

# **TEST AND EVALUATION: SOME OPTIONS FOR THE FUTURE**

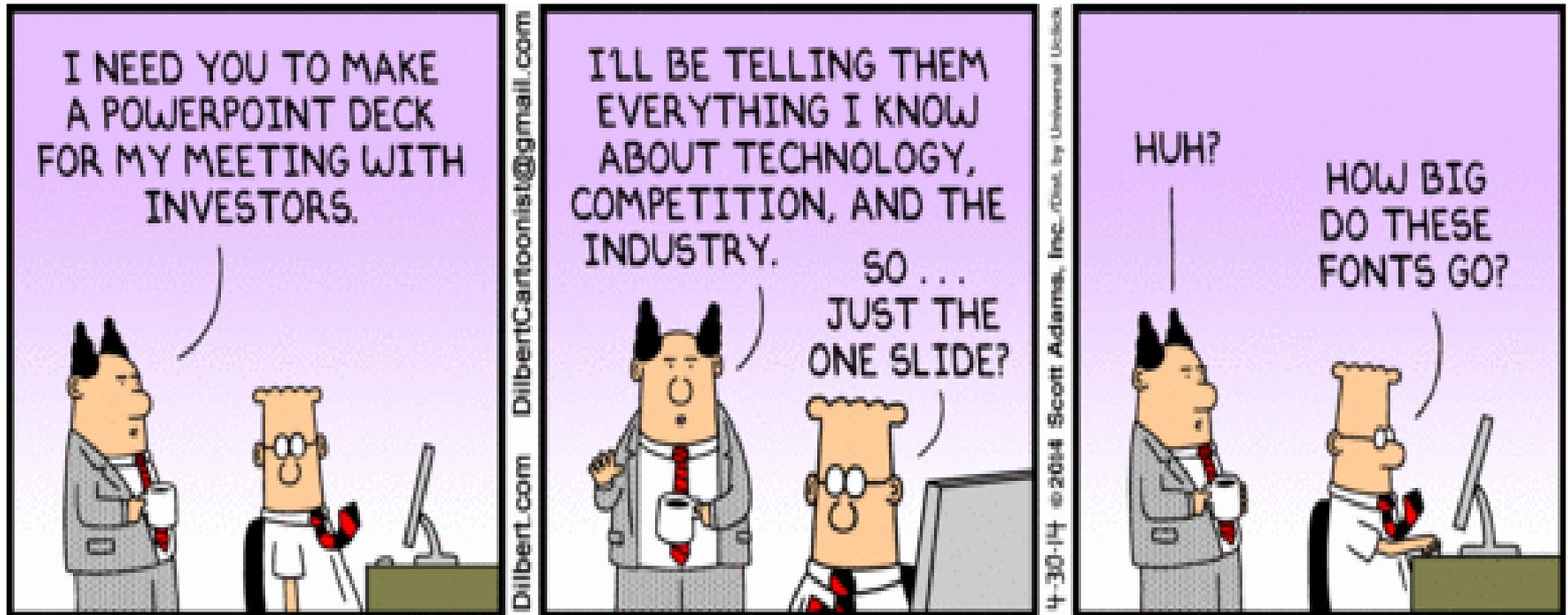
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***17th Test Instrumentation Workshop:  
“Test and Evaluation on a Sustainment Budget”***

***International Test and Evaluation Association***

John B. Foulkes  
JBF Consulting, LLC  
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# The Art of Creating PowerPoint Charts: *The Input*



## A Sample of Math Questions

1. Solve for “x”:  $2 \cdot \log_{10} x = 20$

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Answer:

$$2 \cdot \log_{10} x = 20$$

$$\log_{10} x = \frac{20}{2} = 10$$

$$x = \frac{10}{\log_{10}} = \frac{10}{\log_{10}} = \frac{1}{\log}$$

## A Sample of Math Questions

2. Simplify:  $\frac{\sqrt{18}}{6}$

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Answer:

$$\frac{\sqrt{18}}{6} = \frac{\sqrt{9 \cdot 2}}{6} = \frac{\sqrt{9} \cdot \sqrt{2}}{6} = \frac{3 \cdot \sqrt{2}}{6} = \frac{3 \cdot \sqrt{2}}{\cancel{6}_2} = \frac{\sqrt{2}}{2} = \sqrt{\quad}$$

