

Presentation at the Naval Postgraduate School Monterey, California

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“The views and opinions expressed in this course are not necessarily those of the Department of Defense....

(although they probably should be.)”

JAMES F. O'BRYON

Three Types of Risk

I. Risk of Program Failure

II. Risk of Technology Obsolescence

III. Risk of Life and Limb

* Testing must be the conscience of all three

***Why PMs &
Industries View T&E
As A Risk***

- **Cost Hazard**
- **Schedule Hazard**
- **Fear of Failure**
- **Obstacle**
- **Adverse Publicity**

Conflicting Perceived Benefits Yield Conflicting Risk Responses

“The cost versus benefit is what we generally have a tug of war about. Listening to it all, it seems like that in the T&E world, **contractor testing and DT** generally **provide business benefit to the PM**. **LFT and OT** **provide military benefit** and it's hard to hang dollar signs on military benefit.

I think that's where we end up arm wrestling, because you [DOT&E / LFT&E] and we [the Services] differ in our rationales of assigning value to the military benefit when **we are trying to stay in budget** and **you are trying to bring us along to best meet the desire of the legislation.**”

(CAPT Richard Virgilio, NAVSEA, LFT&E National Conference, LLNL, CA)

How Do We Change T&E From Being Seen As A Program Risk?

- Proactive Campaign**
- Better Partnership with PMs**
- Better Education**
- Industry can Help**

- **(Mr. Richard Lockhart, DT&E, OSD**
 - **NDIA, March 2003)**

(Never Forget
Your Customer!!)



Eric Feferberg / AFP

IMPACT OF LIVE FIRE TEST & EVALUATION PROGRAM

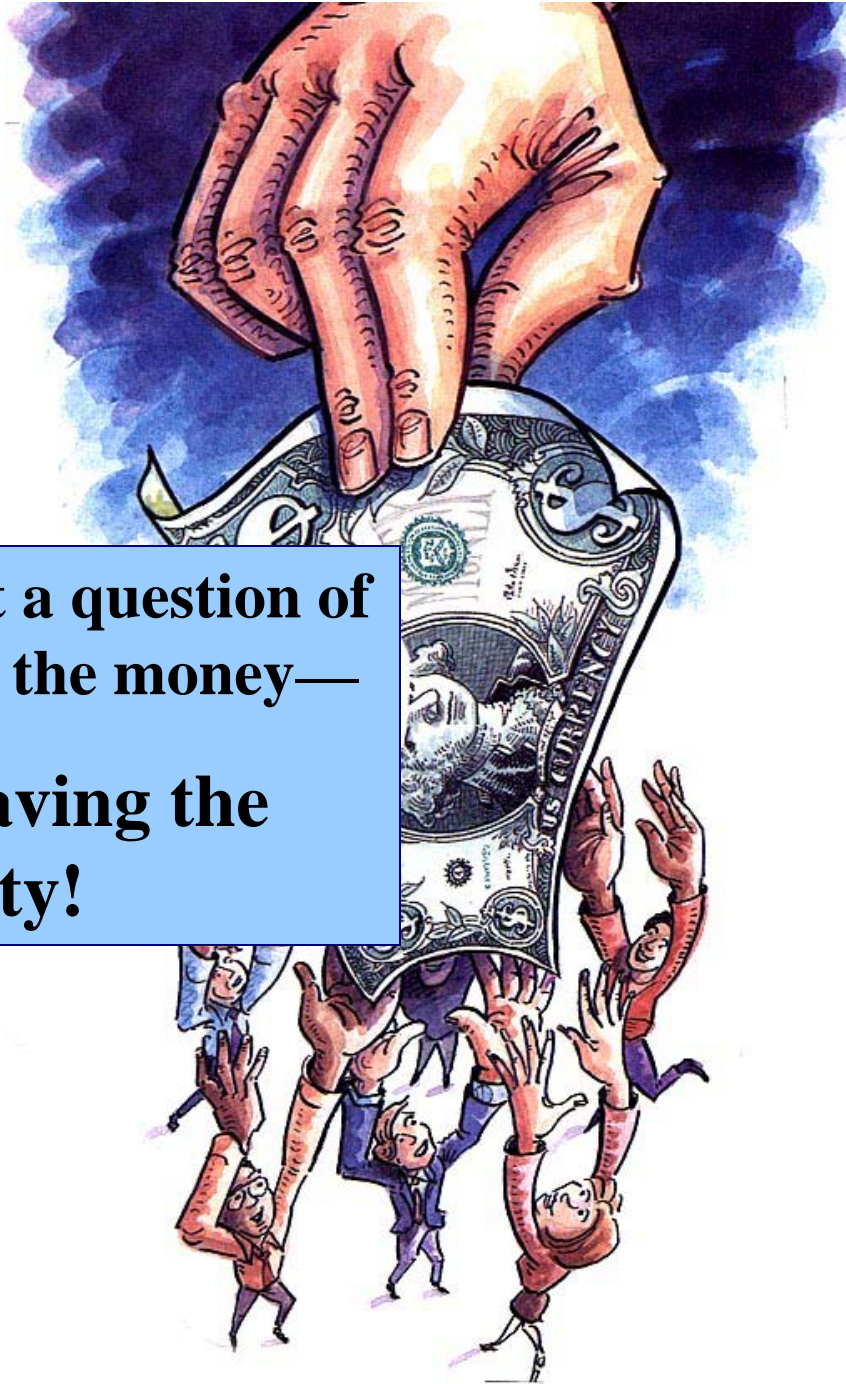
NAVY STATEMENT

**"THE [LFT] LAW HAS HELPED
DIRECT RESOURCES TO THE
[SURVIVABILITY] PROBLEM.
WHILE, IN THE PAST, HEARTS
MAY HAVE BEEN IN THE RIGHT
PLACE, WE DIDN'T HAVE THE
RESOURCES."**

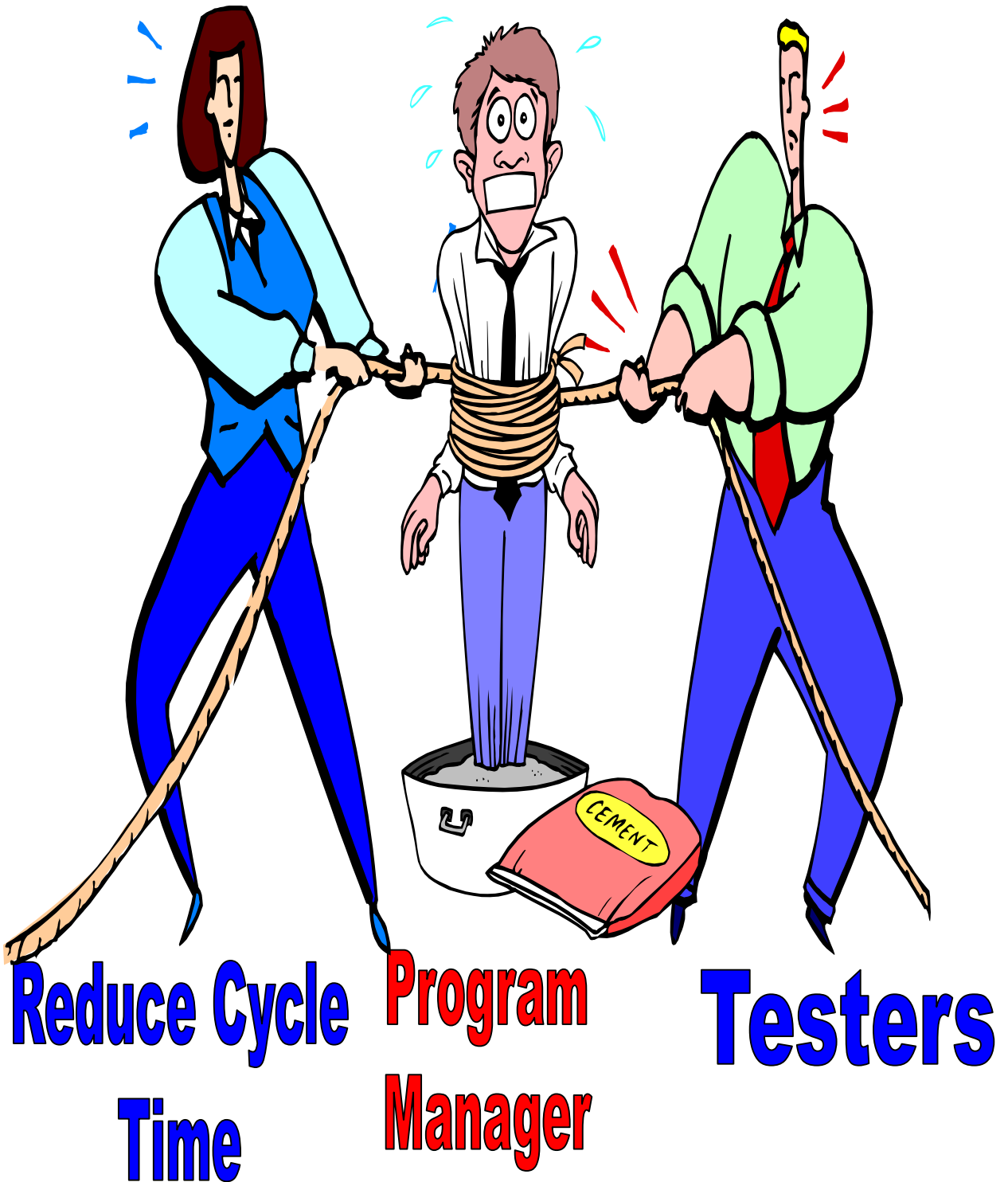
**(MR. TIM HORTON, CHINA LAKE, A/C SURVIVABILITY, ADPA LFT&E SYMPOSIUM, LLNL,
JANUARY 1997)**

