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**Resolving America's Defense
Strategy-Resource Mismatch:
The Case for Cost-Per-Effect Analysis**

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The “Impossible” Challenge

- Demand for aerospace power is increasing, but resources will likely decrease
 - Combination of peer adversaries, mid-tier threats, and continued instability via non-state actors demand capacity and a broad range of capabilities
 - COVID-19-related fiscal realities are likely to result in a defense spending decline
 - Space Force and passthrough exacerbating Dept AF budget challenges
 - Dept AF was already stretched too thin managing a long-delayed modernization effort—either systems reset; mission options sunset; or catastrophe results



The F-15C/D and B-1B are just the tip of the iceberg when it comes Air Force aircraft that must be replaced or see their missions sunset for want of viable airframes

Circumstances demand asking which investments will yield the greatest return

Status Quo Calculus Must Change

- Calculations like ***unit cost*** and ***cost per flying hour*** dominate current procurement decisions
 - Focus on a narrow band of cost absent consideration of mission effectiveness
 - Drives buying capabilities that may be more expensive to operate and offer less mission value in the real world
- Maximizing long term value—cost and operational return—demands harnessing ***cost-per-effect*** analysis
 - Measuring the *enterprise* expense associated with accomplishing missions



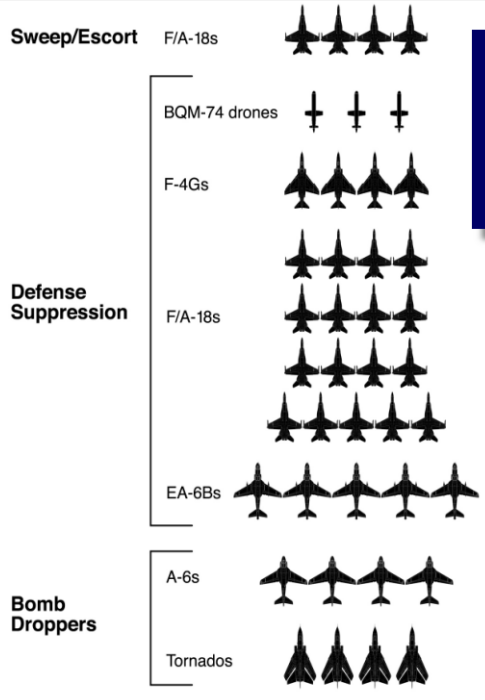
*Which aircraft “cost” more?
The “expensive” aircraft often yield lower
enterprise expense despite what critics and
traditional analysts say*

How aircraft accomplish their mission is what matters over the long haul

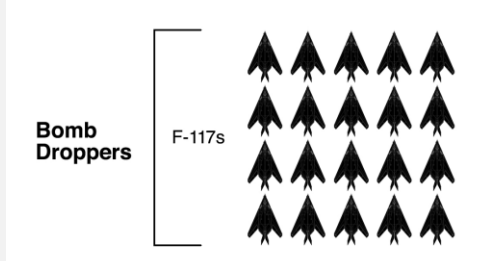
A Proven Concept

The Leverage of Stealth: Non-Stealth vs Stealth Attack*

*Comparison of first conventional attack package in Desert Storm with stealth attacks at same time.



**41 Aircraft/ 8 Bombers
1 Target—3 Aimpoints**



**20 Aircraft/ 20 Bombers
28 Targets—38 Aimpoints**

Stealth Multiplier: $(41/3)/(20/38) \sim 19$



Was the F-117 more “expensive” taken in this context?

Future Factors to Consider

- Cost-Per-Effect applied to the missions of air superiority and strike:
 - Precision Effectors (kinetic and non kinetic)
 - Survivability
 - 5th Generation Technology
 - Range and Payload
- Any other mission could easily derive its own set of cost-per-effect metrics
- Easily translates to joint examples
- Allows for comparative assessment
- Increasingly important in the JADC2 era, where teams of distributed assets increasingly net objectives



