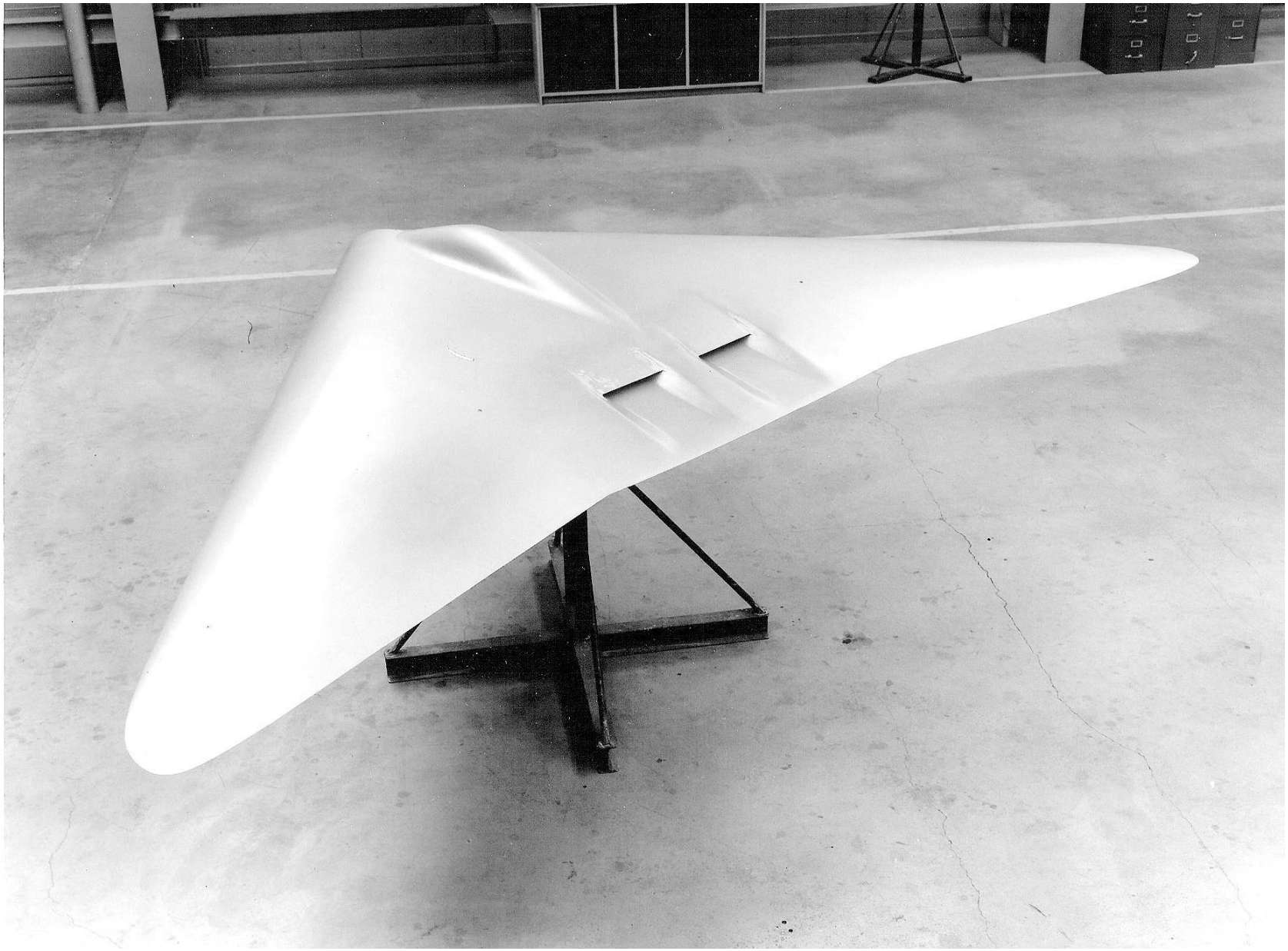
Early A-12 History

- GD Missed Early Stealth Competition
  - Solicitation delivered to wrong location!
- Initial Studies – Mid-late 1970's early 80's
  - Air-to-Surface (ATS) Technology Integration and Evaluation – AFFDL Sponsor
    - "Sneaky Pete", "Plain Jane", "Short Snort"
- 1995 Fighter Technology
  - Air-to-Air Emphasis
- Internal Air Force Controversy



Navy Interest

- Navy became interested in A-6 replacement in early to mid 1980's
- SecNav John Lehman directed formation of two competing teams
  - **Northrop plus Grumman**
  - **GD plus McAir**
- Sold as stealthy "Baby B-2"
  - Technology ***already in hand*** made fixed-price development feasible

The A-12 Avenger - Topics

- *Aircraft Description*
- *Development History*
- *High-Leverage Design Features*
- *Configuration Rationale*
- *Program Cancellation and Aftermath*

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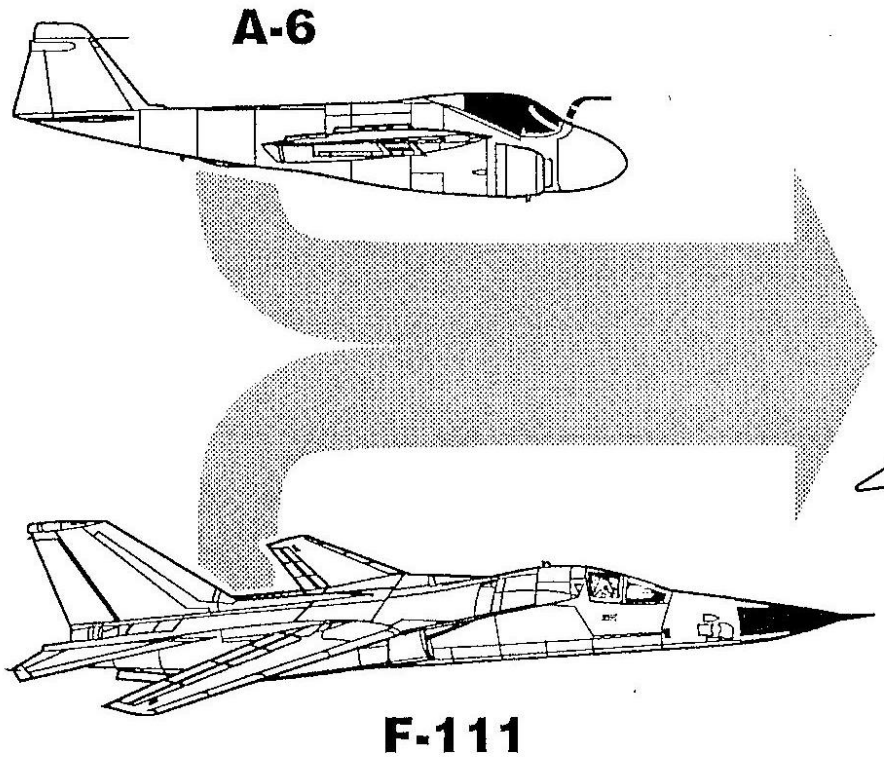
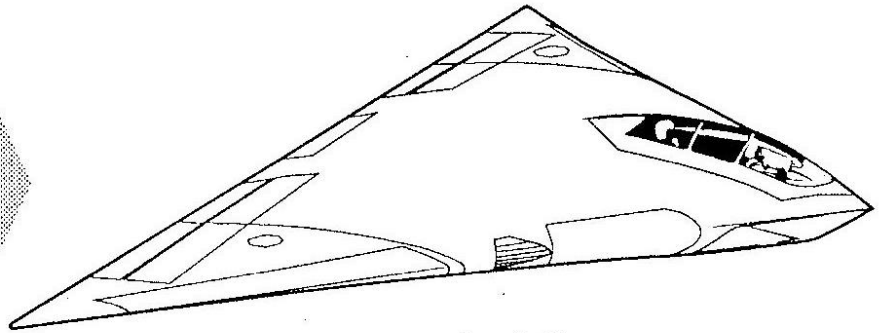
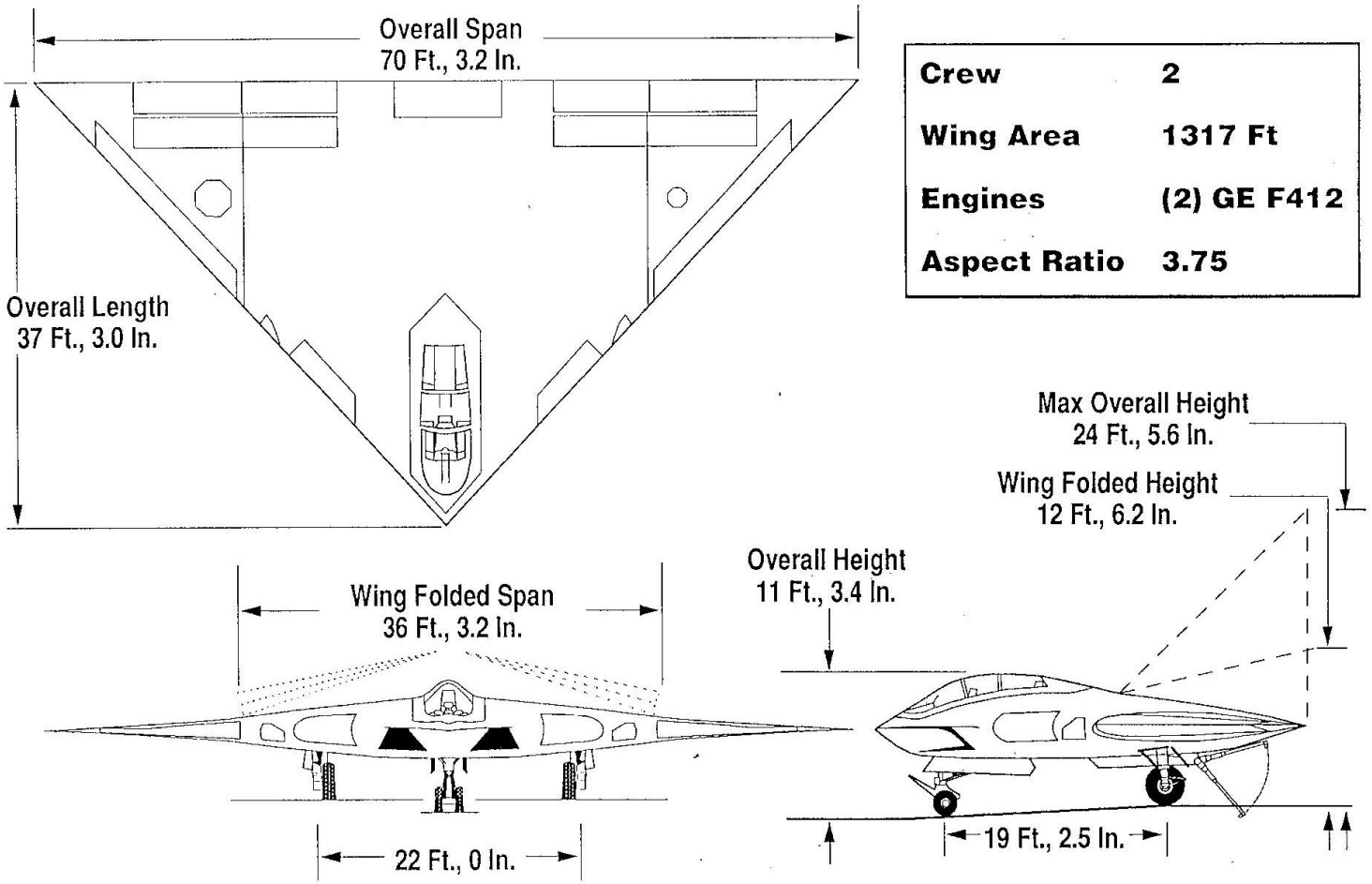
The A-12 Was to Replace the A-6 and F-111