## A Sample of Math Questions

3. Expand:  $(2x + y)^3$

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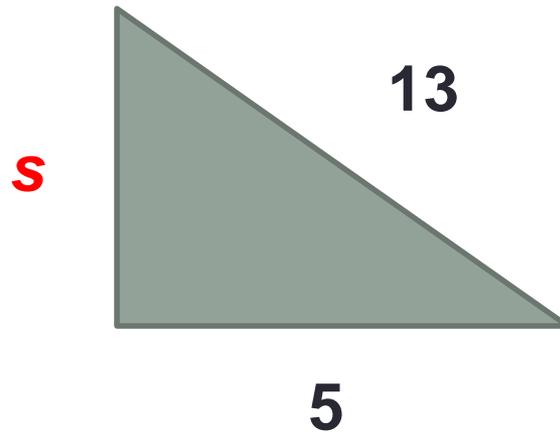
3. Expand:  $(2x + y)^3$

Answer:

$$( 2 x + y )^3$$

## A Sample of Math Questions

4. Find “**s**”:

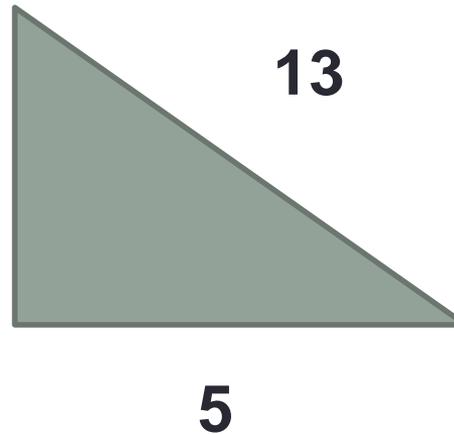


## A Sample of Math Questions

4. Find “**s**”:

Answer:

*Here it is !!* → **s**



# Weapons-systems costs up half-trillion dollars

Congress and Pentagon trying once again to reform defense acquisition practices in an era of tightened spending

BY CHRISTIAN DAVENPORT

The costs of the Pentagon's major weapons systems have ballooned nearly half a trillion dollars over their initial price tags, and the 80 programs have average schedule delays of more than two years, according to a report released Wednesday.

The report by the Government Accountability Office came during a congressional hearing in which senators from both parties vented about continued cost overruns, billions of dollars wasted when contracts are canceled and a system that is plagued by a high level of turnover that prevents anyone from being held accountable.

Sen. John McCain (R-Ariz.) listed a series of failed programs, including the attempt to replace the fleet of presidential helicopters, saying they were examples of "locally unacceptable cost overruns we've seen in the past, and apparently a failure to get a lot of it still under control."

For decades, Congress and the Pentagon have struggled with creating a more efficient system for buying weapons, tanks and airplanes, with limited success. In its report, the GAO noted that "too often we report on the same kinds of problems today that we did over 20 years ago."

But now, the renewed efforts, underway in both the House and Senate Armed Services committees and at the Pentagon, come as spending is tightening, which officials say gives an added urgency.

"We are going to have flat defense budgets as far as the eye can see, and the problems we're trying to deal with around the world are not flat," Rep. Mac Thornberry (R-Tex.), who is leading the effort in the House, said in a recent interview. "So the



The F-35 Joint Strike Fighter, the Defense Department's costliest-ever weapons system, has had six acquisition managers since 2001.

things we have tried have had little discernible impact."

Fixing the problems that plague defense acquisition "isn't as easy as many people think," he said. But he said there has been improvement in recent years and pointed to the Pentagon's Better

Program managers since 2001.

Part of the problem, many senators lamented, is the way the armed forces shuffle workers in and out of contracting positions. While it is okay to be stationed temporarily at some jobs, which allows service members to gain

continuity. You need expertise. You don't need a new guy every 18 months."

