



Science and Technology Affordability
Conference
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Composites Affordability Initiative

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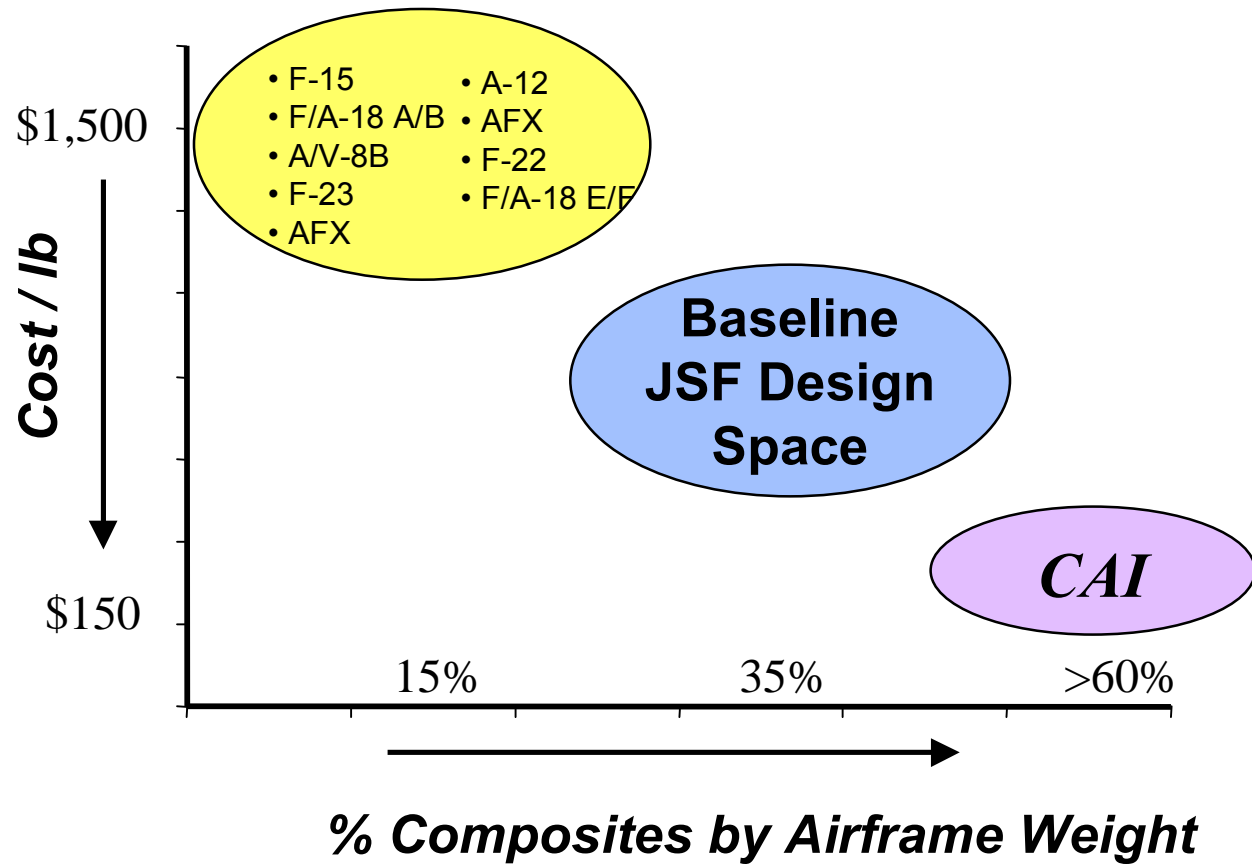


Problem

- Composites are Expensive
- Composites are used on virtually all DoD weapon systems
- Composite structures are proven to reduce weight, fatigue & corrosion damage resulting in
 - improved range
 - improved speed / maneuverability
 - improved payload capability
 - improved stealth
- Cost, risk and inefficient designs have limited the use of composites on advanced weapon systems



Composites Environment





What is CAI?

- Long Range (8-10Year) Initiative to Change the Culture in the US Industrial Base on How We Design and Manufacture Advanced Composite Structures to Make Them More Affordable
- Initial 3 Year Effort Has Been Defined
- Initial Customer Has Been Identified/"On Board"
- Air Force/Army/Navy/Industry Initiative
- Integrated budget, schedules, testing plans, and risk management approaches have been defined