Finding “Funds”

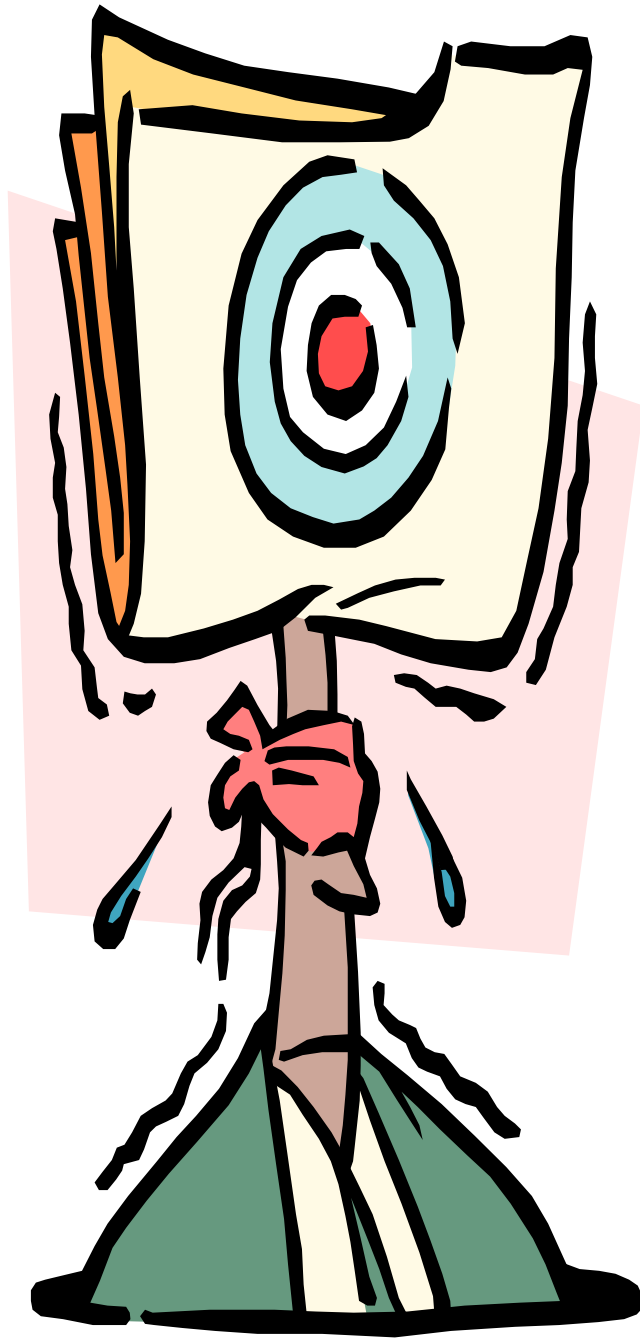
**It's not a question of
having the money—
It's having the
priority!**



Schedule



The Buck Stops Here!



Dilbert's Theorem on Salary

Dilbert's Theorem on Salary

Mathematical Proof that:

**“Engineers and Scientists can never
earn as much as Business Executives and
Sales People”**

Dilbert's Theorem on Salary

"Engineers and Scientists can never earn as much as Business Executives and Sales People"

Given:

Knowledge is Power!

Time is Money!

Dilbert's Theorem on Salary

“Engineers and Scientists can never earn as much as Business Executives and Sales People”

Given: Knowledge is Power

:Time is Money

We Know that $\text{Power} = \text{Work} / \text{Time}$

Substituting we get:

$\text{Knowledge} = \text{Work} / \text{Money}$

Solving for Money we get:

$\text{Money} = \text{Work} / \text{Knowledge}$

Dilbert's Theorem on Salary

“Engineers and Scientists can never earn as much as Business Executives and Sales People”

Given: Knowledge is Power

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Solving for Money we get:

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Hence as Knowledge approaches 0,
Money Approaches Infinity

(Regardless of Amount of Work
Done)

Dilbert's Theorem on Salary

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Solving for Money we get:

$\text{Money} = \text{Work} / \text{Knowledge}$

Hence as Knowledge approaches Zero, Money Approaches Infinity
(Regardless of Work Done)

**QED: The Less You
Know, the More You
Earn!!**

LFT&E MBO

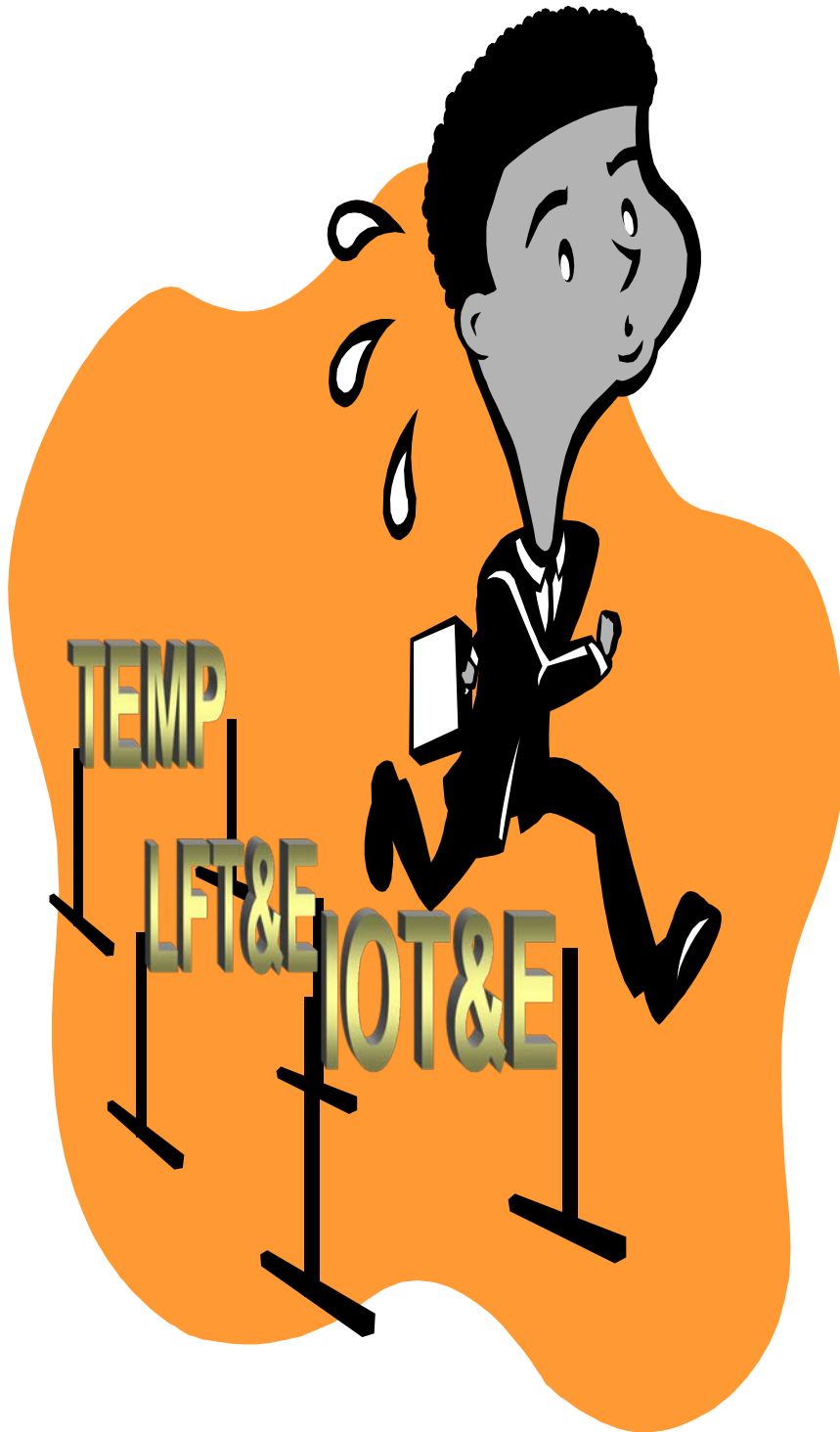
(MANAGEMENT BY OBFUSCATION)

*(O'BRYON'S 21 AXIOMS FOR "HOW TO
NOT MANAGE LFT&E")*

**1) Treat independent
LFT&E oversight as a
terminal illness:**

- **Denial**
- **Anger**
- **Withdrawal**
- **Bargaining**
- **Acceptance**

Test--An Obstacle to Success ?