A-12

A-12 Three-View



Crew	**2**
Wing Area	**1317 Ft**
Engines	**(2) GE F412**
Aspect Ratio	**3.75**

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Aircraft Survivability - the Problem in the Mid 1970's

- ***Threat Missiles were Improving***
  - Shorter Time Constants
  - Turn Capability > 3 Times Pilot Tolerance
  - Monopulse Seekers - Less Vulnerable to ECM
  - Speeds to Mach 3+
  - Effective at All Aspects

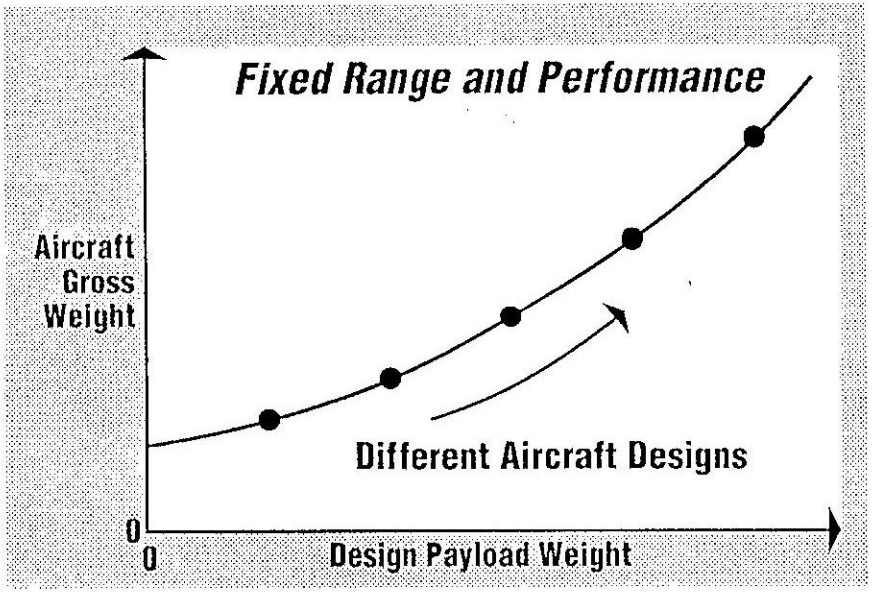
- ***Threat Aircraft were Improving***
  - Look-Down/Shoot Down Capability
  - High Maneuverability
  - Speeds to Thermal/Dynamic-Pressure Limits

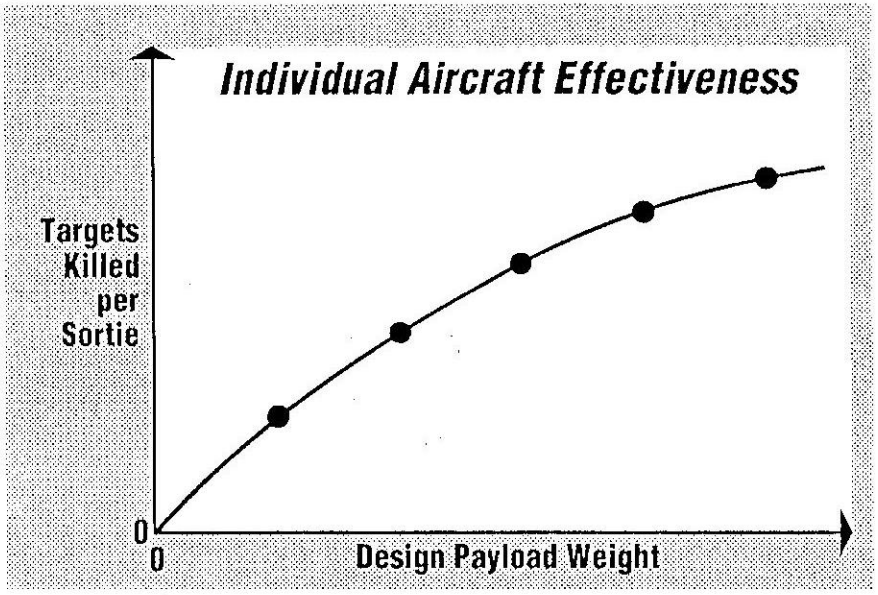
- ***Cost-Effectiveness of Further "Classical" Performance Improvements was Questionable***
  - Speed
  - Maneuverability
  - Very High or Very Low Altitude