Vision/Strategy

Vision

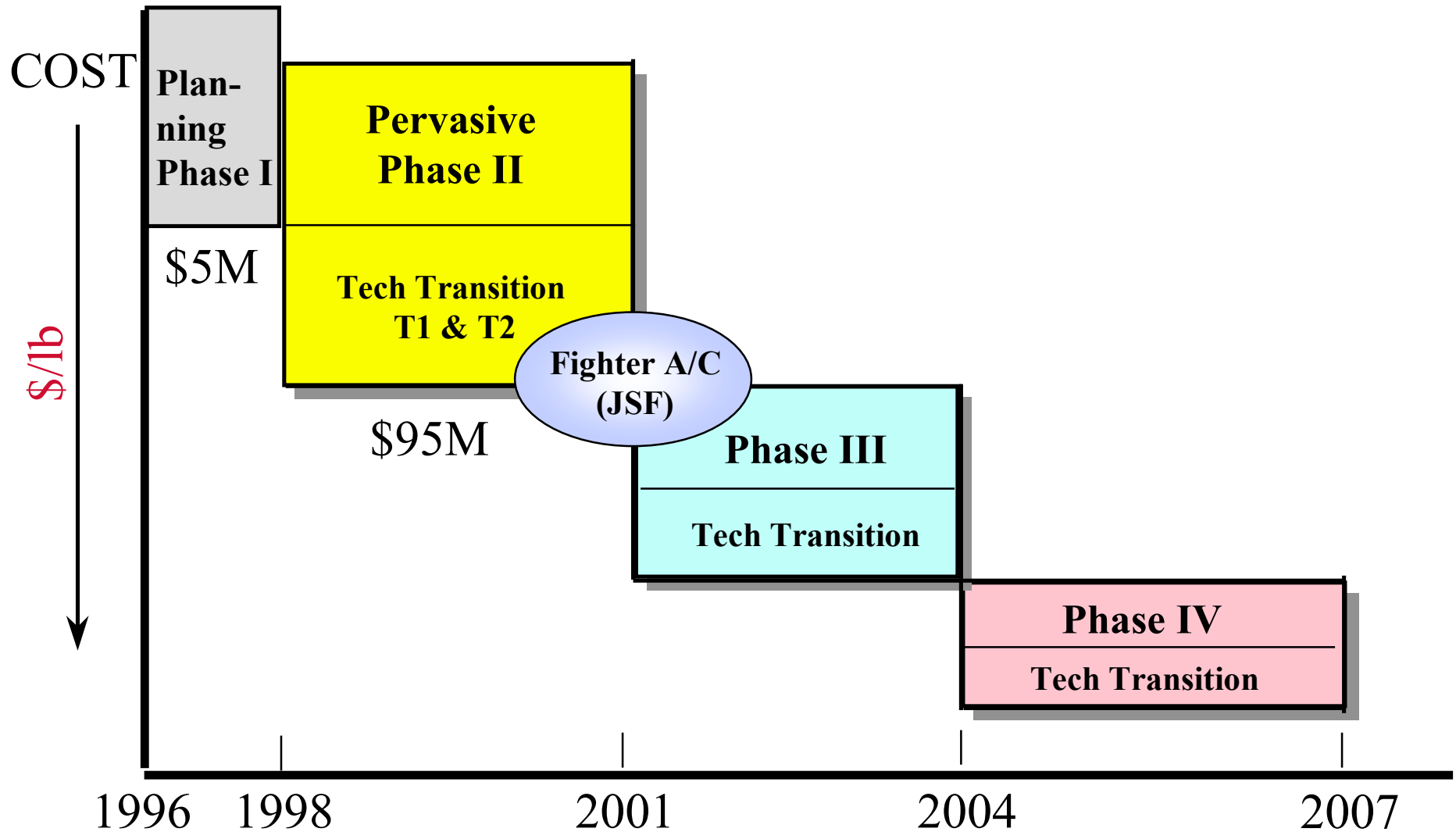
Reduce Acquisition Costs of Advanced Composite Structures by an Order of Magnitude

Strategy

Focus on cost reduction through a joint Government-Industry effort of technology development and transition



Vision/Strategy





What's Different in CAI? Management

Current

- Government Directed Effort
- Service Segregated Technical Efforts
- Segregated 6.2, 6.3, & 7.8 funded Projects
- No Resource Sharing
- Standard Contracting
- Primes and Subcontractors
- Government Management

CAI

- Government /Industry Collaborative Effort
- Leveraging Army/Navy/Air Force Resources
- 6.2, 6.3, & 7.8 Combined Resources
- Industry Resource Sharing (50/50)
- Cooperative Agreements, 845:Other Transactions
- Cross Company Teams
- Government/Industry Team Management

ALL ARE TRAINED IN IPPD



What's Different in CAI? Technical Approach

Current

- Focus on Components
- Focus on Manufacturing Improvements
- Moderate Risk/High Pay-Off
- Affordability = Cost
- Bolted and Bonded Structures
 - Moderately integrated

CAI

- Systems Level Technical Emphasis and Cost Analysis
- Create a Paradigm Shift in the Design/ Manufacturing Communities
- High Risk/High Pay-Off
- Affordability: Best Value of Performance, Producibility, and Risk
- Major Emphasis on Bonding and Co-curing
 - Highly integrated



IPPD Structure

Responsibilities

- Strategic Direction
- Advocacy
- Funding

- Program Management
- Integration
- Planning
- Assessment
- Communications

- Program Execution
- Resource/Technical Management

Team

Executive Council

Leadership IPT (LIPT)