LFT&E MBO

(MANAGEMENT BY OBFUSCATION)

*(O'BRYON'S 21 AXIOMS FOR "HOW TO
NOT MANAGE LFT&E")*

**2) Treat all programs as
unique and not subject to
the rules)**

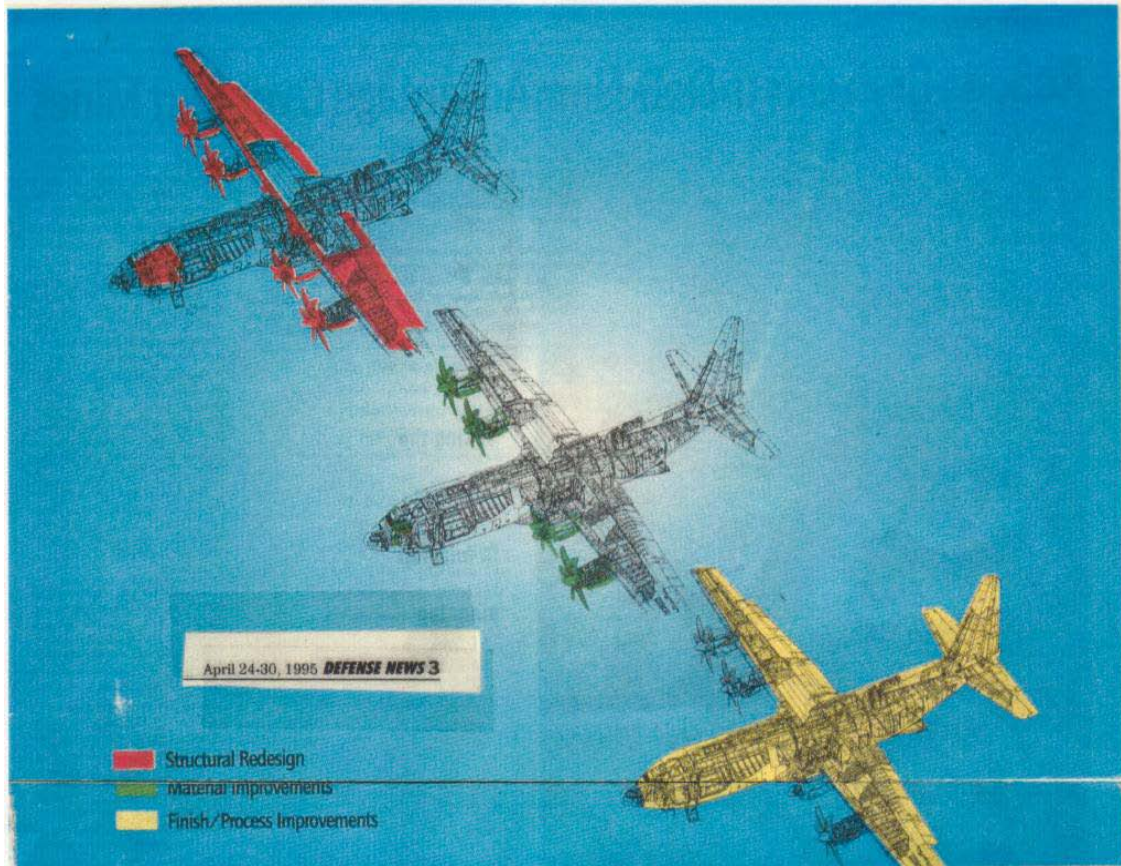
LFT&E MBO

(MANAGEMENT BY OBFUSCATION)

*(O'BRYON'S 21 AXIOMS FOR "HOW TO
NOT MANAGE LFT&E")*

**3) If logic gives
unacceptable conclusion,
call on a lawyer to give you
a more acceptable one.**

How Different Does an Upgrade Have to Be to Qualify as an LFT&E Program??



All new... tip to tip, nose to tail.

We at Lockheed Martin, home of the C-130 Hercules, have enhanced our rugged transport to meet the demands of the 21st Century.

In addition to fully integrated digital avionics and displays, the new C-130J boasts scores of cost-effective advances in structure, materials, and processes throughout. The list includes redesigned wings, composite propellers, improved sealants and corrosion protection. As a result, the C-130J reduces manpower requirements by 38 percent, and operating and support costs by 35 percent.

What's more, it incorporates state-of-the-art defensive systems for improved survivability, while an upgraded navigation system permits pinpoint aerial delivery accuracy.

Look for the C-130J to continue a long tradition of humanitarian and peacekeeping commitments around the world. Some things you just can't improve upon.

LOCKHEED MARTIN 

e,

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

4) Revise operational concepts when testing shows flaws (kick and move the goalposts, if at first you don't succeed, lower your standards)

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

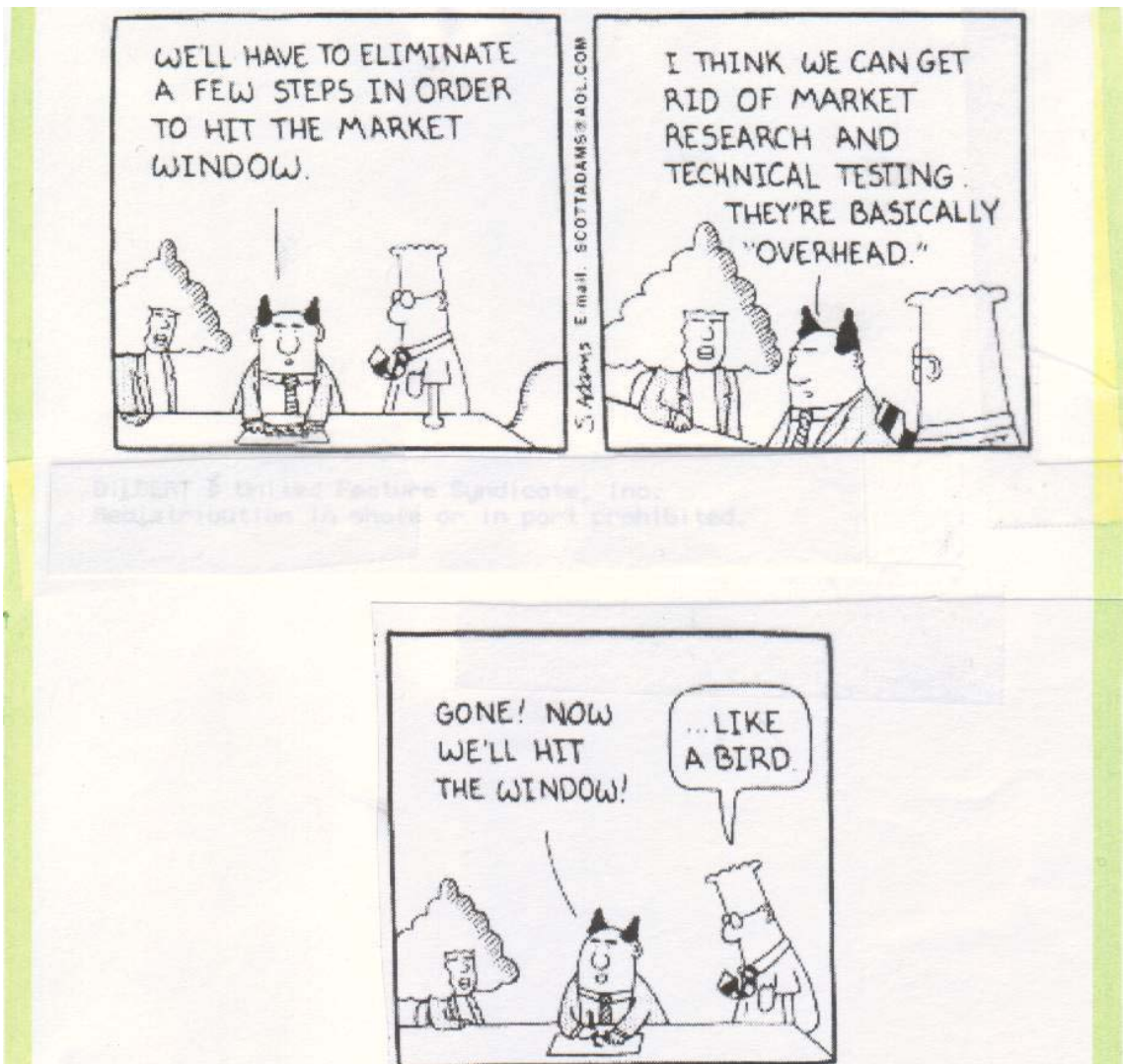
**5) Keep program
management mobile
(a moving target is hard to
hit, be a politician, not a
statesman)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

6) Make test and evaluation the bill payer for any other expense that may arise.

Don't Let LFT&E Funds Become the Bill payer for Other "Priorities"



LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

7) Keep controversial agreements verbal (verbal Agreements are as good as the paper they're printed on.)