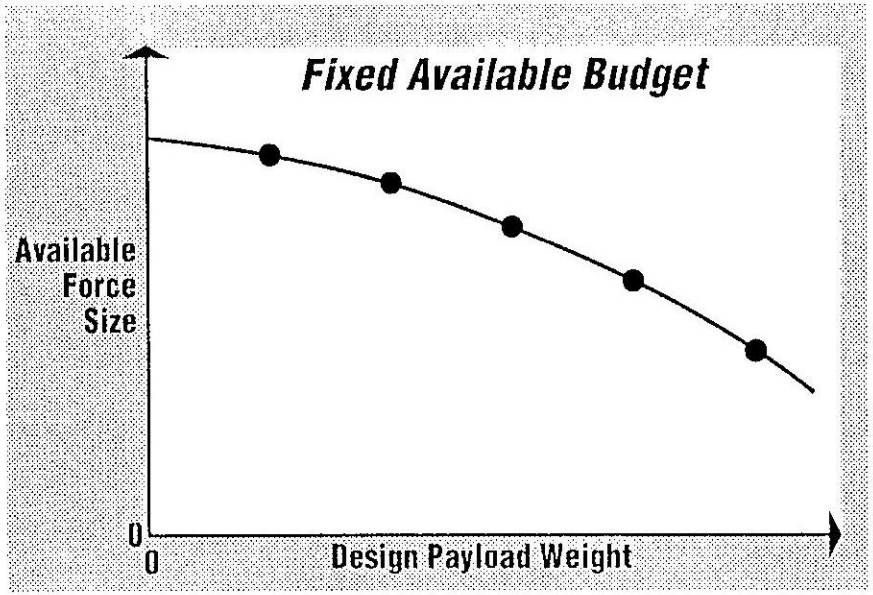
Cost Growth

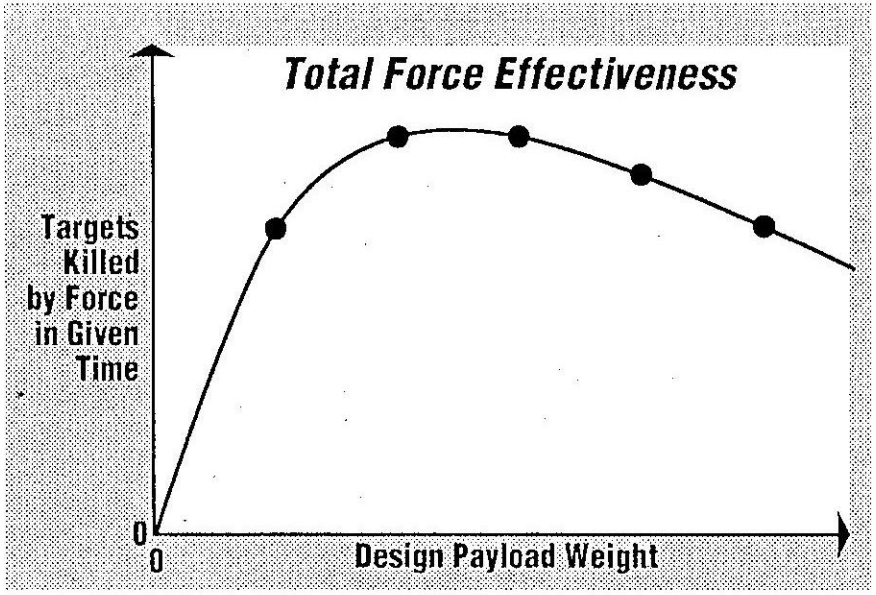
- ***Historical Trend for Military Aircraft Has Been to Strive for Maximum Performance***
- ***"Technology Explosion" has Meant That More Performance Can Now be Designed-In than Afforded***
- ***The New Problem - What Do You <u>Leave Out?</u>***
  - And How Much of Each Type of Performance Do You Buy?

Cost-Constrained Aircraft Requirements Analysis









DESIGN FOR
SURVIVABILITY

Enthusiasm for Low Observables

ENTHUSIASM LEVEL

- ***Discovery that RCS Reductions Could Defeat Many Enemy Radars*** — **High**

REACTIVE THREAT STUDIES

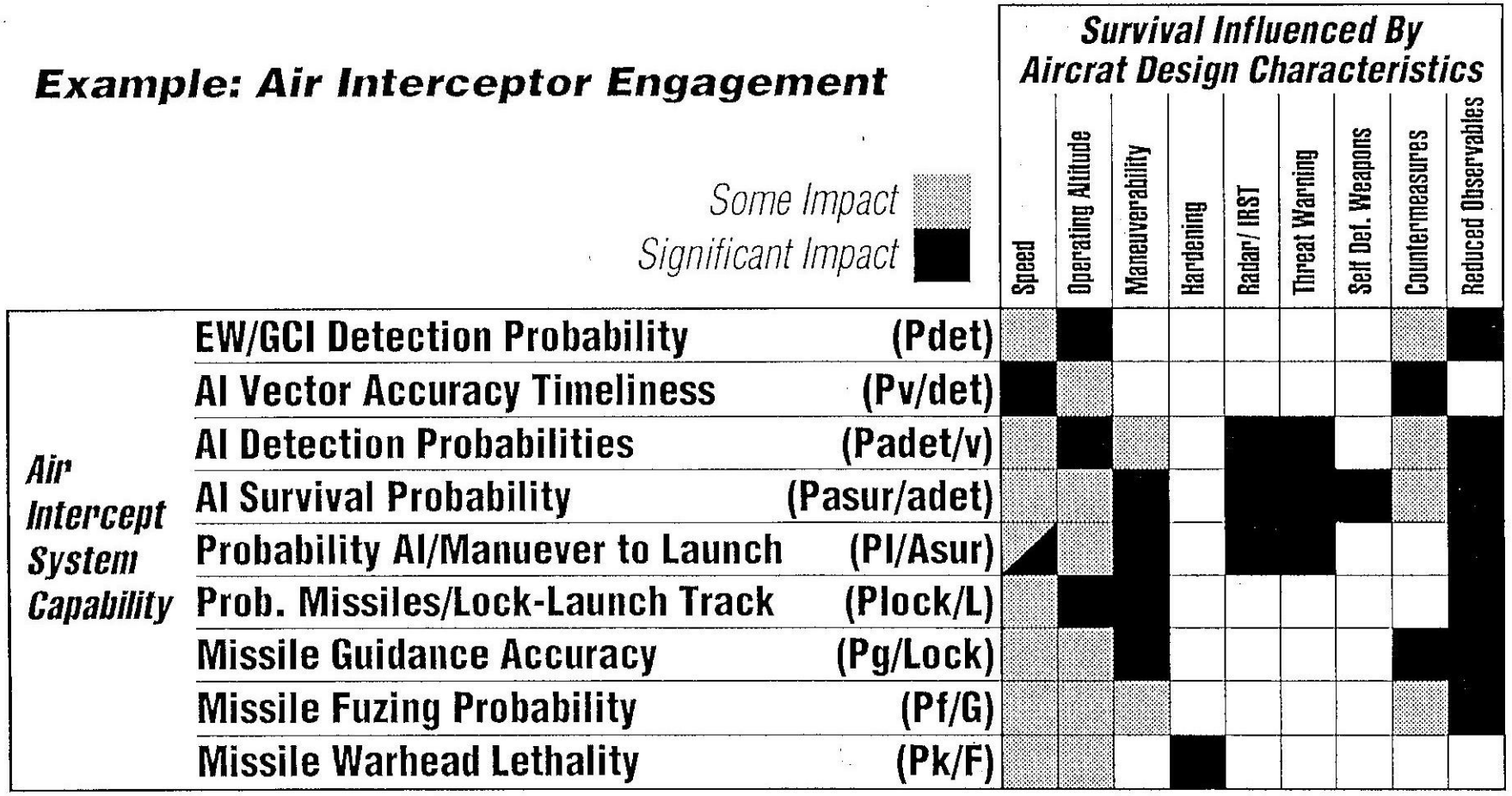
- ***Discovery that Aircraft Could Always be Detected, Given Threat Developments*** — **Low**

MORE IN-DEPTH TRADES

- ***Discovery that Low-Observables has Many Favorable Interactions with Other Variables*** — **High**
  - Design
  - Tactics

Survival is Influenced by a Chain of Events

Example: Air Interceptor Engagement



Overall Loss Probability is Multiplicative:

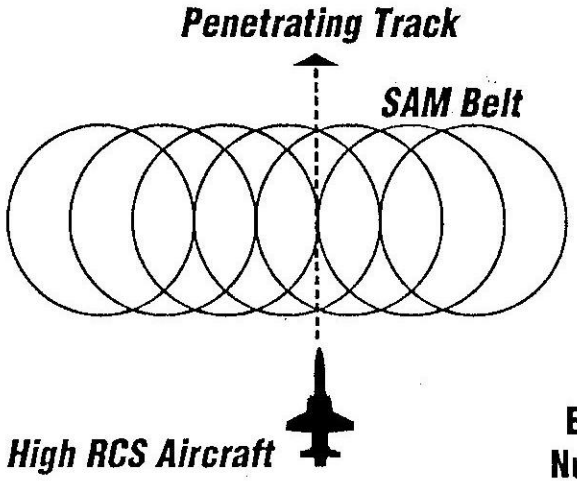
$$P_L \sim P_{det} \times P_{v/det} \times P_{a\ det/V} \times \ldots \times P_{K/f}$$