Activity IPTs

T1 _____ →

T2 _____ →

Pervasive Tech _____ →

Members

Dr. C. Browning - AF	Mr. Fred Schwartz - JSF
Mr. R. Perkins - Navy	Mr. T. Arthurs - NGC
Dr. D. Paul - AF	Mr. L. Winslow - Boeing
Mr. D. Rossi - Navy	Mr. D. Swiggart - LMA
TBD -Army	

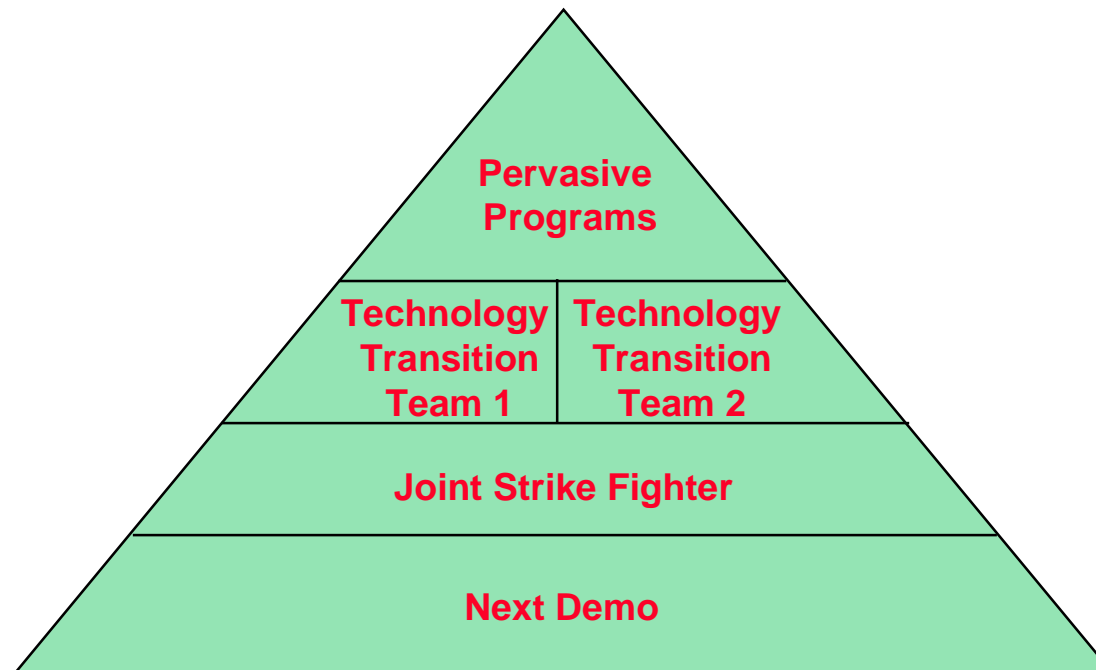
Mr. D. Beeler - AF	Mr. B. Birchfield - Boeing
Ms. J. Koury - Navy	Mr. R. Ramkumar - NGC
Mr. R. Barlow - LMCO	Mr. D Arnold - Boeing
Mr. M. Peroziello - JSF	Mr. W. Roy - Army

_____ →	Charlie Anderson/Jerry Marsh (Boeing)
_____ →	Paul Alexander (Lockheed Martin)
_____ →	Dee Gill (Boeing)



Technology Transition Programs

Migrate the innovative designs, manufacturing and assembly technologies to EMD for JSF.



Pervasive supports the Technology Transition Teams by providing essential technologies & data.