LFT&E MBO

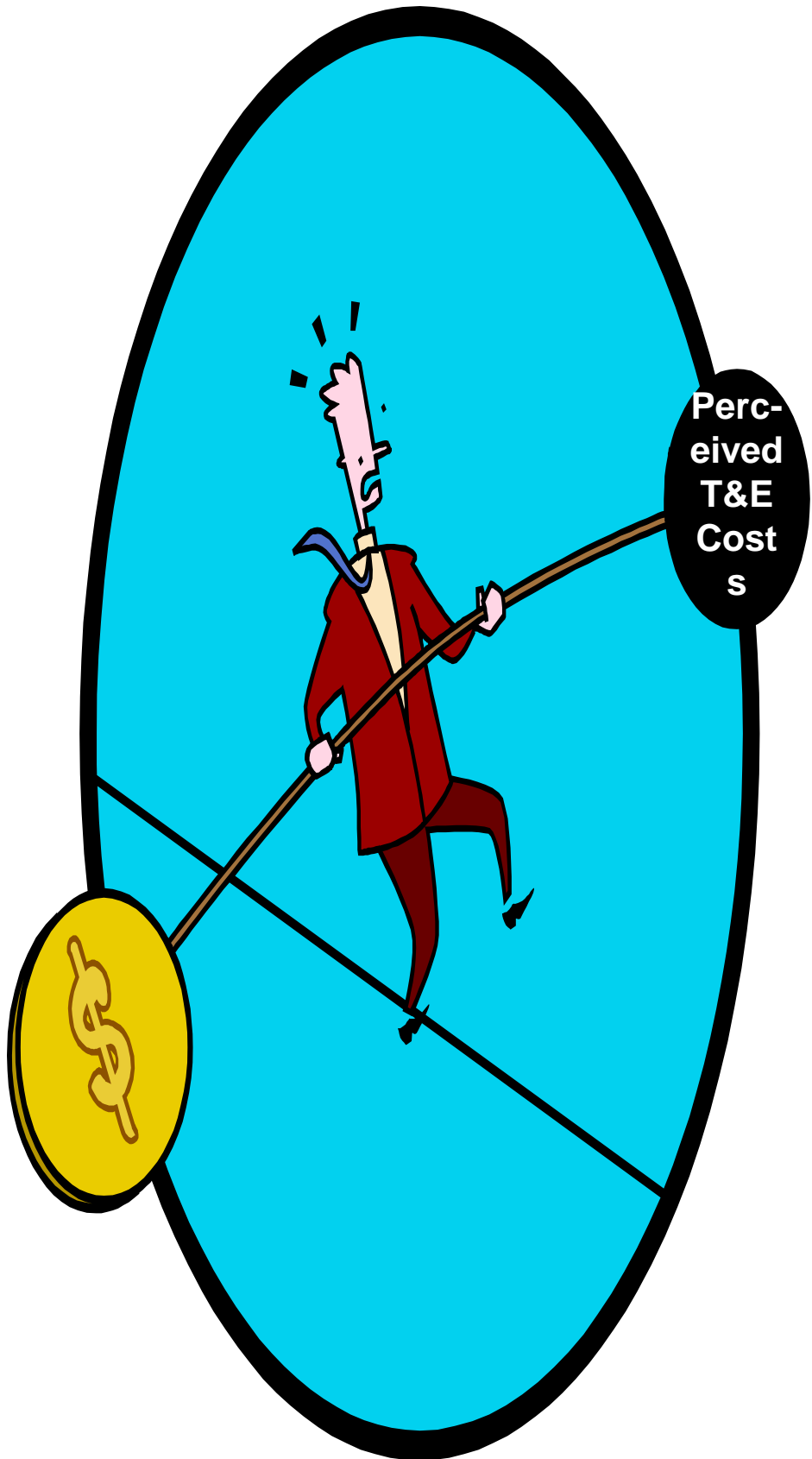
(HOW NOT TO MANAGE LFT&E)

8) Exaggerate costs where their expenditure might jeopardize the program (discreditation by exaggeration)

Perceived Cost of Testing



Testing is a huge cost burden



Actual Costs of LFT&E

**LFT&E COSTS
RARELY
EXCEEDS 1/3 OF
1% OF ANY
GIVEN PROGRAM**

LFT&E Shouldn't be Bill Payer for other Costs

“Survivability equipment, Schloesser said, was a "bill payer" for the Army in the last several decades.

"It was easier to cut [it] when we had short, relatively short engagements where we didn't have an enemy that was constantly firing at us all the time," he said. "There's nothing that will kind of concentrate your mind on the requirements than to have someone actually shooting at you."

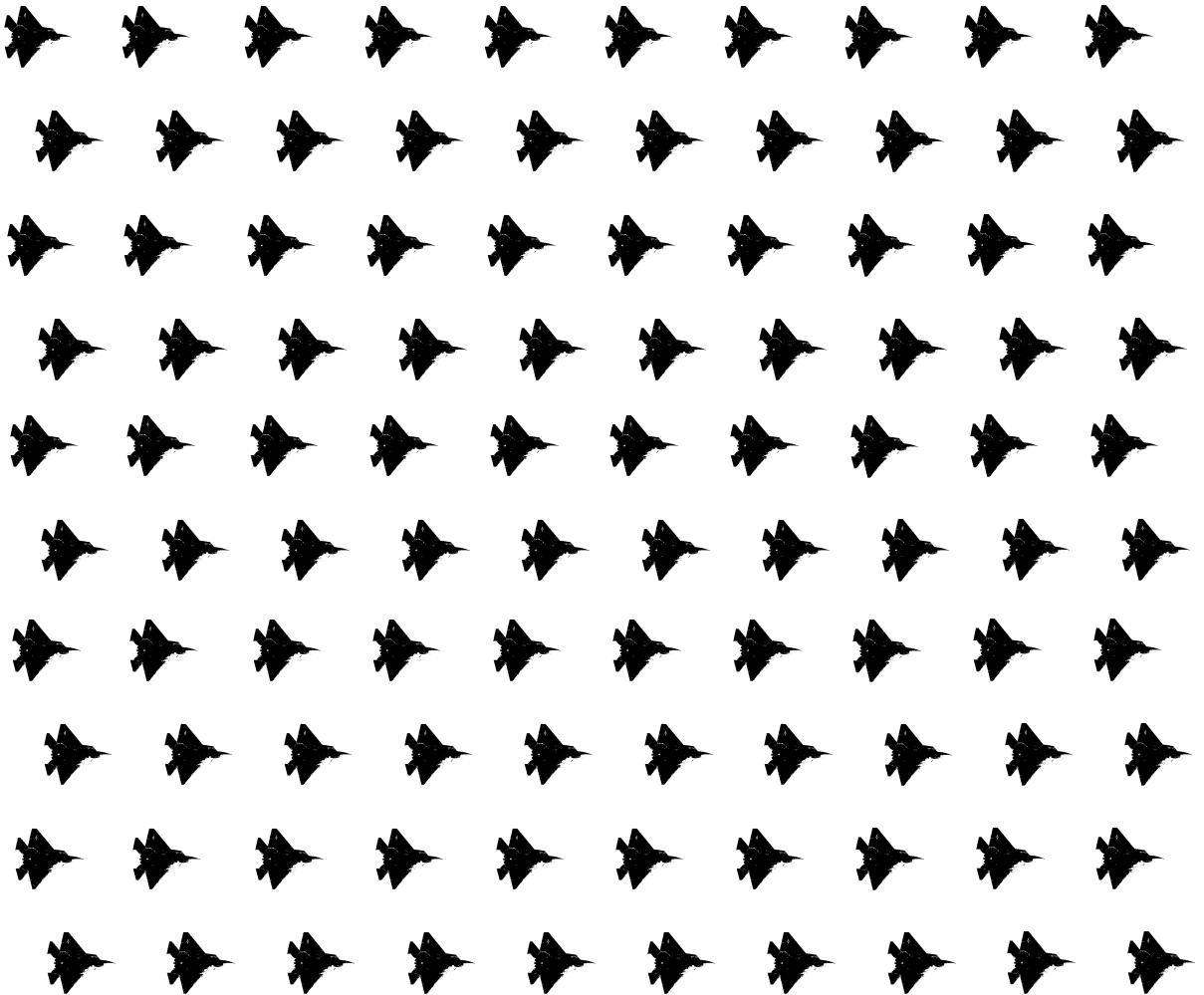
-- Brig. Gen. Jeffrey Schloesser, Head, Army's Aviation Task Force, during an Oct. 22, 2004 interview, on the momentum for change gained within the aviation program from Iraq war.

