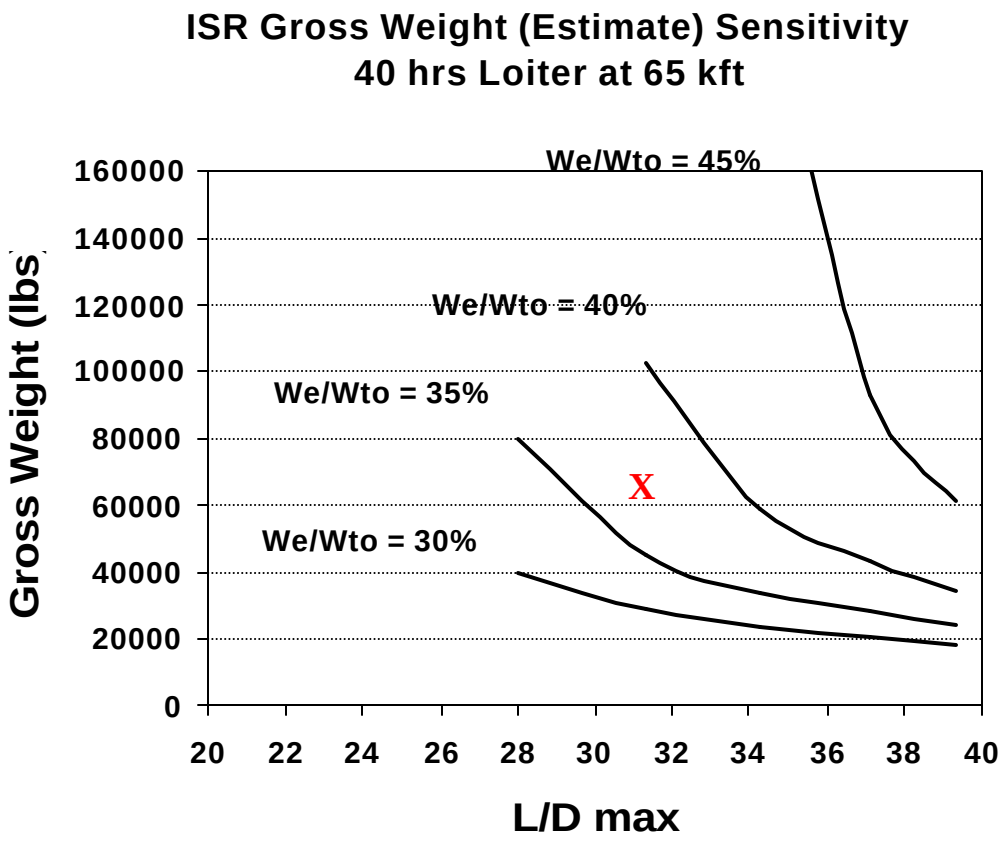
UAV/ISR Technology Assessment



A place to Start … State-of-the-Art Wto = 70000 lb

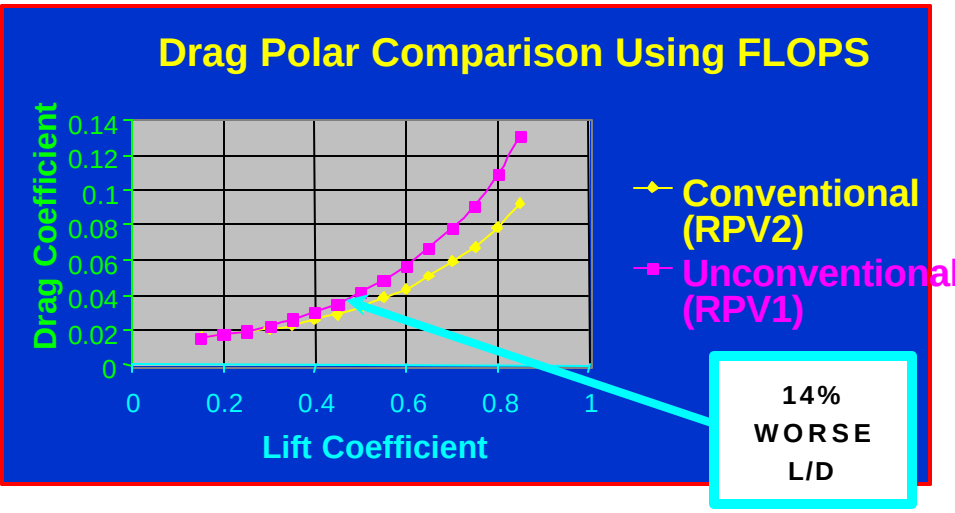
Note: We need targets for weight budgets