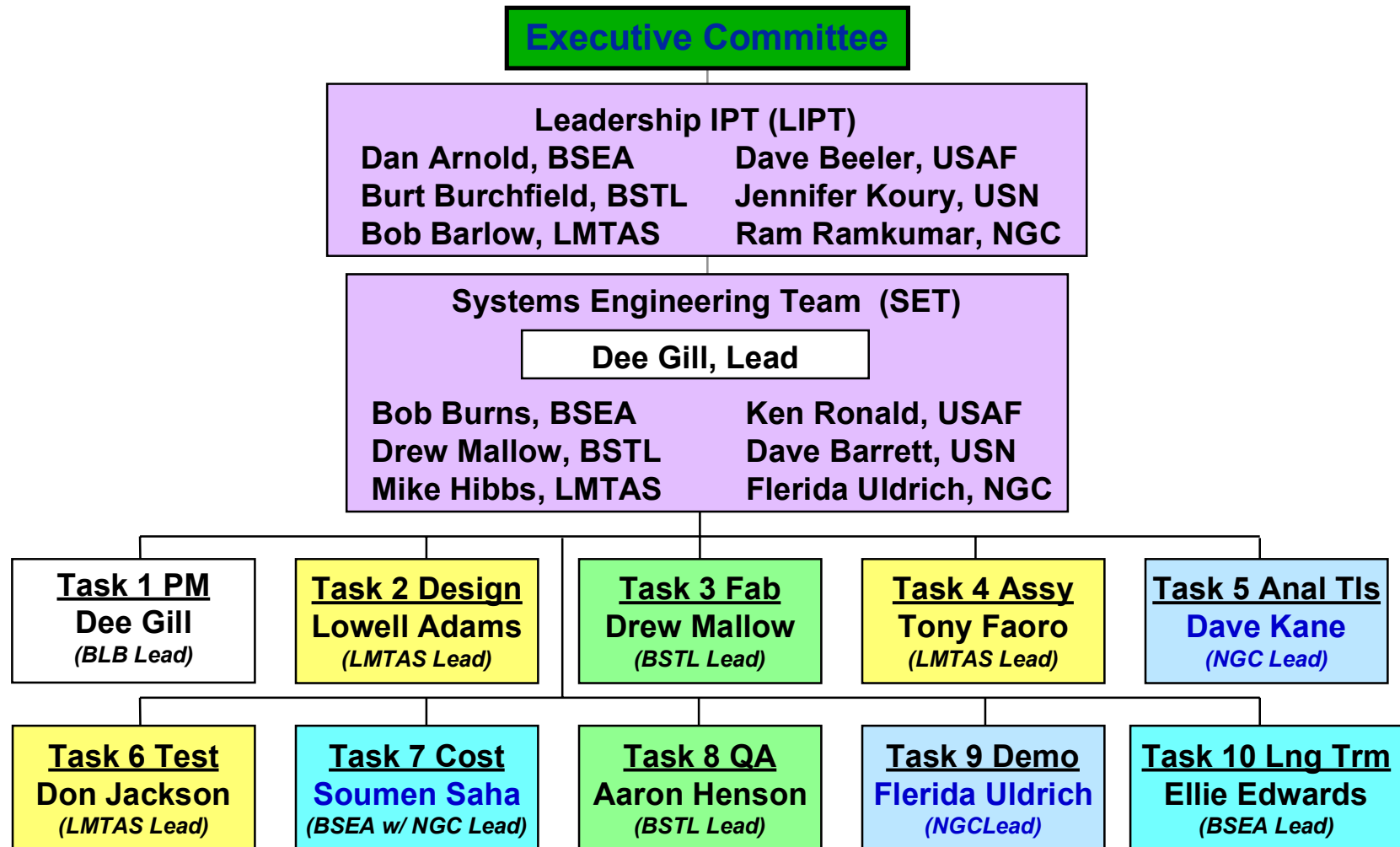
3 Primary Efforts

The “Pervasive Technology” development effort focuses on maturing design, materials, and processes **essential** to implement revolutionary changes required for unprecedented improvements in affordability.

The 2 Technology Transition efforts will migrate the innovative designs, manufacturing / assembly technologies, tools, etc. from the Pervasive Technology Development Program to the JSF program.



Pervasive Program Management

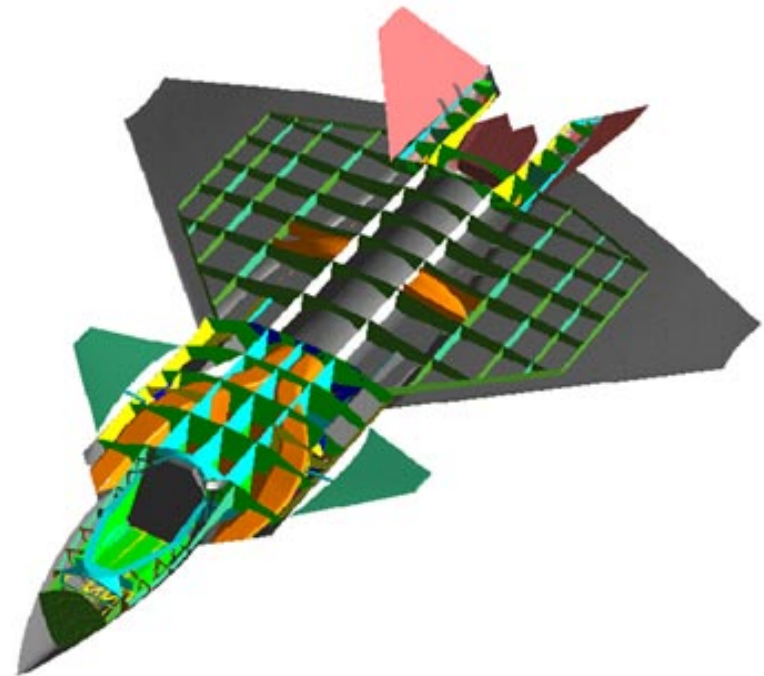




Configuration A

Moderate Risk (50% Cost Reduction)

- Conventional assembly breaks (multi-sectional fuselage with one-piece wing)
- Minimize substructure & reduce fasteners
- Process Technologies: Integral to design and assembly features
 - VARTM
 - RTM
 - Stitching
 - Z-pinning
 - Co-cure