(Inside the Army)

Relative Cost of F-22 LFT&E



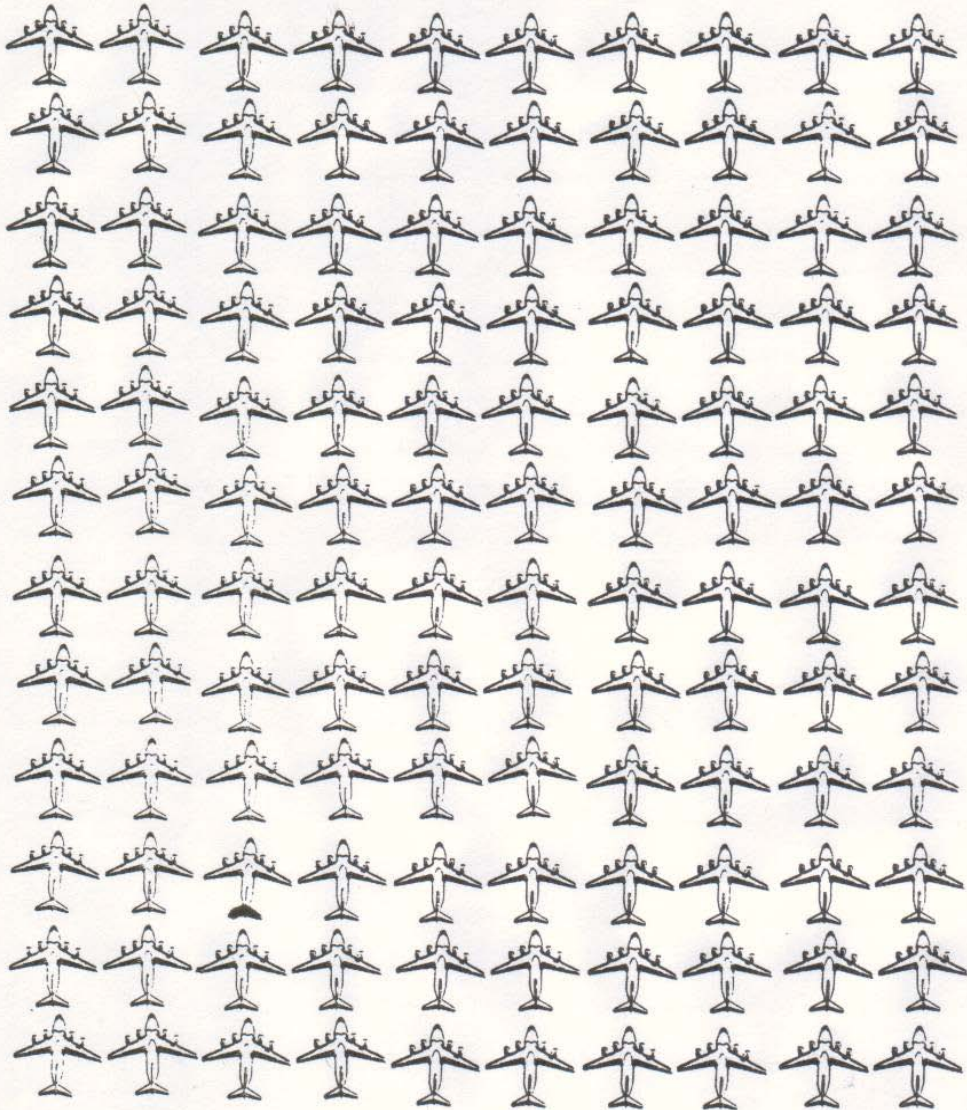
Relative Cost of F-22



Relative Cost of F-22 LFT&E



The “Tail” of Getting Adequate LFT&E Funding



LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**9) Cite test results only
after their successful
completion.**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**10) Withhold data that might
be damaging
(bunker mentality.)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

11) Believe computer models that give desired answers, & discredit all others (inconsistent use of computer models.)

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**12) Let a potential
capability become a
required capability
(Parkinson's gotcha)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**13) Ignore the tactical usage
and environment of the
system (Green golfball
syndrome)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**14) Use irrational or
outdated threat description
to justify building
the system
(Caisson corollary.)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

15) Be preoccupied with the cost of testing and not on its potential benefit to the system under test

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**16) Focus only on the
quantifiable, not the
significant.
(Gresham's Law)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**17) Allow system contractor
to perform his own
independent assessment of
system performance (Miss
50 America)**

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

18) Only believe statistically significant test data, and discard the rest.

LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

**19) Minimize contact with
OSD oversight (Fram filter)
(Washington is
Non-Newtonian)**

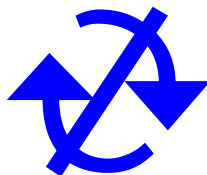
Testers seen as Sharks--Here to Hurt, not to Help



LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

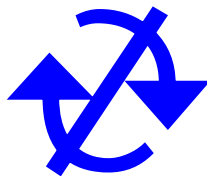
20) Work around those who disagree with you and wait for a window of opportunity: discredit those you can't work around.



LFT&E MBO

(HOW NOT TO MANAGE LFT&E)

21) If all else fails, call for a study and do nothing until it's done (“Paralysis by analysis”)



How Do We Change T&E From Being Seen As A Program Risk?

- **Proactive Campaign**
- **Better Partnership with PMs**
- **Better Education**
- **Industry can Help**

- **Mr. Richard Lockhart, DT&E, OUSD(AT&L)**

KEYS TO CONDUCTING EFFECTIVE LFT&E PROGRAMS

- **UNDERSTAND LEGISLATIVE AND OSD TEST REQUIREMENTS**
- **ASSURE THAT ADEQUATE TEST RESOURCES ARE IDENTIFIED EARLY**
- **IDENTIFY CRITICAL LIVE FIRE TESTING ISSUES EARLY**
- **MATCH TESTS TO CRITICAL ISSUES**
- **INTEGRATE LFT&E INTO OVERALL TESTING STRATEGY (TEMP)**

KEYS TO CONDUCTING EFFECTIVE LFT&E PROGRAMS

- **GAIN ACCESS TO ALL RELEVANT COMBAT DATA ON SIMILAR SYSTEMS**
- **MAINTAIN CONSISTENCY BETWEEN OPERATIONAL REQUIREMENTS AND LIVE FIRE TESTING CRITERIA**
- **ASSURE TESTS ASSESS REALISTIC THREAT AT IOC AND DURING ANTICIPATED SYSTEM FIELDING**

KEYS TO CONDUCTING EFFECTIVE LFT&E PROGRAMS

- **ASSURE ADEQUATE LFT&E FUNDING IS IN PLACE AND PROTECTED**
- **USE MOST UP-TO-DATE VULNERABILITY MODEL TO MAKE PRESHOT DAMAGE PREDICTIONS**
- **BALANCE TESTING & EVALUATION**

Role of Operational Requirements in Successful LFT&E Programs*

- 1. Identify the tasks required of the system in likely combat and non-combat scenarios / levels of cap-abilities required to do these tasks (i.e. mission-relevant capabilities).**
- 2. Identify physical status of system required to produce the mission-relevant capabilities (i.e. critical components, subsystems required to be functional, etc)**
- 3. Identify events/activities combat / non-combat and the effects of those activities on physical status of system required to produce mission relevant capabilities. (Cont'd)**

(See printed handout)

***Dr. Martha Nelson, “Simulation & Modeling in Cost-Effective Assessment of Capabilities: The Role of Operational Requirements”, Franklin & Marshall College, Lancaster, PA**

ACQUISITION REFORM

&

TEST AND EVALUATION

REALISTIC LFT&E IS SOMETIMES LOOKED AT AS THREATENING BY THE SYSTEM PROPONENT

"ACQUISITION REFORM OF T&E IS SOMETIMES LIKE SANDPAPER. PEOPLE COME ALONG AND COMPLAIN ABOUT HOW MUCH DUST AND HEAT ARE GENERATED BY SANDPAPER. SO THEY REMOVE THE GRIT FROM THE SANDPAPER AND MAKE IT SMOOTH. YOU HAVE NO DUST, NO HEAT ... BUT ALSO NO POSITIVE IMPACT. REALISTIC TESTING IS MUCH THE SAME. IT GENERATES DUST, HEAT, TAKES SOME TIME BUT THE PRODUCT IS MUCH IMPROVED."

(JIM O'BRYON)

FOCUS ON IMPLEMENTING
POLICIES IN PLACE, NOT ON
HOPING POLICIES CHANGE

**“THE DEFENSE DEPARTMENT
ALREADY HAS CONDUCTED 128
STUDIES ON ACQUISITION REFORM.
ENOUGH IS ENOUGH! THE
PROBLEM IS IMPLEMENTATION. THE
BUREAUCRACY IS VERY SLOW.
SOME PROGRESS HAS BEEN
ACHIEVED IN ACQUISITION
REFORM. WE DON’T NEED ANY
MORE STUDIES. THE CURRENT
ACQUISITION PROBLEMS CANNOT
BE BLAMED ONLY ON
CONTRACTORS. RESPONSIBILITY
CANNOT BE OUTSOURCED. THE
GOVERNMENT HAS TO BE A SMART
BUYER.”**

(HONORABLE EDWARD C, PETE ALDRIDGE, UNDERSECRETARY OF DEFENSE
FOR ACQUISITION, TECHNOLOGY AND LOGISTICS, NATIONAL DEFENSE
MAGAZINE, JANUARY 2002, PP 8)

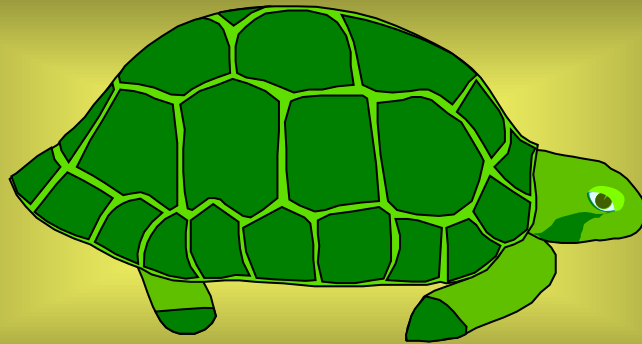
Corporate Philosophy

must recognize that LFT&E is an Enabler
to Success



The Testing Paradox

“Why is it that we never seem to have enough time to do it right but we always seem to have enough time to do it over?”