Understanding how missions are executed is key

Precision Is King

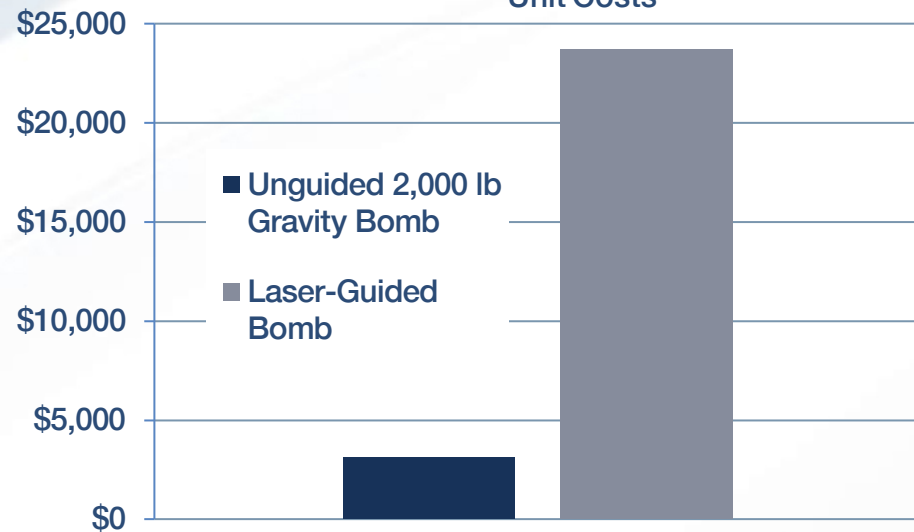
- Yield the greatest return using the lowest volume of force possible
 - Understand the underpinnings upon which the enemy depends
 - Strike these targets rapidly to deprive an adversary of time and decision space
- Vietnam: the precision revolution
 - 420 feet was average unguided bomb CEP
 - Between 1965 and 1972, 870+ sorties were flown against Dragon's Jaw Bridge
 - Strike packages included 40+ aircraft
 - 11 aircraft lost and bridge still functioned
 - May 13, 1972, 14 F-4s dropped guided munitions, bridge destroyed
 - One mission, job complete, no losses
 - Between April 6 and June 30, 1972, 8th TFW destroyed 196 separate bridges with LGBs



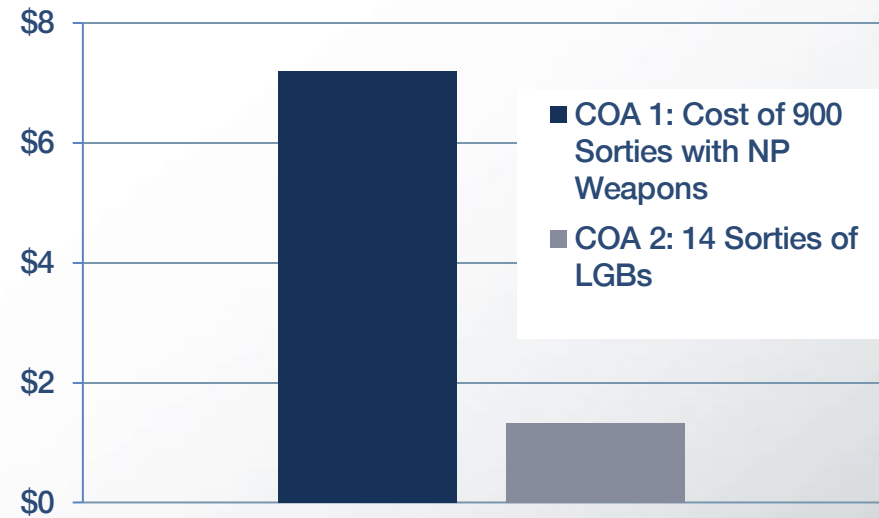


Precision is King

Comparing Individual Munition Unit Costs



Comparing Costs (\$M) of Non-Precision & Precision-Enabled Strikes



The modern equivalent of this example lies in 5th Gen, JADC2, ABMS, and next gen weapons—the threat will demand an enterprise approach