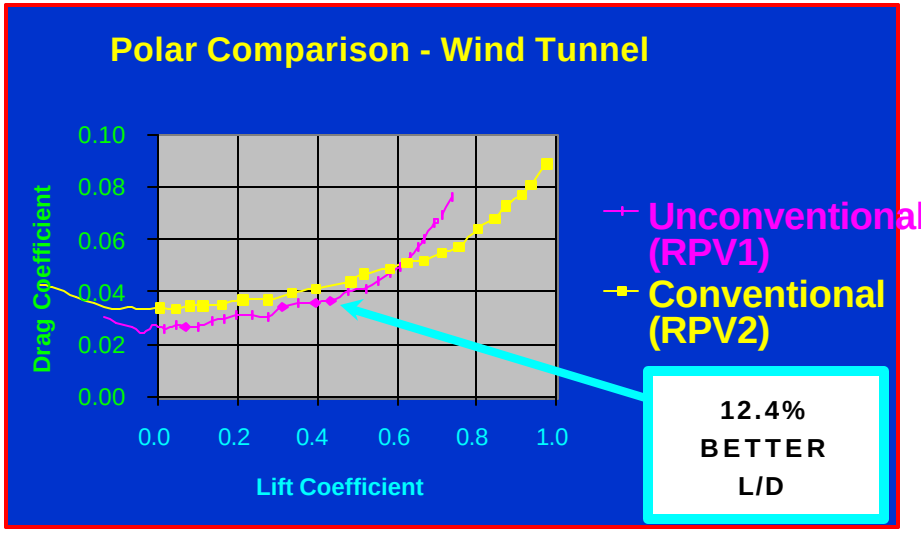
- **How is the Weight Distributed ?**

UAV/ISR Technology Assessment

Experience with Design/Analysis Codes

Unconventional configurations may need to be tested to ascertain limitations in analysis codes. What is the credibility of analytical results ??





UAV/ISR Technology Assessment

Structural Aspects

Challenge: Initial sensitivity analysis showed ISR platform requires significant weight reductions for extended loiter times.

Solution: Explore benefits of affordable structures technologies to reduce weight fraction.

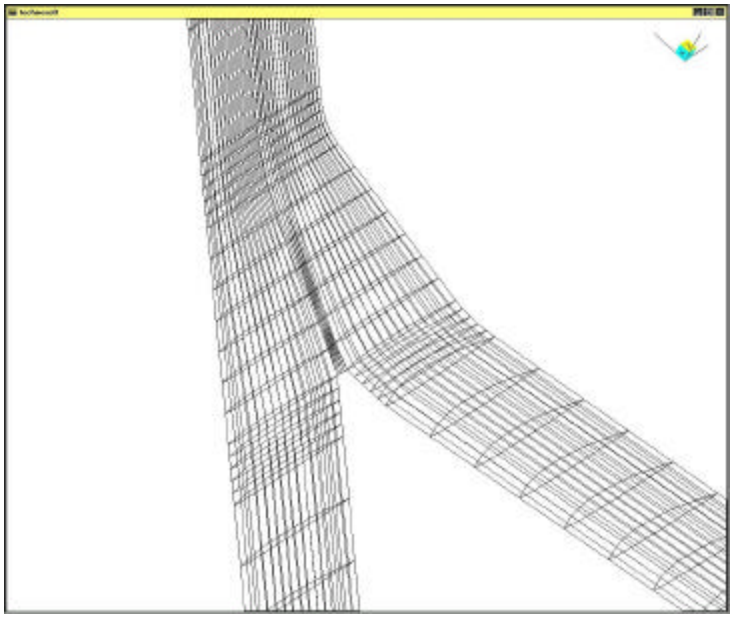
Approach: More detailed structural analyses to quantify technology payoffs from the system design.

UAV/ISR Technology Assessment

Structural Aspects

Design Issue: The joined-wing is inclined to buckling and aeroelastic complications with the presence of compressive loads.

Solution: Design joined-wing configuration with Aeroelastic Tailoring to control the load path, reduce weight and reduce maneuver drag.



Approach: The design team will develop and orchestrate a rapid joined-wing design capability with both configuration and structural variables.