Large Improvements from Either:

- A Break in the Chain
- Degradation of Several Links

DESIGN FOR
SURVIVABILITY

Penetrating a SAM Belt - Random Flight Path



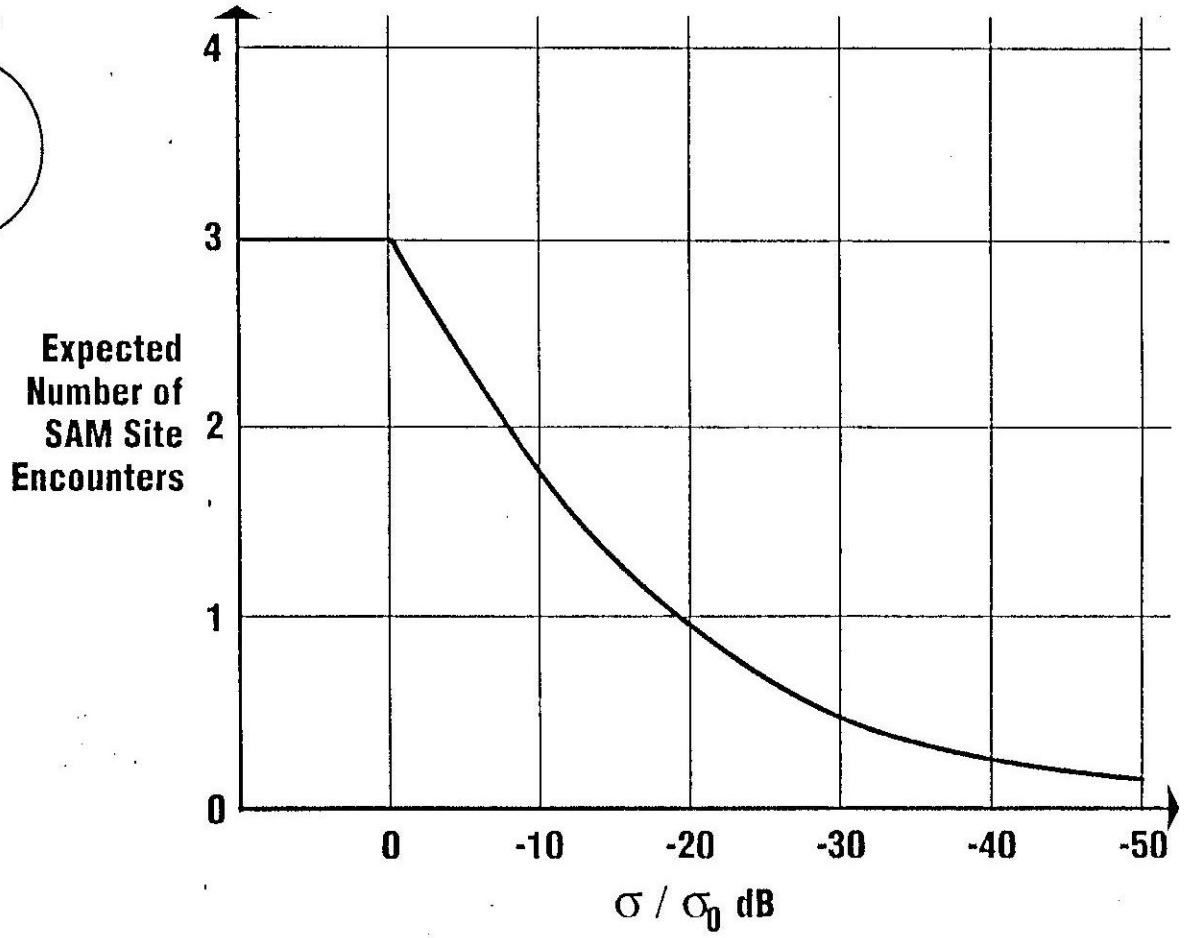
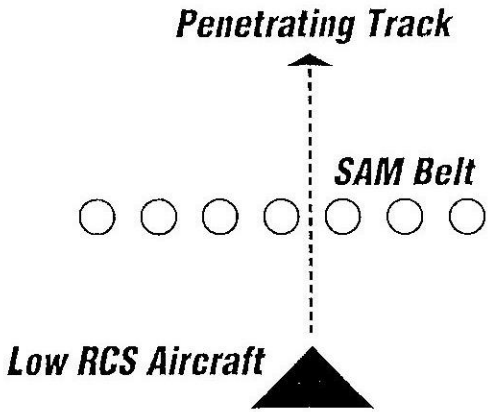
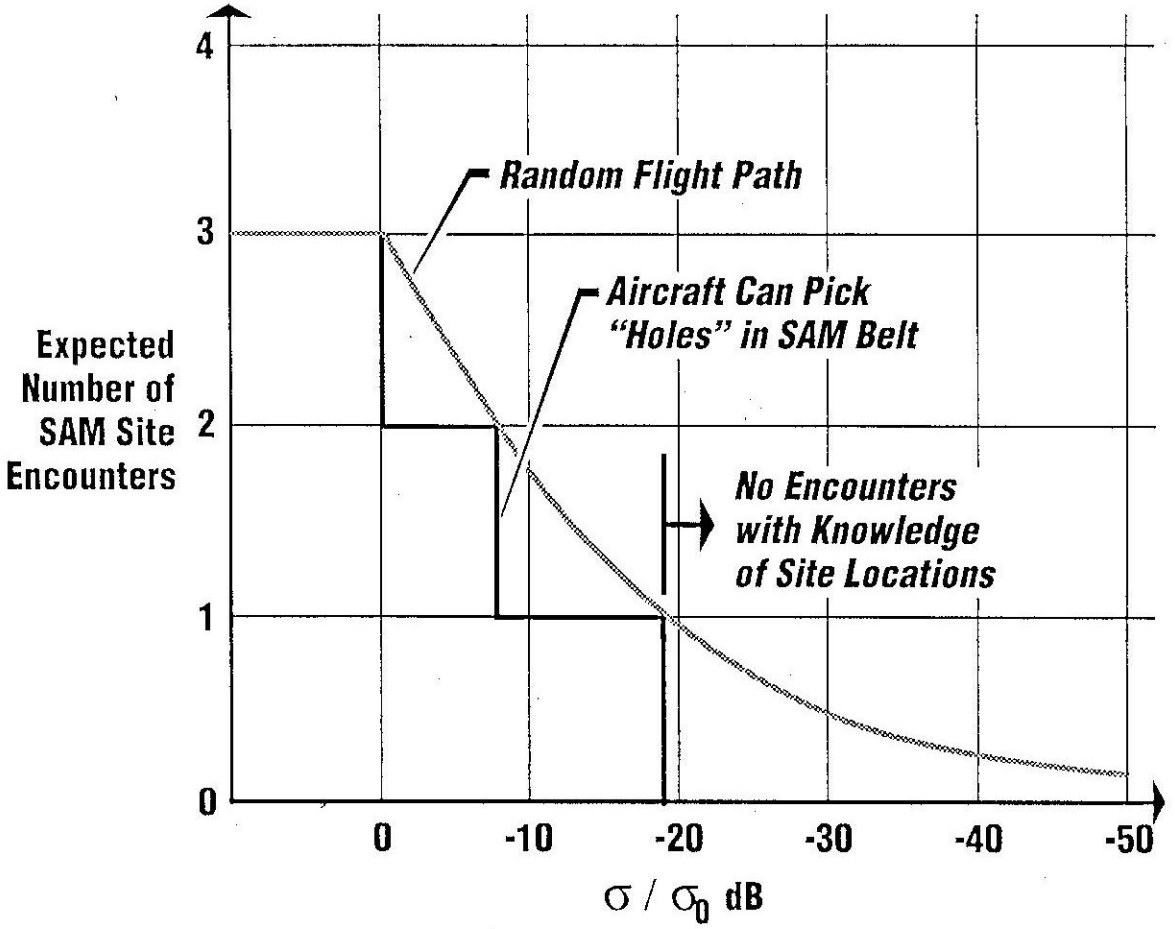


FIGURE 5

Penetrating a SAM Belt - Site Locations Known





Low Observables

- ***A Powerful Contributor to Survivability***
  - Impacts Many Phases of an Engagement
- ***But Long-Term Robustness Comes Only in Combination with Other Design Features***
  - Sensors
  - Weapons
  - Countermeasures
  - Vulnerability Reduction
  - Compatible Levels of Speed and Maneuverability