**“Government programs tend to start
slow... and then tail off.”**

Norm Augustine



USD(AT&L) on T&E

“I believe that the various changes in military requirements, business practices, and modern technologies have the following implications for DoD testing:

1. Shorter development cycles require that we must **begin testing much earlier** in the development process and we must **perform early testing** in more realistic situations (for example, in the presence of likely countermeasures, such as information warfare).
2. As we become more successful in focusing new weapons on the use of **demonstrated technologies**, then the emphasis in testing shifts to the integration of these elements in the weapon system and to the determination of whether it meets the user's needs-including the interfaces with other system in a joint and coalition environment.
3. As we expand our efforts to adopt commercial products and processes to defense procurement, we must seek **closer ties between commercial testers and government testers**. We must also be aware that a previously-tested **commercial product embedded in one system may present new problems** when embedded in a different system.

--Hon. Jacques S. Gansler, USD(AT&L), Remarks to
ITEA Conference, Atlanta, GA, September 22, 1999

ACQUISITION REFORM*

OBJECTIVE:

- BETTER
- FASTER
- CHEAPER

PRACTICE:

- CHEAPER
- FASTER
- BETTER

*As expressed by a Defense
Industry Executive

Ethics Issues in Defense Acquisition

Ethics Issues in Defense Acquisition

The first of an expected 360 V-22 Osprey was delivered to the Navy in March 2000. Not long afterward, one crashed killing 19.

On December 5, 2000, Marine officials tried to convince the Navy's top acquisition official that the Osprey was ready for full production - as many as 30 per year, twice the pace planned.

On December 29, 2000, 11 days after the [V-22] crash [killing all four crew members], the Squadron Commander called the members of his squadron into his ready room to talk about maintenance problems. He did not realize that one of the men was secretly taping the conversation. He talked about his frustrations with the V-22 system that undercut readiness and the folly of letting an osprey sit for repairs over a holiday.

Ethics Issues in Defense Acquisition

"We need to lie.

And the reason we need to lie or manipulate the data or however you want to call it is that until the decision to go to full production is made, this program is in jeopardy.

Everyone says the readiness was bad ...

Everyone's hitting on this particular bit of information ...

Believe me, the general gets a briefing at seven o'clock every morning.

Once a decision is made to go full production, we can go back to truthfully reporting."

Ethics Issues in Defense Acquisition

Before the squadron personnel left for the New Year's weekend, the pending work orders for Ospreys were deleted from the computer. The downtime clock stopped and when the New Year (2001) began, the unit looked perfect.

After the holidays, after all officers were back for duty, a sober look at the situation made it clear that the "cooked" numbers were not believable. A plane crashes and you go from 20% to 100% readiness? The Commander called off the deceptive process and told his superiors that the squadron would rise or fall on the real readiness numbers.

It was too late - the taped speech had been mailed to the Secretary of the Navy. CBS's "60 Minutes" also got a copy of the tape and broadcast portions in mid-January

Ethics Issues in Defense Acquisition

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Ethics in Government ?

A Recent Example: The Bitter Trade

“Ex-Boeing Exec Expected to Plead Guilty”, Seattle Post-Intelligencer, November 13, 2004

“Long Fall for Pentagon Star”, (Washington Post, November 14, 2004)

“McCain vs. U.S. Air Force: Tanker Deal Continues to Dog Top Leaders”, Defense News, November 15, 2004

“Long Shadow: Fallout from Druyun / Boeing Investigation Spreads Beyond the Air Force”, Aviation Week & Space Technology, November 15, 2004



Fall from Grace

- **“One of the most feared women in military contracting”**
- **Helped direct AF \$30 billion procurement budget.**
- **At peak of her power in 1999, she scolded Lockheed Martin for some work on rockets and satellites.**
- **Tone was blunt: “Pitiful software, crappy design.”**



A Little History About Ms. Darlene Druyun

- **She began her career in government in 1970, AF Contractor negotiator at Warner Robbins, GA**
- **Father had worked at the base for 40 years, was “instrumental” in getting her the job.**
- **Husband William Druyun is retired AF official who was mid-level manager at Fall Church-based General Dynamics Corp (before retiring in September 2004)**
- **For next 20 years, she bounced between the AF, OMB, and NASA before being named AF deputy acquisition chief, which she held until retirement November 2002.**
- **“No sooner had she climbed the heights of AF procurement than she became very involved in a controversy over work she had done three years before. (She and 4 other AF officials were accused by the IG of improperly funneling \$349 million to McDonnell Douglas Corp in 1990 to keep the C-17 transport aircraft on track.**
- **A separate AF investigation found no wrongdoing. Defense Secretary Aspin dismissed one general and disciplined 3 others, saying the program was poorly managed. Druyun was cleared. “**

A Narrow Escape but the Pattern Continues

- **AF Chief of Staff McPeak petitioned SecDef : “She’s a strong person, strong leadership, if I save one person, it’s Druyun.”**
- **“She was the one who would come into my office and tell me I was wrong about something. not a yes-woman.**
- **She reinvented herself as a “reformer”, developing “Lightning Bolt” initiatives, to make AF procurement programs more “efficient” and stressed importance of a company’s past performance in awarding new contracts. AF said program saved \$20 billion.**
- **Fortunes of defense contractors rested on Druyun’s decisions on competitiveness, her policy decrees, and her awards of bonuses.**
- **She actively discouraged her staff from making recommendations. He began accreting this authority up to her. Don’t send it up with a recommendation, just send it up with information.”**
- **Her power creep did not escape the notice of her superiors.**

The Continuing Slide

- Her rough edges emerged. Staff were frozen out of meetings. People feared going to see the “Dragon Lady.”
- When her daughter’s fiancé Michael McKee was looking for a job in 2000, she contacted longtime Boeing associate, Michael Sears, Boeing’s CFO, for help. McKee was hired for position in St. Louis.
- She then helped her daughter Heather, land a job at Boeing 2 years later - a position created for her.
- After fostering a reputation as the defense contractors’ toughest adversary, she felt **indebted** to Boeing, resulting in her series of decisions that were **rooted in this sense of gratitude**.
- She was a hands-on kind of person. People above and around her in the AF **should have been overseeing her**. (Gansler)

Enter the New Boss

- In 2000, she increased size of Boeing's contract for C-17 by \$412M.
- In 2001, she picked Boeing over Lockheed to upgrade C-130's avionics stunning industry analysis.
- (Still, industry analysts pointed to her decision on the C-130 as proof that Boeing's strategy to apply commercial technology to the military sector was working and that Lockheed was failing to capture the AF's imagination.)
- **Enter Ms. Druyun's new boss, Marvin R. Sambur, appointed as AF acquisition chief in late 2001.**
- He was surprised that she, and not her subordinates, was deciding the outcome of competitions and contract bonuses. He discovered that she hoarded information and kept the decision-making process secret. Sambur felt like "summer help."
- During meetings, people would look to her to see if she agreed with what Sambur had to say. People recognized that while he might be there for a couple of years, she would be there for a long time.
- Sambur began dismantling Druyun's power, stripping her of the ability to decide competitions, then took away her authority to negotiate final contract terms or change requirements.
- With her **diminished authority**, she announced to Sambur that she **intended to retire**.

The Rest of the Story

- **However, she soon forged a handshake agreement to join the executive ranks of Lockheed, the Pentagon's largest contractor.**
- **Meanwhile, she also met with Lockheed's largest rival, Boeing, about a job, using her daughter Heather as intermediary. The daughter indicated to Boeing that her mother would consider moving out of DC but it would have to be for a position with considerable responsibility.**
- **Federal regulations restricted what kind of job she, with the civilian equivalent of a lieutenant general, could take in defense industry.**
- **She soon reneged on her agreement with Lockheed and accepted a \$250,000/year VP position with Boeing.**

The Final Ethical Meltdown

- **In her final months at the Pentagon, she was the chief negotiator of a \$20 billion lease, then to purchase, Boeing 767s converted into refueling tankers.**
- **The proposal attracted the attention of Senator John McCain who called it a “welfare program for Boeing” and criticized Sambur and other AF officials with their handling of the deal.**
- **She had barely moved in at Boeing when she became the center of controversy again over this tanker deal and others. Critics saw more than a coincidence that she would promptly take a job with Boeing.**
- **Boeing tried to publicly defend the tanker deal but privately hired a firm to investigate Druyun.**
- **They found violations of the law, and Druyun was fired. Later she failed two polygraph tests regarding preferential treatment to Boeing as a “parting gift”.**

The Rest of the Story

“Getting to the truth of matters can sometimes be difficult. There is no denying Darlene made a serious mistake and there is no denying she had difficulty coming to grips with certain matters.”

–Statement by John M. Dowd, attorney for Ms. Darlene Druyun, to the presiding judge prior to her sentencing.