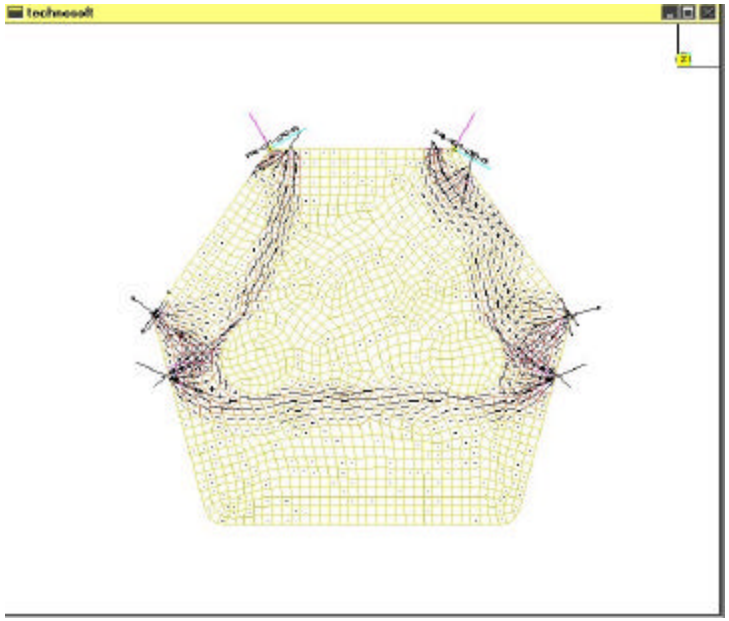
UAV/ISR Technology Assessment

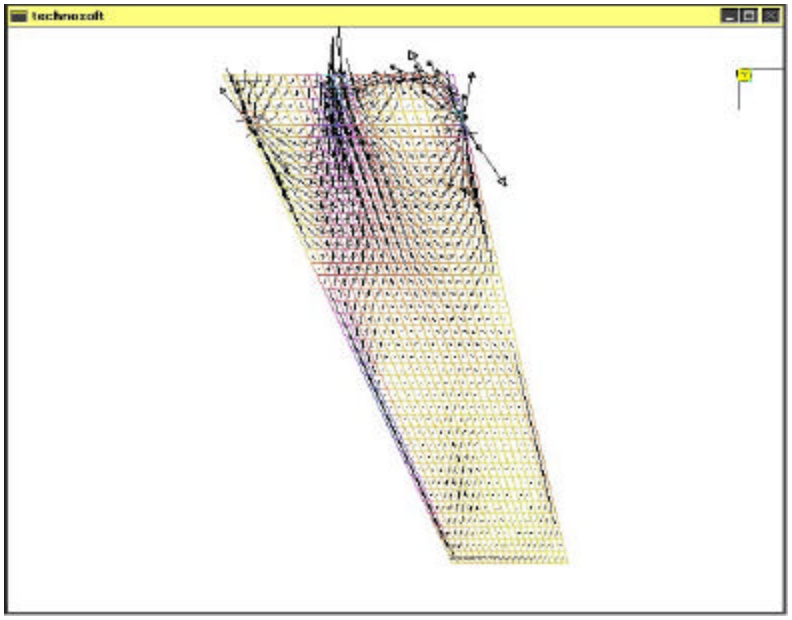
Structural Aspects

Technical Challenge: Efficient design of structures

Approach: Use the STTR design development by Samara State Aviation to create a functional VA capability.

Schedule: To be performed in the follow-on detailed analyses.





UAV/ISR Technology Assessment

Candidate Technologies

Technology	Payoff	Impact
• Active Flexible Wing	• Optimize L/D at all flight conditions	• Increased range/time-on-station
• Affordable Structural Concepts	• Reduced structural weight fraction	• Meets mission with reduced system cost
• Active Flow Control	• Optimize L/D at all flight conditions	• Increased range/time-on-station
• Conformal Load Bearing Antennae	• "Payload weight" reduces structural wt	• More efficient integration
• Energy-Based Design Methods	• Design optimization	• Reduced system cost

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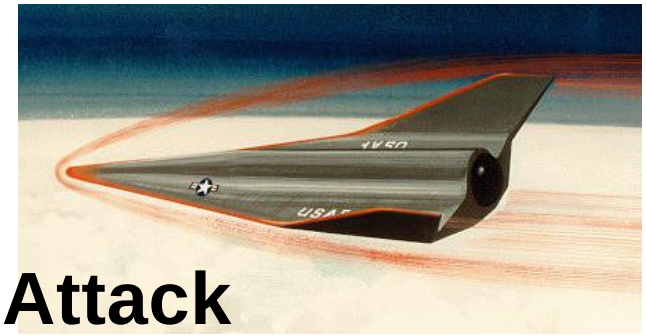
A Really Smart Structure!!!

Surveillance

On Demand



Attack