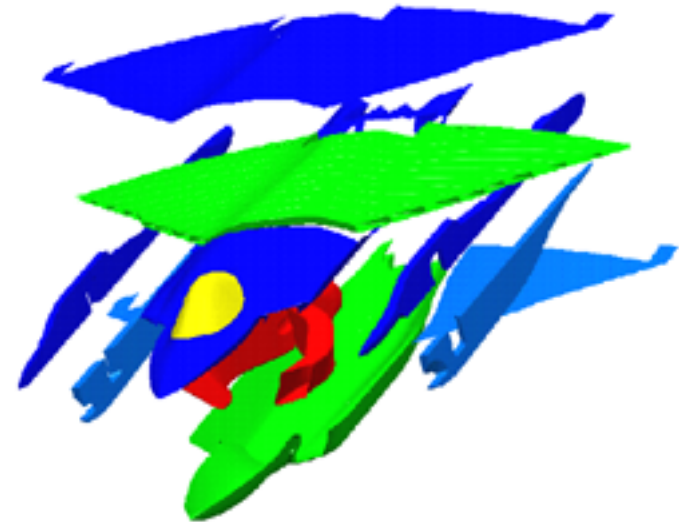




Configuration B

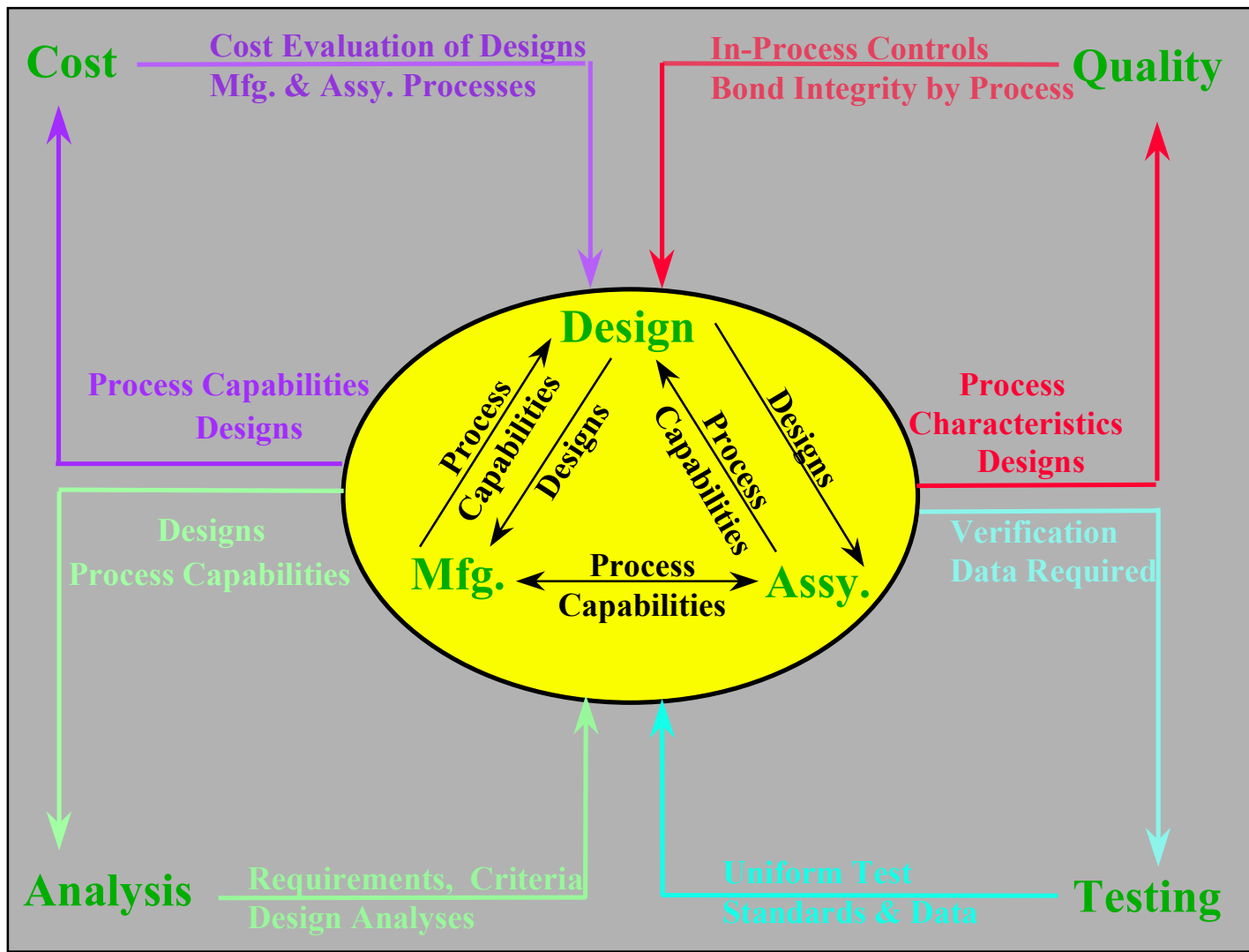
High Risk (>50% Cost Reduction)