Class Discussion on Defense Ethics

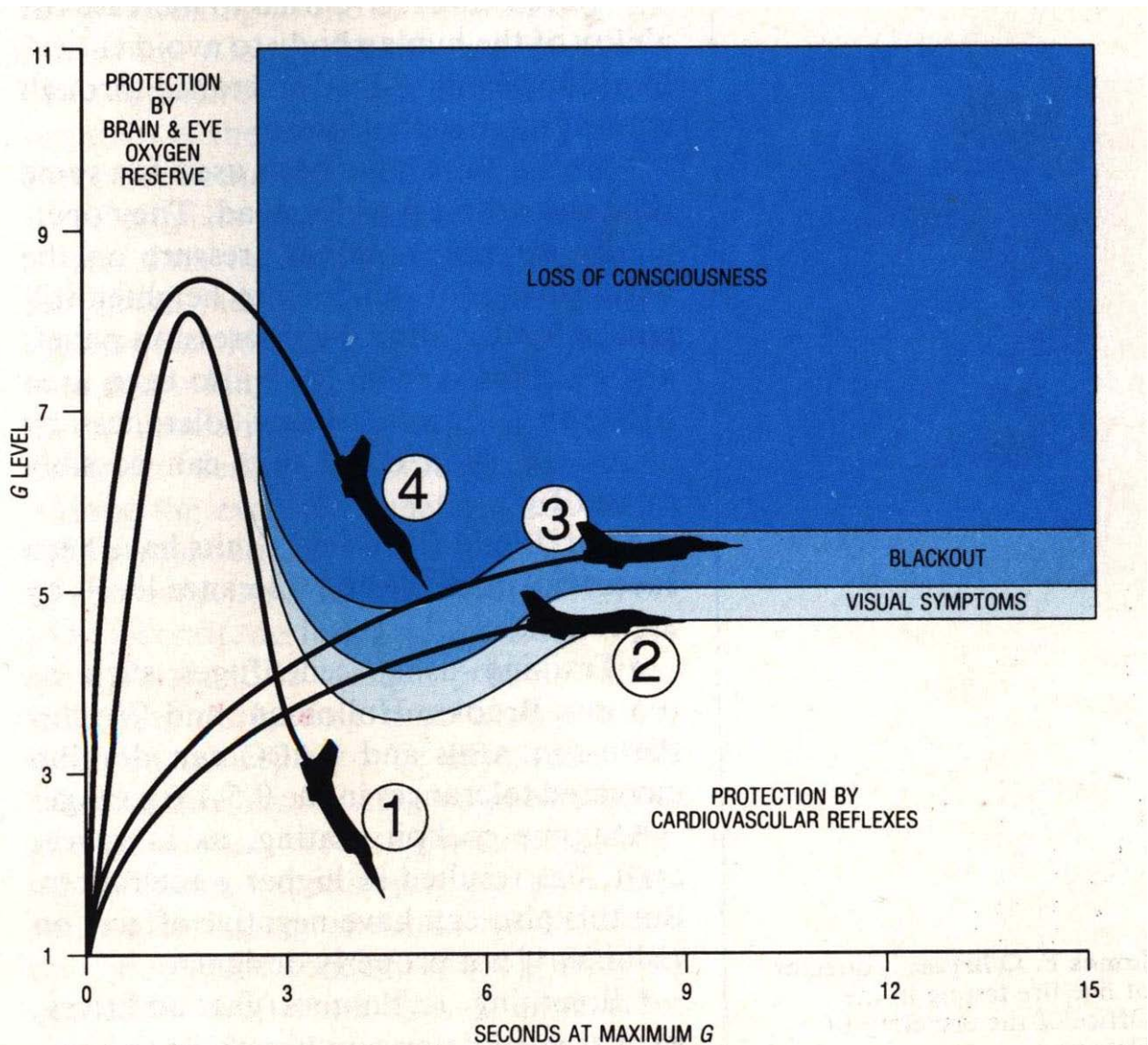
**If We Have Time, Let's
Address Serious
Survivability Issue:
Aircraft Crew Casualties**

Focus of LFT&E is Reducing User Casualties

**What Has Been and Is One
of the Largest Sources of
User Casualties in Fixed
Wing Military Fighter
Aircraft over the Past 25
years?**

G-LOC

Gravity-Induced Loss of Consciousness



G-LOC Incidents

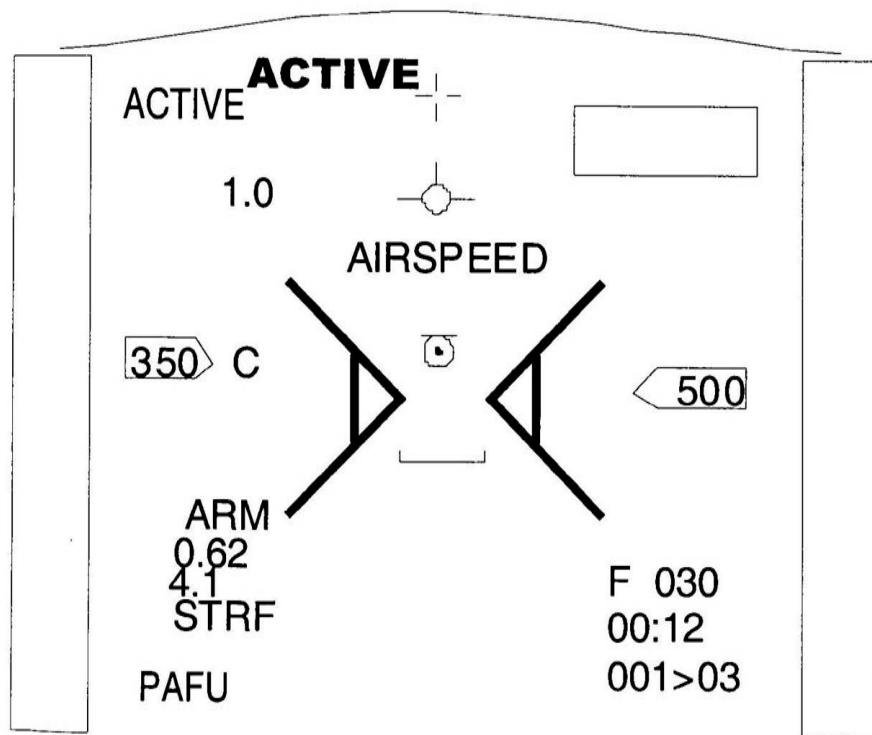
Aircraft	G-LOC Incidents	Total Flight Hours	G-LOC per 1000 Flt Hrs
EA-6B	15	116,033	1.29
A-6	39	173,383	2.25
A-7	45	187,490	2.40
F-14	6	125,668	4.85
F-4	20	36,964	5.41
F/A-18	29	22,485	12.90

Auto-GCAS (Automatic Ground Collision Avoidance System)



**A technology
whose time
has come to
combat
terrorism and
make aviation
safer.**

Pilot/Aircraft Interface



- Chevron Separation is proportional to “time-to-fly up”
- Chevrons appear at edge of HUD 5 seconds to Fly up and then move to the center
- Auto-GCAS Status indicated in upper left of HUD

Current Deployment

- **Swedish Grippen Fighter**
- **Planned for Future U.S. Fighter Jets**
- **Could be retrofitted into current front line combat aircraft**
- **Could be installed in inventory commercial aircraft**

Potential Benefits of Auto-GCAS

- **Prevents aircraft from being directed to “kamikaze” target**
- **Prevents aircraft crash under any circumstances provided Auto-GCAS system is activated and aircraft fuel is sufficient**
- **Reduces/eliminates controlled flight into terrain during disorientation or poor visibility**
- **Provides aircraft preplanned flight if pilot is unconscious or becomes terror victim**
- **Provides time to address air emergency**
- **Could serve as deterrent to attempted hijacking**

Class Discussion on Crew Casualties

**If We Have Time, Let's
Address Serious
Survivability Issue:

Stealthy Aircraft
and Survivability**

WHY NOT JUST DEPEND ON STEALTH & MANEUVER?

“AS YOU KNOW, MANY FACTORS INFLUENCE AIRCRAFT SURVIVABILITY. DETECTION & TRACKING, SUSCEPTIBILITY, PERFORMANCE & AGILITY AND TYPES OF WEAPONS USED ALL PLAY A ROLE, AS DO AN AVIATOR'S SKILLS AND THE EFFECTIVENESS OF HIS TACTICS. BUT EVEN IF ALL OUR SUSCEPTIBILITY REDUCTION TECHNIQUES WORK PERFECTLY, THE ODDS ARE WE WILL STILL TAKE SOME HITS. THEREFORE, MINIMIZING PHYSICAL VULNERABILITY IS AN EQUALLY IMPORTANT FACTOR IN THE OVERALL SURVIVABILITY EQUATION”

**(RADM JOHN CALVERT, PEO TACTICAL A/C, ASN, RDA, A/C SURVIVABILITY
MAGAZINE SEPTEMBER 1990, PP 6)**

Can Stealthy Aircraft Depend on Their Stealth to Survive?