Michael Sullivan, the author of the GAO report, told the committee that the contracting workforce lacks "training and business experience and career

very few prime contractors on which to rely in each industry. The Defense Department and the contractor often develop products together, making the collaborations harder to walk away from.

"The department's relation-

WASH. POST 5/1/2014

TOM HEYER/LOCKHEED MARTIN VIA AP/WIDEWORLD

WASH. POST 4/28/2014

# What to expect from defense firms as 2014 plays out

Mixed earnings reports, shrinking U.S. budget force priorities to shift

BY AMRITA JAYAKUMAR

Washington defense firms Lockheed Martin, General Dynamics and Northrop Grumman last week released their first earnings reports of the year. The results were largely mixed. All three posted higher profits, but sales plummeted in the combat and information systems segments as the government's defense budget continued to shrink. Company executives had warned that 2014 would bring budget challenges and political wrangling.

Here's a roundup of what to expect this year and how contractors are adjusting their priorities, according to industry analysts.

## Alternate revenue streams

Many contractors will invest in other segments of their business in 2014, turning their focus away from defense, analysts say.

General Dynamics' aerospace sector was the only one to grow in the first quarter, because of orders for Gulfstream business jets, the company said.

Gulfstream will continue to be the key driver of future returns, said Loren Thompson, a defense analyst and consultant to Lockheed Martin.

Phebe Novakovic, chief executive of General Dynamics, said in a call with investors that she "liked the balance" between the company's aerospace and defense operations.

Lockheed has started diversifying into many areas, Thompson said, from cybersecurity to aquaculture to pilot training.

Bush recently said that Northrop was less interested in chasing new markets, preferring to focus on what it does best.

## International orders

As domestic demand dries up, contractors are expecting more business from foreign customers in 2014.

"The U.S. taking its boots off the ground has created enough of an incentive for our allies to begin arming themselves," said Jason Gursky, an analyst at Citigroup.

The Middle East and parts of Asia are driving demand, he said. In its earnings report, General Dynamics noted a \$10 billion training contract with the Canadian government's commercial contracting agency. The ultimate recipient of that order is Saudi Arabia, the company said.

This global shift will help offset some of the drop in U.S. orders, analysts say, but it won't be enough to make up for it.

Lockheed will benefit from increased orders for its F-35 fighter jets, and General Dynamics from orders for the commercial Gulfstream jet, analysts say.

Northrop Grumman chief executive Wes Bush told investors that global orders made up 14 percent of the company's year-end backlog in the first quarter. Bush said he expects growth to continue in 2014.

But foreign contracts "are notoriously difficult to time, to peg when they will come through," said Cai von Rumohr, an analyst with Cowen and Co. So even though international business will expand, it may not make its way onto companies' books until late in the year.

Northrop has a higher potential for growth than Lockheed or General Dynamics, analysts say, given that it has a smaller share of global business. Northrop is betting on increased interest in unmanned aerial vehicles, especially its Triton and Global Hawk systems, von Rumohr said.

## A rocky road

All three defense giants reported a drop in sales for the information systems and technology segments in the first quarter. Washington's latest jobs report also showed that the professional services sector, which includes government contractors, shed 11,500 positions for the one-year period ended in March.

The good news, according to analysts, is that information systems and technology will start growing again. The bad news, they said, is that growth won't be evident until at least 2015.

"We're going to be reaching the bottom pretty soon if we haven't already," said Gursky, the Citigroup analyst.

Although the bipartisan budget deal reached late last year provided some certainty to contractors, the effects of the agreement haven't been felt yet, analysts say.

Novakovic said that General Dynamics expects growth in its health-care services sector, although it is a largely seasonal business. The contractor acquired health-care technology firm Vangent for \$960 million in 2011.