- Unitized fuselage assembly w/one-piece lower skin
- Fwd fuselage subassembly mates with one-piece keel beams around one-piece duct)
- Tubular spar CT-wing with integral attach fitting
- Process Technologies: Integral to design and assembly features
 - VARTM
 - RTM
 - Advanced Fiber Placement
 - E-Beam





Pervasive Integration



Demo

- Affordable Design
- Affordable Mfg
- Affordable Assy.
- Requirements Stated
- Criteria Substantiated
- Test Data
- Analysis Tools
- Cost Tool
- In-Process Controls
- Bond Integrity

High Risk / High Payoff Mfg. and Assy. technologies and supporting data

Long-Range



Phase II Technology Transition

Transition Affordable Composites Technology to the JSF Program

Tech Transition
T1 & T2

- Focus on proprietary PWSC designs(Boeing-T1, Lockheed Martin-T2)
- Fast paced, focused maturation of enabling technologies not in the baseline JSF PWSC design
- Identify Pervasive technology development priorities
- Leverage Pervasive development results
- Adaptation to JSF specific material requirements
- Mature and demonstrate high risk / high pay-off technologies
- Cost benefit / risk reduction analysis and technology on ramps for E&MD
- Validated technologies integrated into JSF E&MD
- Supports integration into PWSC-E&MD proposals



Technology Transition Team 1 Summary

- **Two Process Development Programs (Approx. 32 mo.)**
- **Emphasis is unitized affordable and light weight composites structures**
- **Development Programs are competing to the JSF requirements and Baseline (cost, weight and performance)**
- **New Processes must earn their way onto the Air Vehicle**
- **Will down select for large scale development and test in mid 2000**
- **Current plan will support integration into the PWSC EMD proposal**





JSF Affordable Composites Technology Transition Program (JACTT)



Critical Technologies Addressed

- **Advanced Structural Concepts**
 - Affordable Design
 - Unitized Structure
- **Low-Cost Manufacturing**
 - Composites Processing
 - Tooling & Assembly

Affordability Leverage Goals

- Reduction In Airframe URF
- Airframe Weight Reduction
- Reduction in Parts & Fastener Counts

Overall Objective

Mature & Demonstrate High-Risk / High Pay-Off Composite Technologies & Designs on a Parallel Path for JSF E&MD

Technical Approach

- Focus on LM Proprietary PWSC Design
- Fast Paced & Focused Maturation of Enabling Technologies and Airframe Designs
- Conduct Demonstration Using Affordable Processes, Practices, & Concepts
- Measurement of Cost & Risk Reduction
- Timely Development for Integration into the JSF PWSC Airframe Prior To E&MD

Key Products

- Reduced Cost & Weight PWSC Airframe Concept
- Validated Low Cost Composites Technologies
- Timely Risk Mitigation for JSF E&MD



Funding

		<u>FY98</u>	<u>FY99</u>	<u>FY00</u>
PERVASIVE	Govt.	9.3	8.5	9.0
	Industry	9.3	8.5	9.0
TECH TRANS T1	Govt.	3.0	3.0	3.0
	Industry	3.0	3.0	3.0
TECH TRANS T2	Govt.	3.0	3.0	3.0
	Industry	3.0	3.0	3.0
TOTAL		<hr/> 30.6	<hr/> 31.0	<hr/> 32.0



Phases III & IV Philosophy

Continue to develop affordable technologies for stringent aircraft requirements and build-off these technologies to meet the multifunctional requirements of other types of systems (marine, space & land).