DESIGN FOR
SURVIVABILITY

Situation Awareness

- ***Enhances Value of Low Observability***
  - And Crucial in Its Own Right
- ***Multi-Spectral Sensors***
  - Broad-Band RF Threat-Warning/Surveillance/Track
  - Infrared Search-While-Track Set
  - Infra Red Missile Warning
  - Large Field-of-Regard Low-Probability-of Intercept Radar
  - All-Around-View Canopy
- ***Full-Color Tactical Situation Displays***
  - Sensor Fusion
  - Two-Man Crew

Speed

- ***"Speed is Life"***
  - Everything Else Equal, More Speed is Always Better for Survivability

- ***But for Supersonic Capability, Everything Else Cannot be Equal***
  - IR Signature Increases
  - Low RCS Shaping More Difficult and Expensive
  - Internal Volume More Costly
  - Target Acquisition More Difficult
  - Employment Frequently Constrained by Fuel Considerations

- ***High Subsonic Top Speed Best Compromise***
  - Air-to-Surface Mission Optimization

DESIGN FOR SURVIVABILITY

Infrared Signature and Afterburner

- ***Infrared Signature***
  - IR Missiles Have Caused Majority of Aircraft Combat Losses in Past Decade
  - Optimized Blend of Reduced IR Signatures and Countermeasures Best Solution
- ***Afterburner***
  - Adding an Afterburner Predicted to Degrade Combat Survivability
    - *High All-Aspect IR (and Night Optical) Signature When in Use*
    - *Increases RCS and IR Even when Not in Use*
- ***Maneuverability Should be Optimized in Dry Power***

Rounding Out the Suite

- ***Hardening***
  - Subsystem Separation
  - Structural Design
  - Fuel Inerting
  - Fire Suppression

  Live Fire Tests Early in Development

- ***Weapons***
  - Standoff From Intense Point Defenses
  - HARM

Lethality

- ***Lethality Derived From***
  - Good Intelligence
  - Accurate Navigation
  - Appropriate Target Acquisition Sensors - FLIR/Multi-Mode Radar
  - Accurate Weapon Delivery System and/or Accurate Weapons

- ***Large Payload Remains Important***
  - Multiple Kills per Sortie

- ***Internal Payload Best***
  - Rapid Suppression of Defenses
  - Supplemented by External Stores as Threats are Beat Down

Also Vital

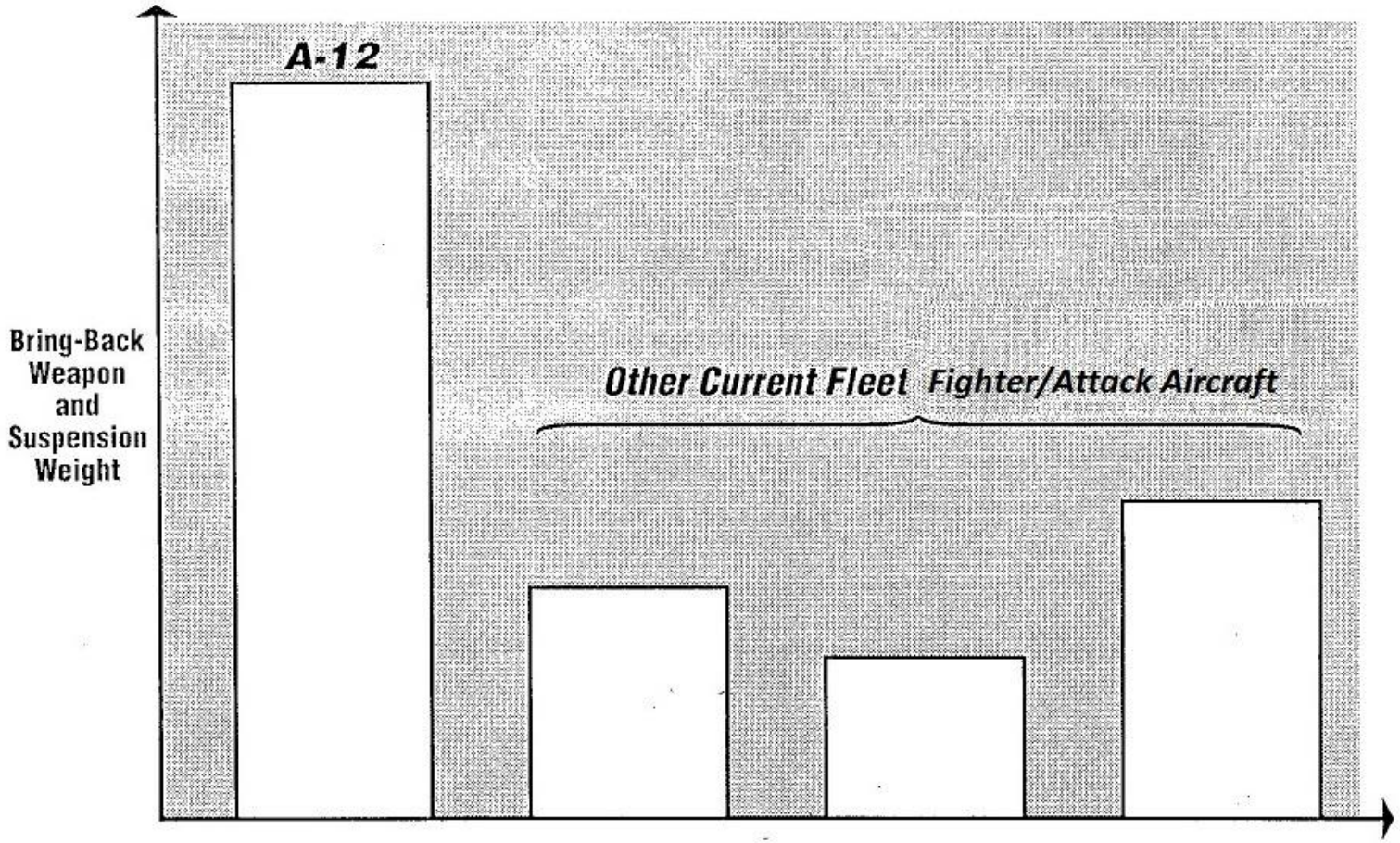
- ***Range - Frequently Under-Rated in Performance***
  - "Zone of Influence" ~ R^2
  - Tactical Flexibility
  - Reduced Tanker Burden
  - Convertable to Combat Speed or Endurance
  - Reduced Fleet Vulnerability

- ***Reliability and Maintainability***
  - Higher Sortie Rate
  - Lower Logistics Burden

- ***Growth and Versatility***
  - Large Internal Volume
  - Range and Endurance
  - Avionics and Control/Display Architecture
  - Power and Cooling Growth
  - Frontal-Looking Sensor "Real Estate"

Bring Back Payload

- ***Limited By***
  - Recovery Wind Over Deck
  - Aircraft Structural Capability
- ***Weight Based on Status at Termination***
  - Operational Fuel Reserves