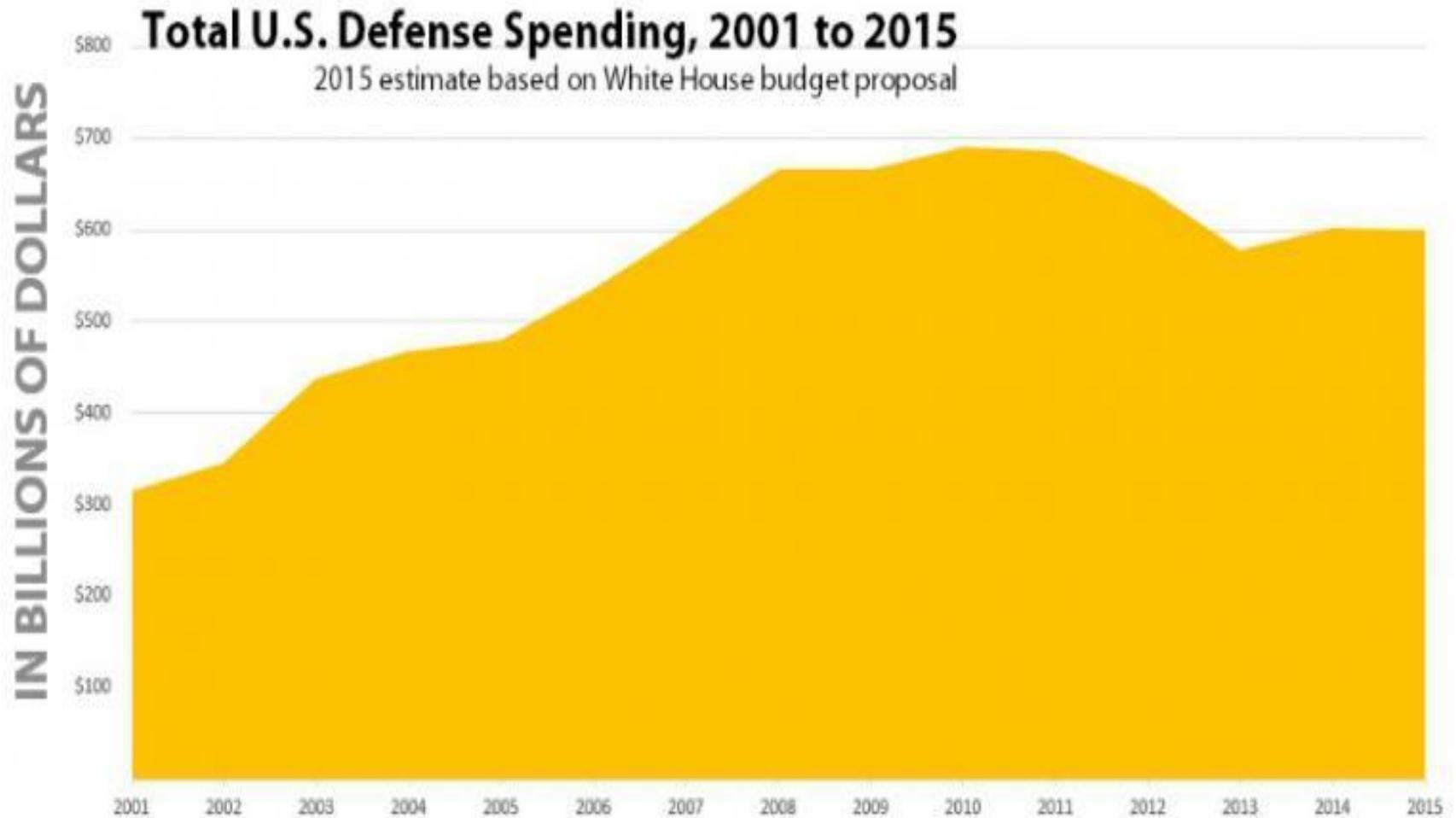
## Cash returns

Shareholders can expect more returns from contractors in 2014. As companies cut costs and try to keep their operating expenses down, they will have more cash to give back, analysts say.

"That's why their stocks have been doing well despite the headlines," Gursky said.