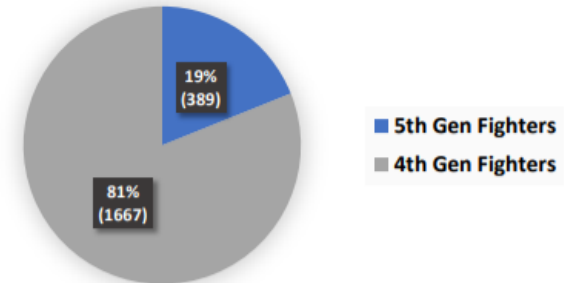
- The “expensive” weapon yielded dramatically lower mission objective cost
- In an era where AF assets are stretched thin, leaders must not lose sight of how to maximize the effect yielded by a limited number of resources
- Adversaries know this and are working counters—which is why 5th Gen, JADC2, ABMS, and next gen weapons are critical precision enablers

What appears “cheap” can often drive extreme fiscal and opportunity cost

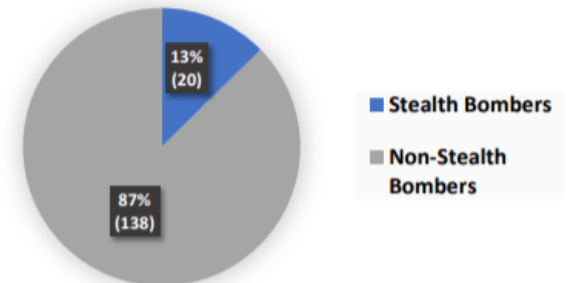
Survivability Counts

- Decisive power projection demands sufficient mass and the right capability mix
 - USAF now too small to absorb combat attrition
 - Budget efficiencies saw AF and DOD stop building attrition and loss inventories
 - Industrial base and training lacks surge capacity
- Attrition and loss are realities of life
 - Vietnam, Operation Linebacker II—15 B-52s in 12 days—today that would be 20% of inventory
 - Yom Kippur War, 102 aircraft shot down out of an inventory of 390 in less than a month
 - Any peer conflict in the modern era would see these sorts of loss factors, or worse

Fighter Total Aircraft Inventory



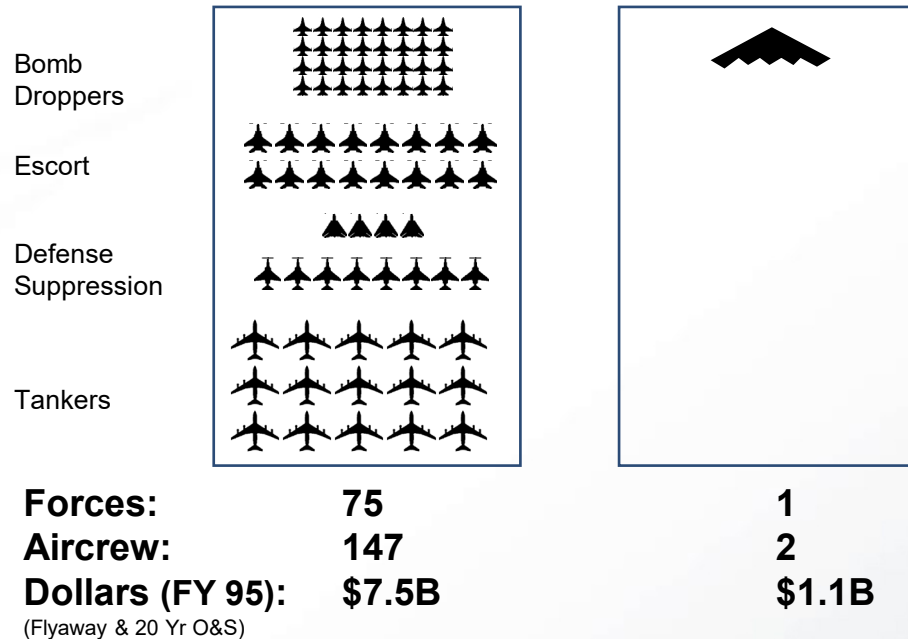
Bomber Total Aircraft Inventory



It's not just about buying more fighters or bombers—it comes down to acquiring the right kind of attributes to field an effective, viable force

We must rapidly build an AF that can operate in a sustainable, effective fashion

Survivability Counts



“I urge you not to focus on dollars per aircraft but overall capability per dollar.”