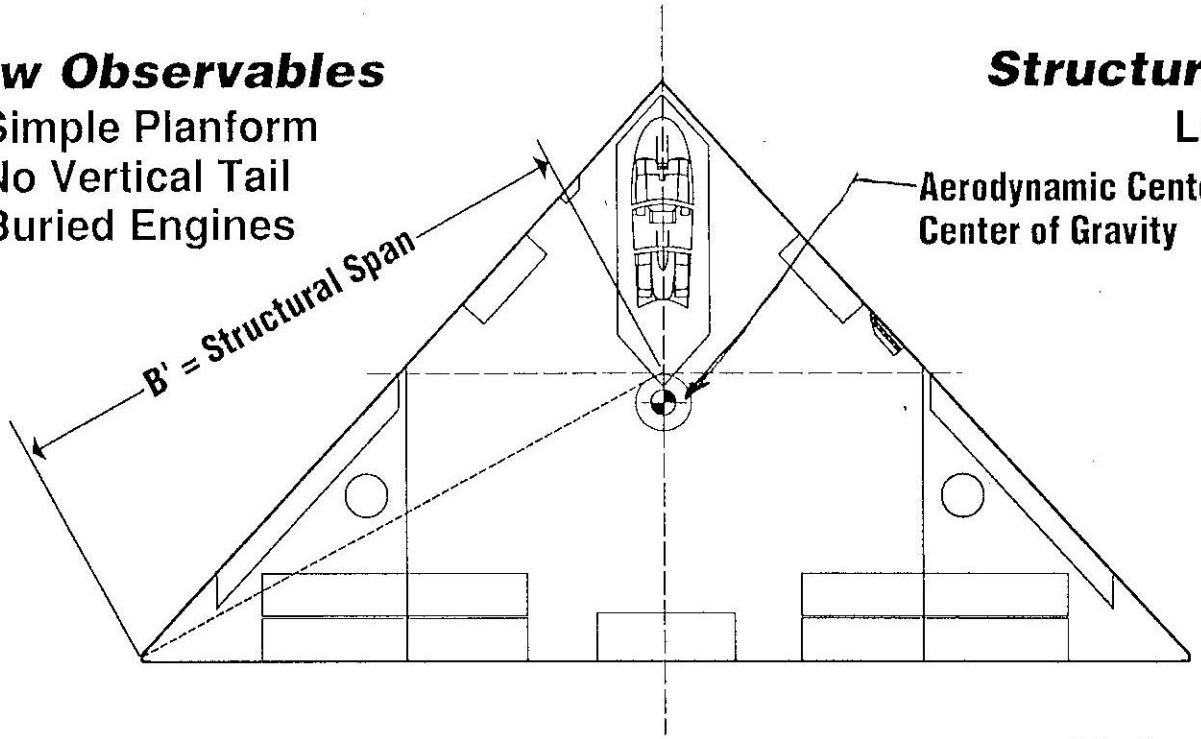
Configuration Rationale

Low Observables

- Simple Planform
- No Vertical Tail
- Buried Engines

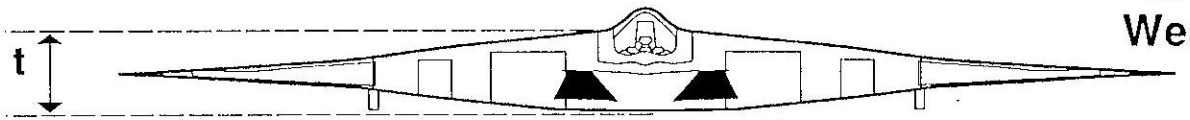
Structural Efficiency

Low B'/t

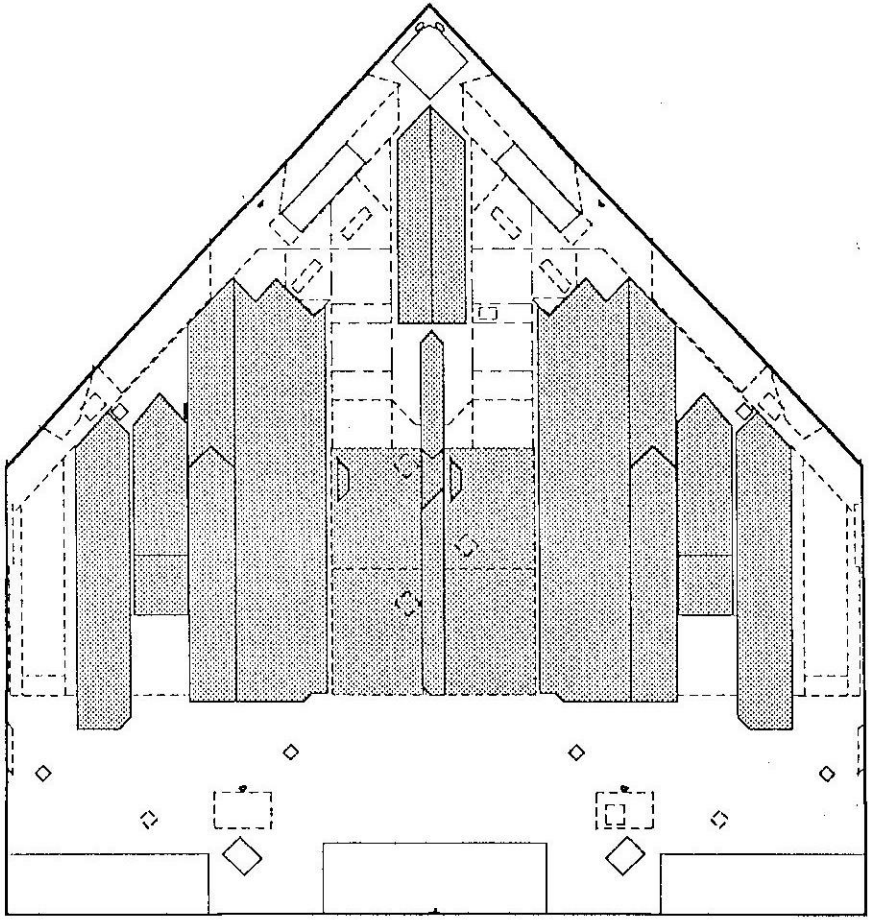


Volumetric Efficiency

- High $\left(\frac{V}{S_{WET}}\right)$
- Large Internal Weapon & Fuel Volume

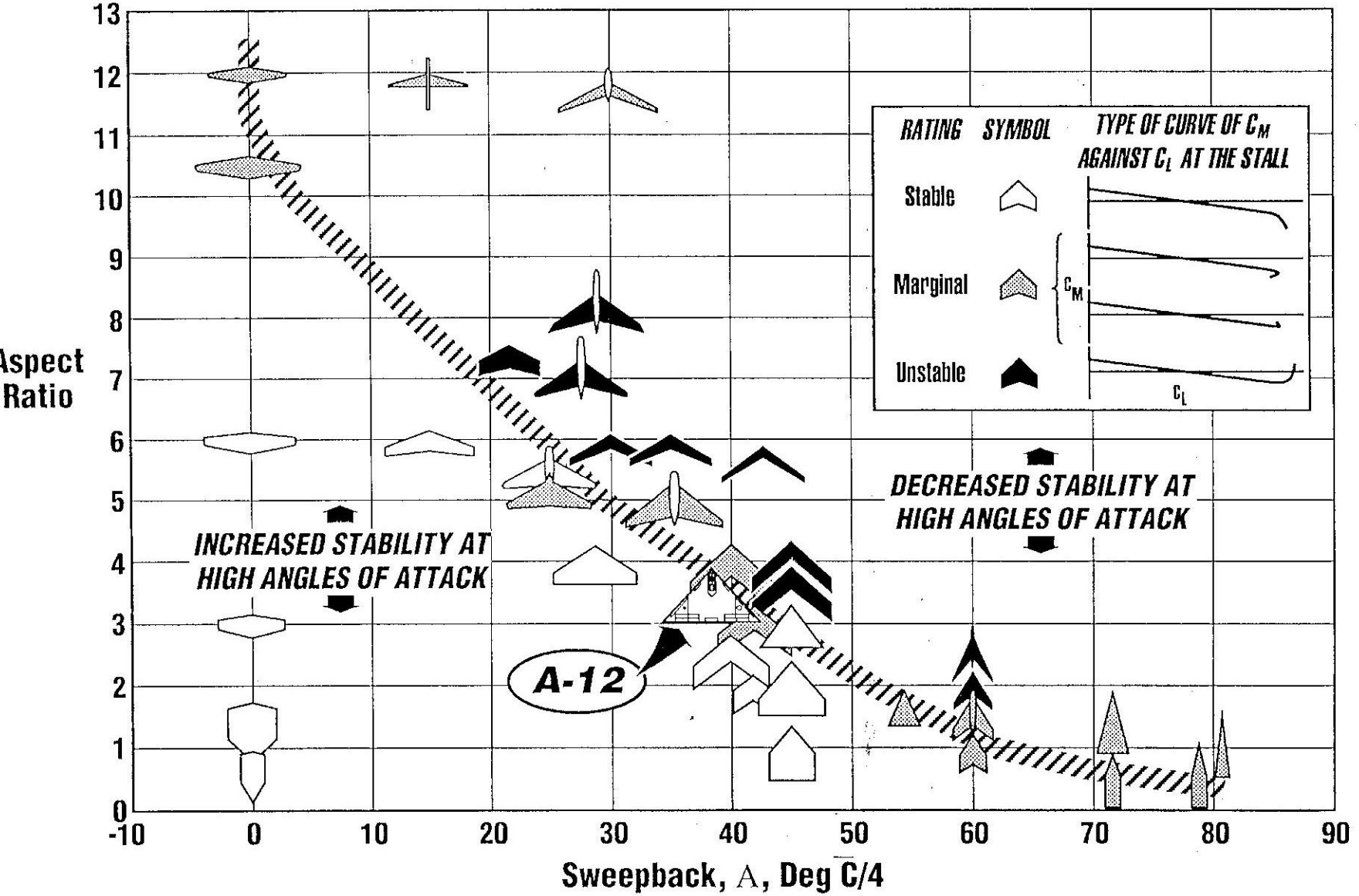


Excellent Packaging Efficiency



- ***Arrangement Yields Little Wasted Space***

Planform Constraints for Fighter-Like Handling Qualities



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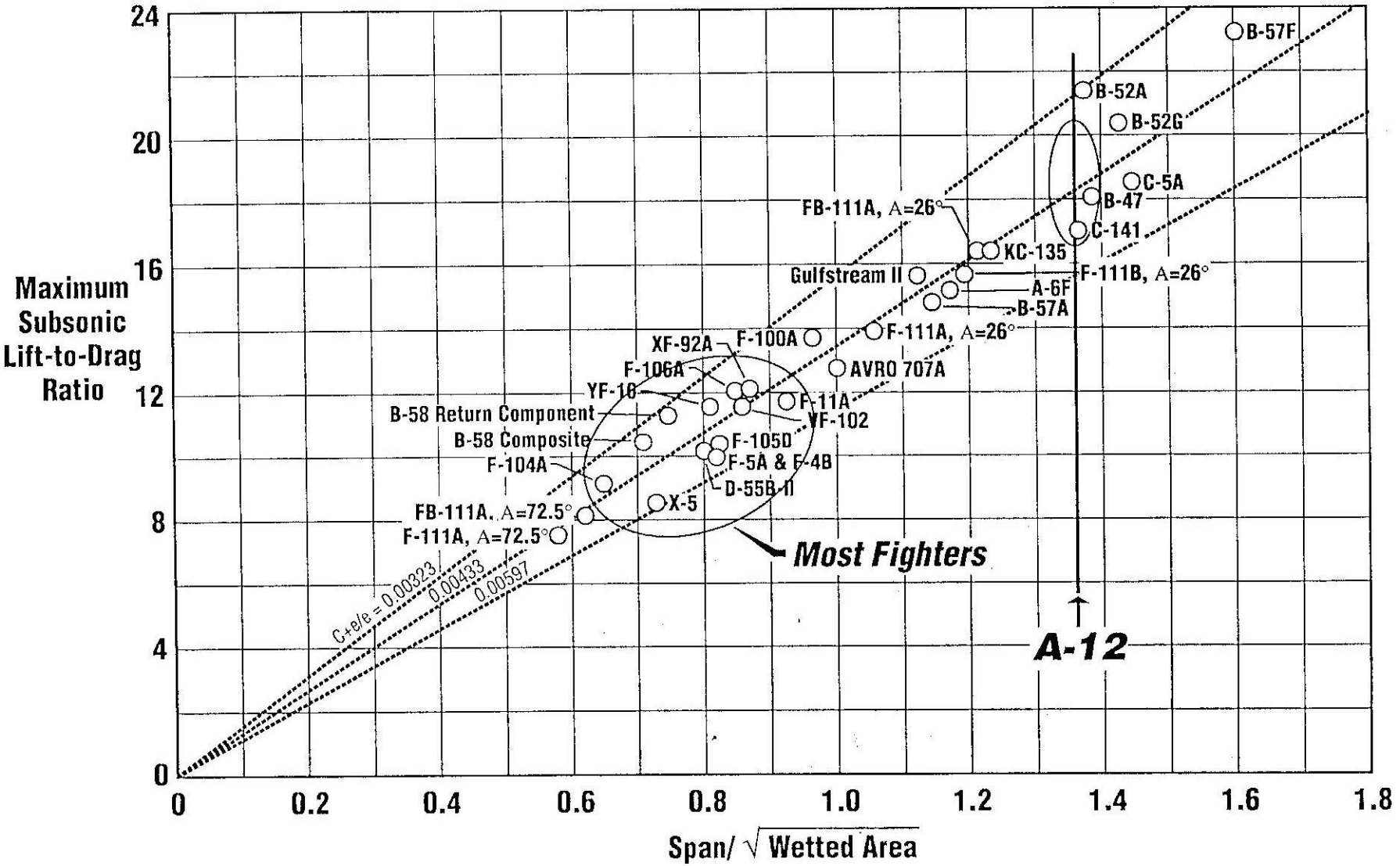