Overall, this will be a tough year for defense contractors, just like the previous one. But if companies can make it through 2014 with no major surprises out of Washington, the worst could soon be in the past.

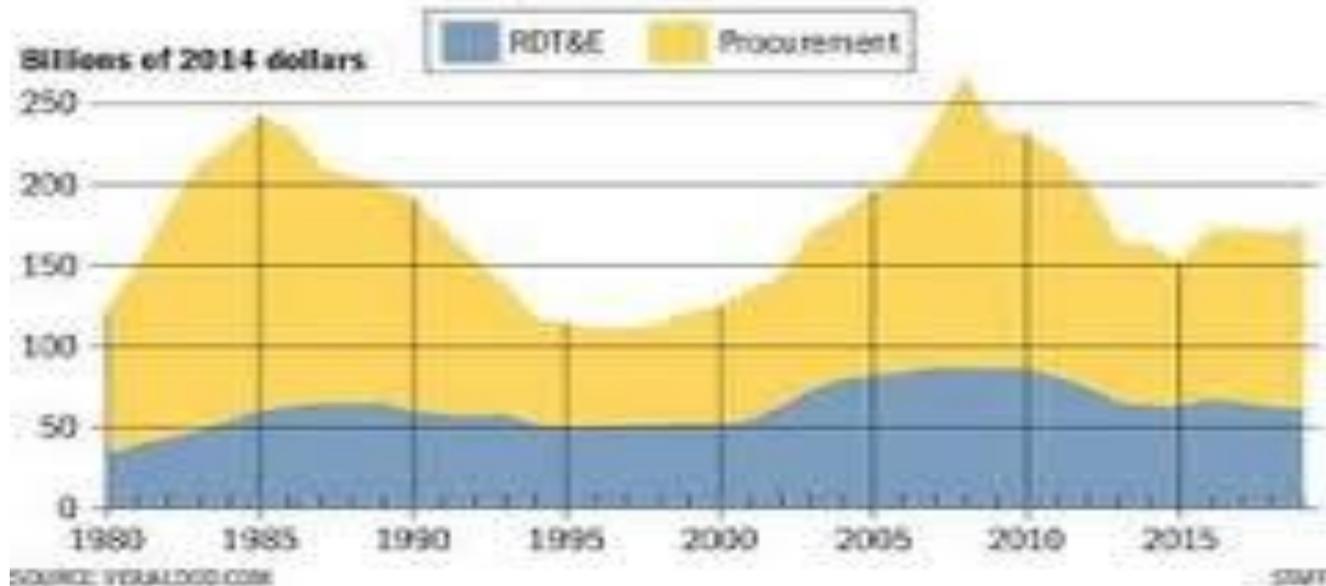
amrita.jayakumar@washpost.com



SOURCE: U.S. Department of Defense

## RDT&E vs. PROCUREMENT

Over the years, the ratio of DoD spending on RDT&E and procurement has risen and fallen, reflecting the relative priorities of immediate needs and investment for the future.



## The Situation

- **Budgets were cut; we adjusted.**
  - *Budgets should remain predominantly flat for the next few years*
- **Leadership continues to look for ways to reduce the cost of acquisition.**
- **Loss of jobs, competencies (particularly technology).**

### Washington Post Articles:

- *“During the past 40 years...(we’ve) seen any number of attempts to improve defense acquisition.....many of the things we have tried have had little discernible impact”.*
- *“All 3 defense giants (Lockheed Martin, General Dynamics and Northrup Grumman) reported a drop in sales for the information systems and technology segments in the first quarter.....the professional services sector, which includes government contractors, shed 11,500 positions for the one-year period ending in March.”*

***Is there a correlation between an increasing frequency of major weapon programs not advancing beyond Milestone C and the loss of technology/operations research skillsets in the workforce?***

## **Some Options for the Future:**

***What can the T&E Community do to Contribute to Cost Reduction?***

***...while maintaining its effectiveness and relevancy....***

- ***Shrinking budgets means shrinking the T&E footprint.***
- ***Examine the entire T&E business enterprise***
  - ***First: Baseline the cost!!!***
  - ***Infrastructure***
    - ***Test and Training Ranges***
    - ***Facilities***
    - ***BRAC versus non-BRAC***
  - ***Process***
  - ***Skills and Competencies***