Phase III

Tech Transition

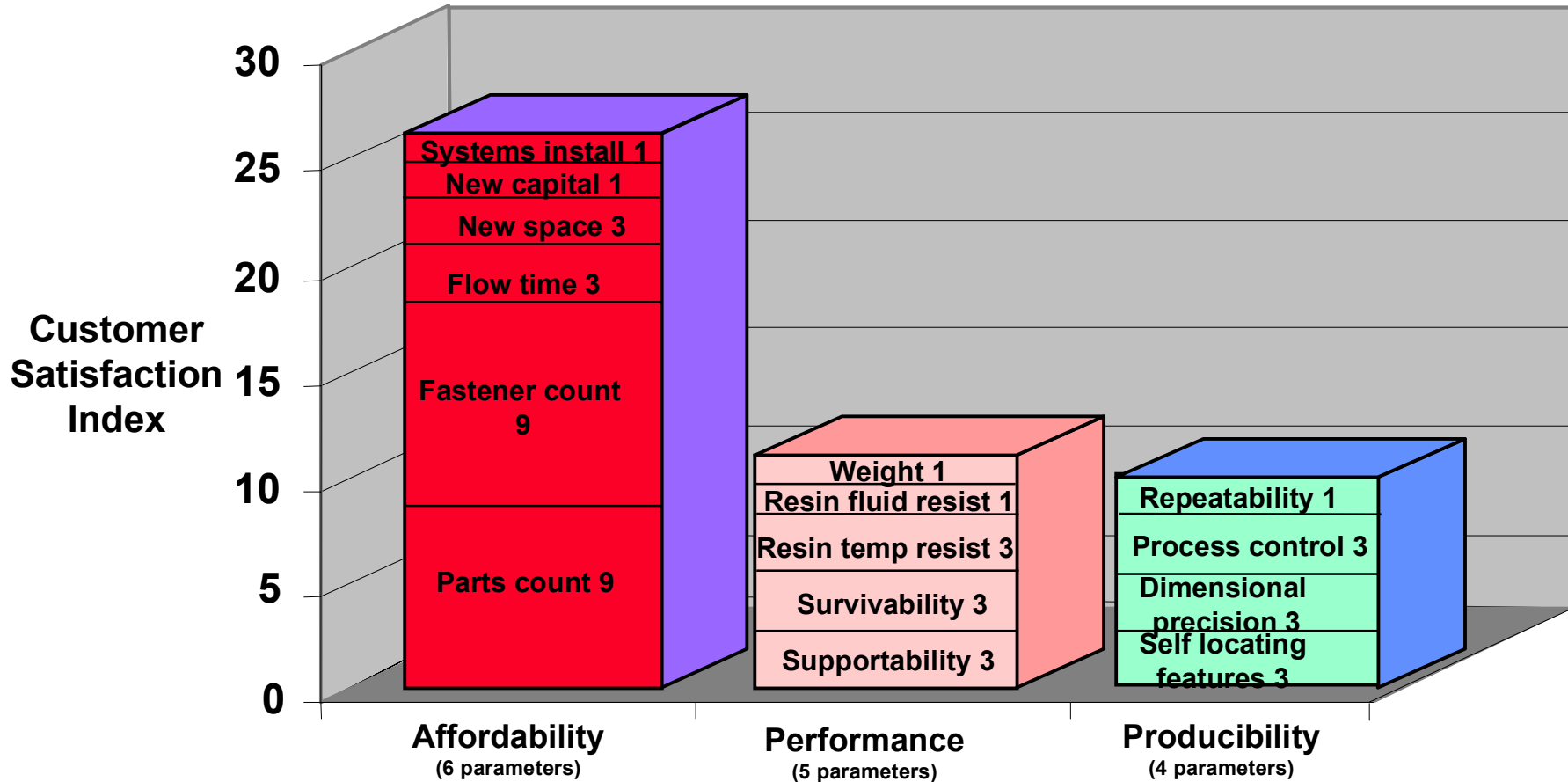
Phase IV

Tech Transition

- Build off of the Phase II technology base
 - Extend the development of affordable designs
 - Extend the development of tools
 - Extend the development of processes
- Mature high risk technologies
- Expand applications requirements envelope for affordable structures
- Phase III - reduce the cost 75% from the Phase II baseline
- Phase IV - reduce the cost 90% from the Phase II baseline
- Total cost reduction - An Order of Magnitude -
- Transition to customers



CAIM etrics

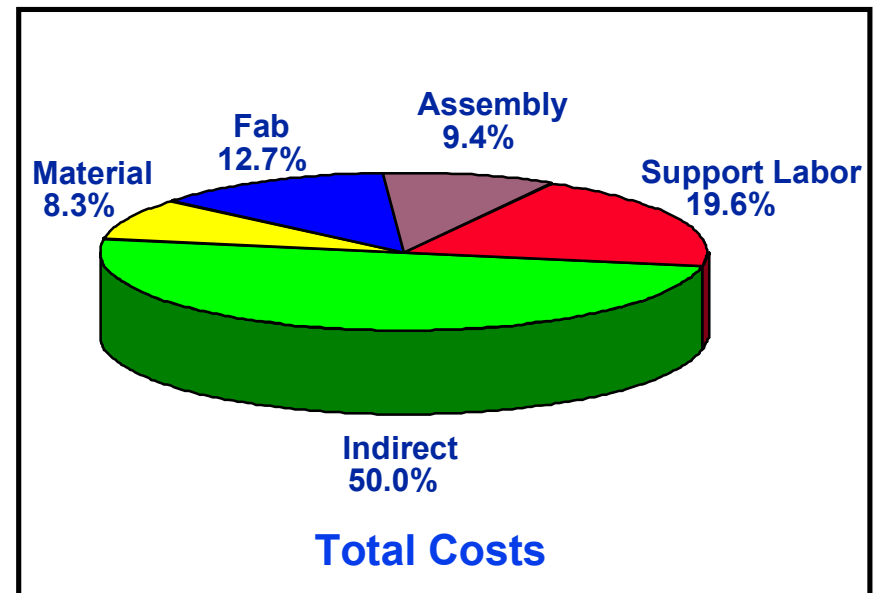
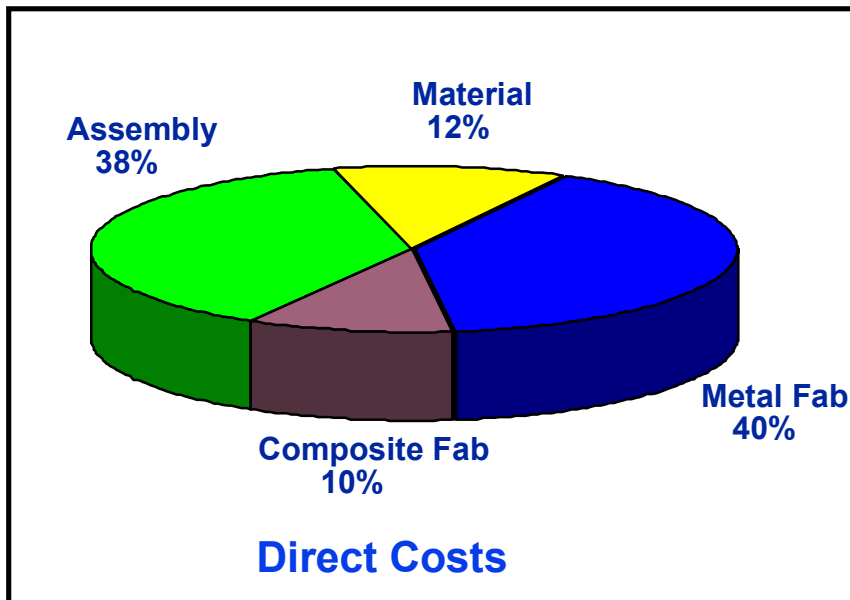