High Aerodynamic Efficiency



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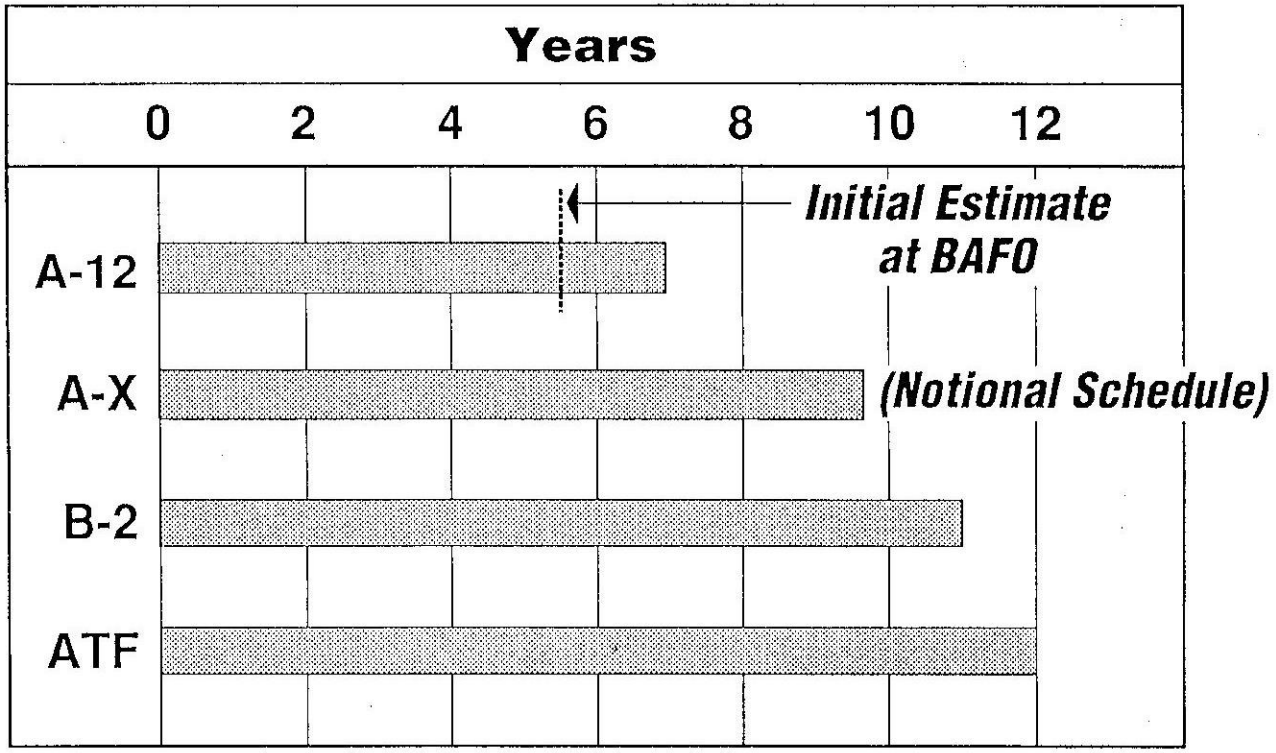
Termination and Legal Aftermath

- Weight Growth – Composite Fabrication challenges led to schedule slippage
  - **Development Cost Growth**
- Collapse of Communism led to Defense budget cuts
  - **Altered Contractor Financial prospects and ability to absorb losses**
- Program terminated by SecDef Cheney Jan 7, 1991 – though Navy still wanted it
- Legal fight from 1991 through 2014
  - **Settled only after Supreme Court Push**