Must Design for Survivability Which Includes Susceptibility Reduction as Well as Vulnerability Reduction

“THE IMPORTANCE OF DESIGNING FOR SURVIVABILITY WAS DEMONSTRATED IN THE INVASION OF PANAMA, WHERE MORE THAN 60 FIXED AND ROTARY WING AIRCRAFT WERE HIT, AND IS ATTESTED TO EVERY DAY IN PEACETIME EXPERIENCES, SUCH AS THE ACCIDENTAL SHOOTING BY ITS WINGMAN OF AN F-15 WITH A SIDEWINDER MISSILE IN ALASKA. ONLY THREE HELICOPTERS WERE LOST IN PANAMA, AND THE F-15 LANDED SAFELY

(SURVIVABILITY, BY NORMAN FISCHER, AIAA AEROSPACE AMERICA, DECEMBER 1990)

REGARDLESS OF HOW MUCH STEALTH, WE WILL STILL GET **HIT SOMETIMES**

**1) ALL 32 BLACKHAWKS USED IN THE
GRENADA INVASION WERE HIT. SO MUCH
FOR MANEUVER.**

(SIKORSKY PLANT VISIT AND BRIEFING, STRATFORD, CT)

**2) THE B-1B CRASH ON SEPTEMBER 28, 1987,
CAUSED BY A BIRD IMPACT KNOCKED OUT
ENGINES 3 AND 4, KILLED 3 CREW AND 3
OTHERS BAILED OUT, AND CONTAINED 107
BLACK BOXES TO REDUCE SUSCEPTIBILITY
WEIGHING MORE THAN 4,500 POUNDS.**

(POPULAR MECHANICS, JANUARY 1988)

PLUS

**OVER 2,000 BIRD STRIKES ON USAF
AIRCRAFT LAST YEAR ALONE**

THINKING ON AVOIDING THE THREAT TO AIRCRAFT MUST BE CLEAR

“In every mission, aircrews plan to avoid all known threats. However, upon encountering a threat, aircrews react by evading the threat, aborting the mission if the threat is too severe, or continuing the mission if success is deemed critical”

(MEMO FROM LGEN HOWARD LEAF (AF RETIRED) DIRECTOR AIR FORCE T&E TO
SAF/AQ ON C-130J LFT&E, DECEMBER 17, 1996)

THINKING ON AVOIDING THE THREAT TO AIRCRAFT MUST BE

cLEAR (CONT'D)

**The Air Force vulnerability
assessment [of the C-130J]
will use information from
both FASTGEN and
COVART models combined
with over 4,000 hits on
433 C-130s from actual
combat”**

(AF Point Paper on C-130J LFT&E), Maj Tye, May
3, 1996)

STEALTH IS NOT INVISIBILITY: IT IS SIGNATURE MANAGEMENT

“STEALTH IS NOT INVULNERABILITY OR INVISIBILITY; IT IS MANAGEMENT OF THE AIRCRAFT'S SIGNATURE. JUST AS THERE IS NO "FREE LUNCH", STEALTH IS A COMPROMISE. THE STEALTHIER AN AIRCRAFT, THE MORE LIKELY IT IS TO DEGRADE OTHER DESIRABLE COMBAT CHARACTERISTICS SUCH AS SPEED, MANEUVERABILITY OR PAYLOAD.

STEALTH IS INHERENTLY EXPENSIVE AND DIFFICULT TO MAINTAIN; THE COATING DEGRADES WITH EACH MISSION. STEALTH IS NOT AN ALL ASPECT CLOAK OF INVISIBILITY. IT IS OPTIMIZED TO DEFEAT RADARS AHEAD OF THE AIRCRAFT, BUT IS LESS EFFECTIVE FROM OTHER ANGLES. ALSO IT WORKS BETTER AGAINST CERTAIN RADAR FREQUENCIES: SOME OLD, LONG-WAVE RADARS ARE MORE DIFFICULT TO DEFEAT. OTHER DETECTION SYSTEMS, SUCH AS ELECTRO-OPTICAL OR INFRARED, HAVE THE CAPABILITY TO DETECT A STEALTH AIRCRAFT. (Continued)

STEALTH IS NOT INVISIBILITY: IT'S SIGNATURE MANAGEMENT (cont' d)

**“A STEALTH AIRCRAFT WOULD BE WELL-ADVISED
TO DO ITS MISSION AT NIGHT.**

**STEALTH CAN BE DETECTED VISUALLY; BEING
RELATIVELY SLOW AND UNMANEUVERABLE. A STEALTH
BOMBER VISUALLY ACQUIRED BY AN ENEMY FIGHTER
AIRCRAFT COULD BE AN EASY KILL.**

**STEALTH IS A PERISHABLE COMMODITY, AND IT IS
LEGITIMATE TO ASK ABOUT THE COST-EFFECTIVENESS
OF STEALTH BOMBERS IN A TIGHT FISCAL
ENVIRONMENT"**

(CONGRESSMAN JOHN R. KASICH, WASHINGTON POST, JULY 19, 1995)

Survivability Has Many Elements, None Can be Ignored



Survivability, essential element of mission effectiveness

Vulnerability Reduction Will Always Be Relevant for Aircraft

- **Birds and Lightning Don't Understand Maneuver & Stealth**
- **Technological Breakthroughs in Radar Tracking are Possible & Probable**
- **Reduced Vulnerability Adds More Robust Design Increasing Damage Tolerance and Increased Lifespan.**
- **High Procurement Cost and Maintenance Costs of Stealth A/C**
- **Aircraft Caught on the Ground Don't Benefit from Stealth, Maneuver or ECM.**

Air Force Leaders Are Concerned About Vulnerability of Transport Aircraft

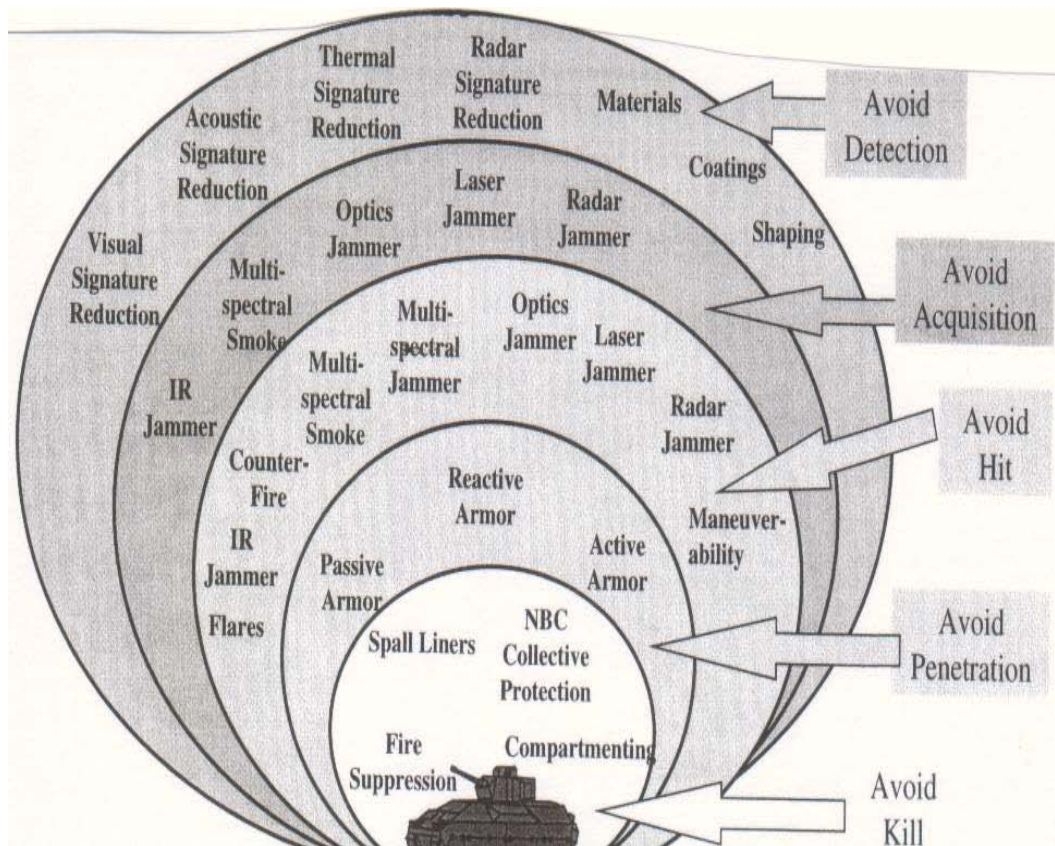


“More money should be spent on defensive systems for Air Transports. . . . The threat of ‘hostile fire’ against a large airplane full of troops keeps me awake at night. . . . I fly about 240 very vulnerable, large, gray airplanes that carry a lot of troops. . . . The more compelling threat are shoulder-fired missiles which are available worldwide.”



**--Air Force General Charles T. Robertson, Jr
Chief of the U.S. Transportation Command
National Defense Magazine, February 2001**

Vulnerability Reduction Will Always Be Relevant. Don't Make it the Last Item to Consider



????????????????????????????

TIME FOR Q&A.

ANY QUESTIONS,

COMMENTS, DISCUSSION
OF SUBJECT MATTER.