Metrics are used for trade studies, milestones, and down selects in the form of a modified QFD (Quarterly Function Deployment)



CAI Cost Baseline

\$ 9.69 Million Constant FY94 \$



Baseline: CAI leveraged data from Lockheed Martin Configuration 140, F/A 18 E/F, and F-22 programs. Weight and parts spread sheets are complete. Cost Analysis uses today's manufacturing processes.



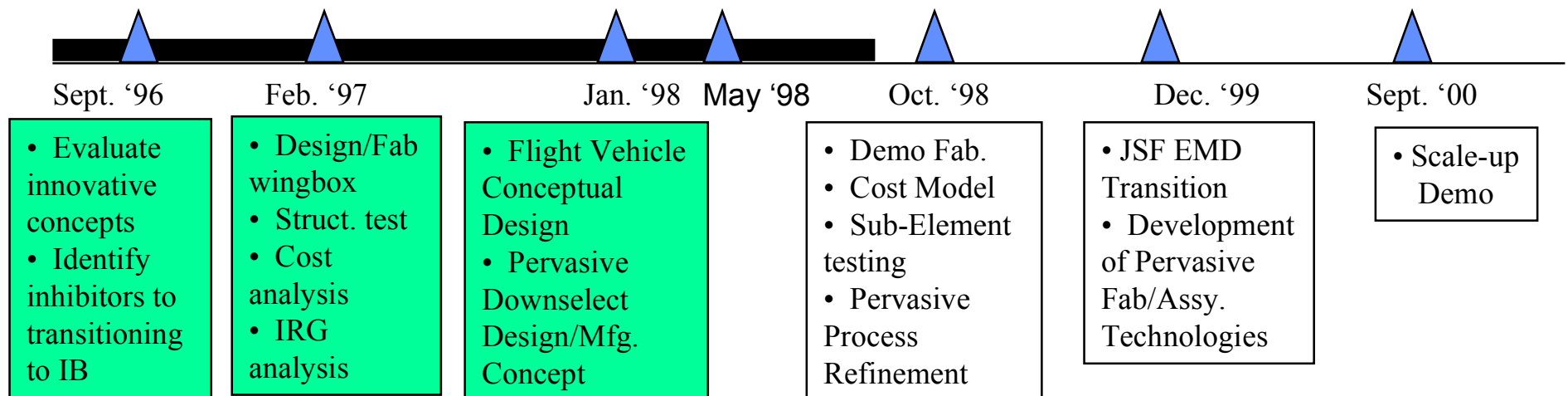
DTO MP 34: Composites Affordability Initiative - Aircraft

Project Goal:

Reduce the acquisition costs of a fighter airframe structure by 50%

DTO Objective:

This DTO will develop and integrate the tools, methodologies and technologies necessary to design and manufacture a composite airframe utilizing revolutionary design and manufacturing practices.





What's Being Delivered

- Revolutionary composite structural designs
- Innovative design for manufacture and assembly philosophy and methodologies
- A change in the corporate culture (paradigm shift) for designing, manufacturing and assembling composite structures
- Structural analysis tools to analyze revolutionary structural designs
- Costing methods and models which take into account these changes in design, production, maintenance and corporate culture.
- Matured affordable manufacturing / assembly practices tailored to revolutionary designs.
- Verification data through structural and performance testing of coupons, subcomponents and full scale test articles



Customer Commitment to Transition

- DoD / Industry are the customer and JSF the first outlet
- JSF, Air Force, Army and Navy participate on the Executive Council, LIPT and AIPs
- Industry 50/50 resource sharing for Technology Transition and Pervasive technology developments (total: \$95M MT, S&T, and industry funding through FY00)
- The JSF weapon system contractors are committed to implementing validated technologies into the EMD proposals
- Funding Strategy in Place