Stealth Multiplier: 75/1 ~ 75

*General Chuck Horner
HAC Testimony, 30 Apr 1991*

- Failing to invest in modern, survivable aircraft demands cost-intensive measures
 - Aircraft focus on keeping one-another alive, not offensive mission effects
 - Extends duration of conflict by diluting force projection
 - Puts more lives and hardware at risk
 - Tremendous logistical, support, and sustainment costs

In this context, are the F-35 and B-21 “expensive”?

5th Generation Imperative

- 5th Gen technology centers upon:
 - Stealth and EW survivability
 - Sensors, processing power, and collaborative connectivity
 - High performance flight attributes
- Designed to understand battlespace, know where and when to maximize desired effects, minimize vulnerability, and team
- Often derided as “expensive,” their extreme effectiveness and survivability yield significant mission value
 - F-15EX (4th Gen+) slated to cost \$80M per unit, F-35A \$77.9 (Lot 14)...5th gen cost penalty eliminated
 - F-15EX expected to cost \$27k per flight hour, with F-35A current at \$35k and declining...the latter offset by smaller strike packages



Mission cost is what matters, not unit cost or cost per flying hour

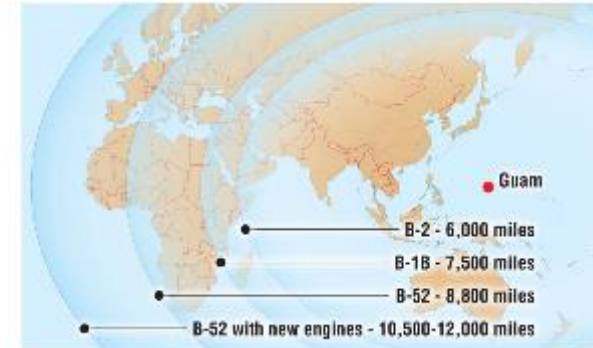
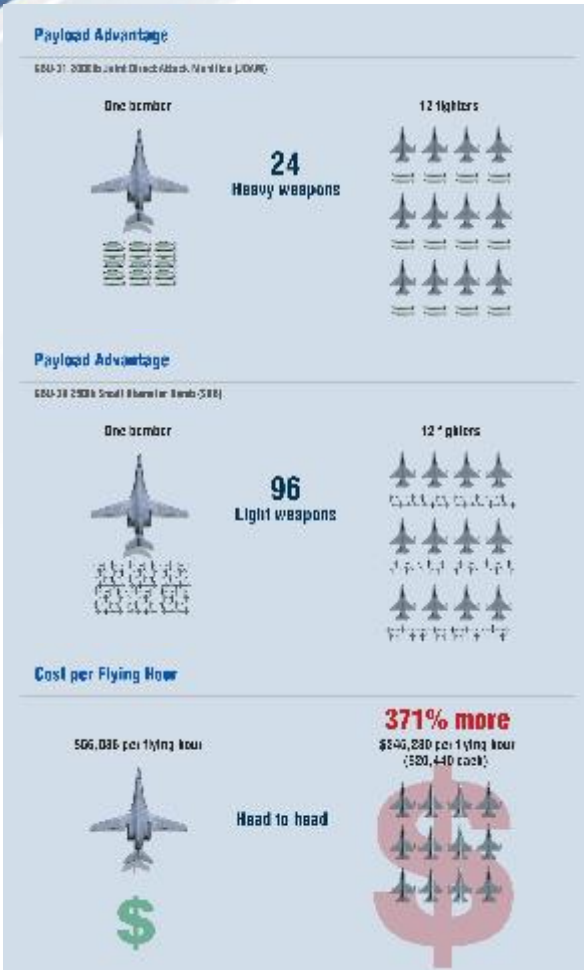
Range and Payload