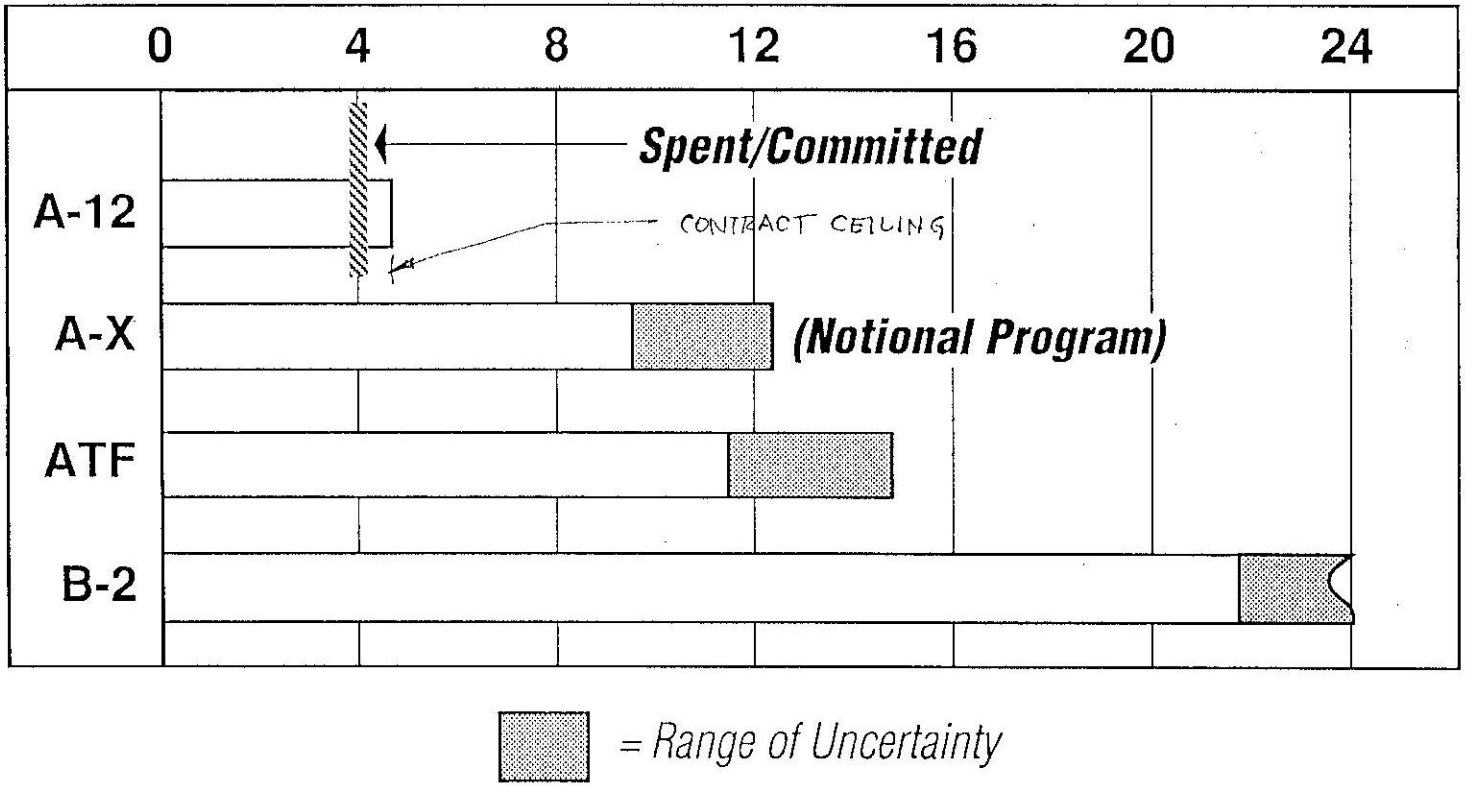
Time from Start of Concept Exploration to First Flight

- ***Production Aircraft***



Development Costs

Billions of Dollars

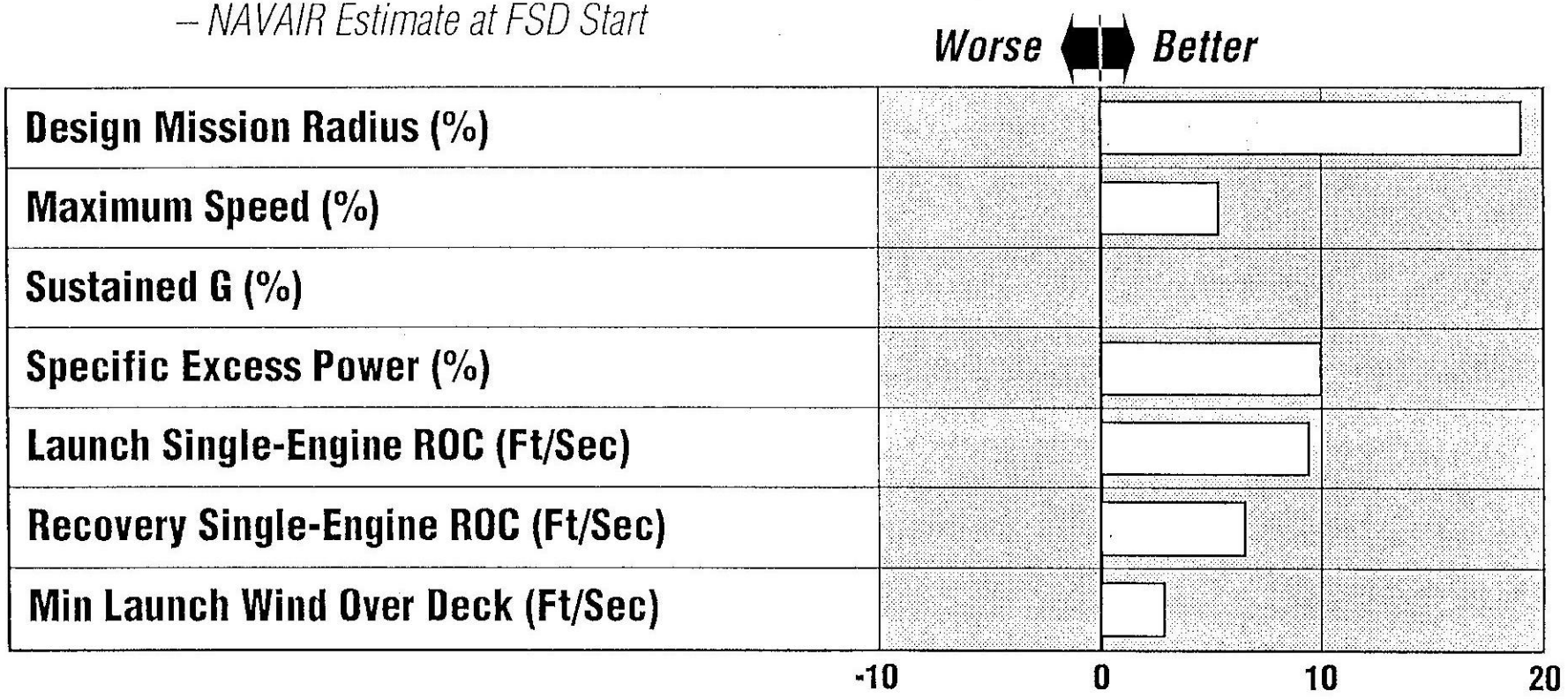


Technical Status at Termination

- ***Successfully Passed Critical Design Review (Nov 1990)***
- ***Relatively Mature Design***
  - 99.2% Drawing Release for Aircraft 1
  - 87.8% Production Tools Complete or Available
  - ~50% Part Complete A/C 1 and 2
  - A/C 1 Software Complete and in Test
  - 8 Engines Running
  - Most Major Subsystems in Test
- ***Weight Growth (Production Configuration)***
  - Less than 6,000 lbs at Termination
  - Navy Evaluation that Performance Acceptable with Additional 2,000 lbs Growth

Aircraft Performance at Termination

- ***Compared to Least of:***
  - *FSD Specification Value*
  - *NAVAIR Estimate at FSD Start*
- ***Weight Status = Value at Termination***



Weight Increase Compensated By:

- Initial Conservatism
- Design Improvements in Other Areas

DCP RELATED PERFORMANCE STATUS (U)

[redacted]

UNCLASSIFIED

PARAMETER	CNO (OP-05) Approved DCP Revision	CURRENT ESTIMATES		
		NAVAIR		CONTRACTOR
SEROC	200 FPM	380 FPM	=/+	400 FPM
SUSTAINED G	5.0	5.5	+	5.6
LAUNCH WOD	0 KTS	0 KTS	+	-5 KTS
ARREST WOD	24 KTS	22 KTS	+	23 KTS
SPECIFIC RNG	0.100	0.102	+	0.103
CRS CEILING	40.0K	43.1K	+	43.0K
V(max)	540 KTS*	568 KTS	+	568 KTS
P(s)	180 FPS*	180 FPS	=/-	178 FPS
STK RAD	785 NM	839 NM	+	839 NM

+ BETTER THAN DCP THRESHOLD
= EQUALS DCP THRESHOLD
- WORSE THAN DCP THRESHOLD

* NO CHANGE - STATUS ONLY

JOE-40.18
1 Jan 91

Some Thoughts on Looking Back

- The A-12 had many desirable qualities that would be valuable today
- Stealth
  - Large Payload (10 1,000 lb JDAMs Internal)
  - Long Range and endurance
  - Strategic Mobility
- The Biggest Problem – A Fixed-Price Development Contract
- The only winners were the Lawyers