- Fewer aircraft achieving more, with less support, yields value
 - Bombers are often deemed “expensive”
 - This fails to realize mission value and efficiency
 - It would take 12 F-16s or F/A-18s to carry the 24 GBU-31 JDAMS of a single B-1B
 - During the initial phases of OIR, a single B-2 could have employed the same volume of munitions on one flight that 30 carrier-based F/A-18s delivered over the course of 12 days
- Bombers have regularly realized this value proposition
 - Operation Allied Force: B-2s flew 3% of strike sorties, but hit 33% of all targets
 - Operation Enduring Freedom: Initial phases bombers flew 20% of sorties, but dropped 76% of munition tonnage



One aircraft accomplishing more with less resources

Range and Payload



Unrefueled bomber ranges upwards of 5 times greater than fighters, reducing aerial refueling demands

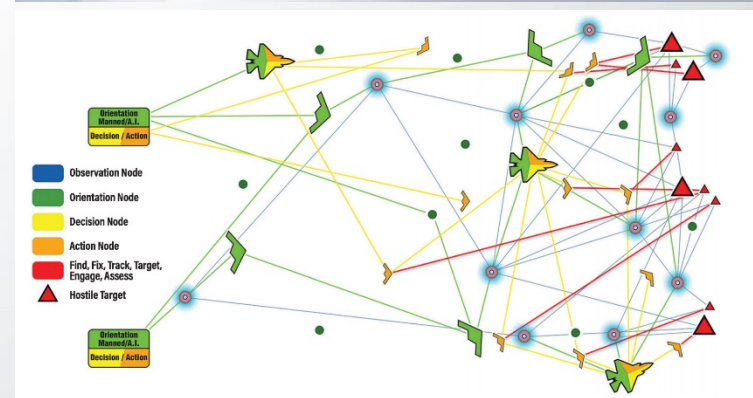
- Cost-per-effect analysis yields more effective, efficient results
 - One aircraft accomplishing more with less resources should be encouraged
 - Unit cost and individual cost per flying hour often incentivizes exactly the opposite
 - DOD, Congress, OMB, GAO, etc. must update their assessment methodology given current mission pressures...otherwise, we will spend more to get less

Given this context, why are we cutting the B-1?

One aircraft accomplishing more with less resources

The Future Is Here

- Stop using industrial age measures when procuring information age capabilities
 - Aircraft employ and fight in radically different ways than in eras past—F-86s and F-22s are not the same—assessment tools not kept pace
 - Battle networks, teaming, disaggregation, etc. see new enterprises replacing legacy options
 - It is increasingly irrelevant and inappropriate to apply assessment tools like unit cost and cost per flying hour when the sum of the parts is what matters, not the individual tools
 - We are buying this enterprise today...it is not theoretical...we cannot afford to get it wrong



Effect measurement must consider all actors

No one fights and wins alone in the modern world



Where Do We Go From Here?

Anticipated Threat

- Peer adversaries investing to erode long-standing US power projection advantages
- Significant portions of the inventory at extreme risk
- Traditional means and methods of power projection now challenged

Necessary Attributes

- *Precision*: tying a given action to a desired outcome
- *Survivability*: essential to maintain mass power projection
- *5th Gen*: survivability, information, lethality, and teaming
- *Range and payload*: yielding more with less

Operational Demands

- Hold enemy centers of gravity at risk
- Defeat offensive enemy systems
- Harness information to boost lethality, while minimizing vulnerability
- Complicate enemy defensive calculus by diversifying power projection options
- Preserve ability to regenerate power

Assessment Tools

- Cost-per-effect analysis vital to assessing modern attributes
- Units cost, cost per flying hour, etc. increasingly irrelevant absent mission context
- Failing to measure the right attributes will yield an ineffective, costly force

Move to Effects-Based Assessment is essential

A New Calculus Required

- Acknowledge the problem—right now nearly all decision-making and oversight bodies are using obsolete tools focused on unit cost
 - Too often the most effective tools are being marginalized because deemed “expensive”
 - JADC2 and ABMS increasingly demand effects-based assessment due to distributed, team-centric design
- Add cost-per-effect as part of the JCIDS process for new procurement decisions
- Apply cost-per-effect analysis as part of Air Force force management—mission effects, not platforms should be measured
- DOD/Congress: think about how COCOMS achieve goals—optimize giving them the most capable, cost-effective set of options



How aircraft accomplish their mission is what matters over the long haul



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