***Putting the “A” into Test Design, ANALYSIS, and Evaluation***

# **The Infrastructure:**

## ***The Hardest Nut to Crack***

### ***The Testing Enterprise***

- ***Six Test Resource Categories***
  - ***Modeling and Simulation Facilities***
  - ***Measurement Facilities***
  - ***System Integration Labs***
  - ***Hardware-in-the-Loop Facilities***
  - ***Installed Systems Test Facilities***
  - ***Open-Air Ranges***

### ***Other Domains (Training and Operations Communities)***

***We have had base closures***

***We have had self-initiated studies***

***Are we “right-sized?” How would we know?***

# The “Short” History of Base Closures

**1961 closures:** [President Kennedy's announced on March 28, 1961](#), for 73 military establishments to be closed-- Congress was informed on 30 March.

**1964 closures:** In December 1963, Secretary McNamara announced the closure of twenty-six DOD installations or activities in the CONUS.

**1965 closures:** Secretary of Defense [Robert McNamara](#) announced 95 base closures/realignments in November 1964: 80 in the United States (33 states & [DC](#)) and 15 overseas.

**1968 Project 693.** [Project 693](#) was established by Secretary [Clark Clifford](#) during the [Vietnam War](#) for reducing programs and personnel, and the project also closed several military installations.

**1969 realignments:** The DoD realigned 307 military bases beginning with an announcement in October 1969.

**1974 Project Concise.** [Project Concise](#) eliminated most of the [Project Nike](#) missile locations which generally each had 2 sites, a radar station on an elevated landform for guidance and command/control, and a launch area that had launch rails and stored missiles and warheads.

**Grace Commission:** [The Grace Commission](#) concluded in 1983 that savings could be made in the military base structure and recommended establishing an ***independent commission*** to study the issue. Public Law 100–526 endorsed the review in October 1988 and authorized the special commission ***to recommend base realignments and closures to the Secretary of Defense*** and provided relief from NEPA provisions that had hindered the base closure process.

**The Carlucci Commission** was chartered by the [Secretary of Defense](#) on 3 May 1988 and in December 1988 recommended closure of 5 AFBs (Chanute, George, Mather, Norton, and Pease).

# The “Short” History of Base Closures

## **Defense Base Realignment and Closure Act of 1990**

The Defense Base Realignment and Closure Act of 1990 provided the basic framework for the transfer and disposal of military installations closed during the base realignment and closure (BRAC) process. The process was created in 1988 to reduce politics with members of Congress that arise when facilities face activity reductions.

## **BRAC Commission closures/realignments affecting Test and Evaluation:**

**1988:**

[Jefferson Proving Ground](#)

**1991:**

[Fort Ord](#); [Fort Rucker](#) (Realigned)

**1995**

*Disestablishing ATCOM, transferring its mission and organizations to Redstone Arsenal to merge with the Army Missile Command to form AMCOM; .[Fort Greely](#) (Realign)*

**2005**

Included a Test and Training Range subgroup to develop closure

The [National Defense Authorization Act for Fiscal Year 2014](#) specifically prohibits authorization of future BRAC rounds: *No future Base Realignment and Closure round for military installations within the United States, its commonwealths, territories, and possessions for realignment or closure shall be authorized until, at the very earliest, the Department of Defense has completed and submitted to Congress a formal review of the overseas military facility structure, which incorporates overseas basing consolidations, an assessment of the need for bases to support overseas contingency operations, and the Department of Defense's Strategic Choices and Management Review.*

[Aviation Technical Test Center](#) to Redstone Arsenal, AL, and consolidating it with the Technical Test Center at Redstone Arsenal, AL

[Relocate the Cold Regions Test Center \(CRTC\)](#) headquarters from Fort Wainwright, AK, to Fort Greely, AK .

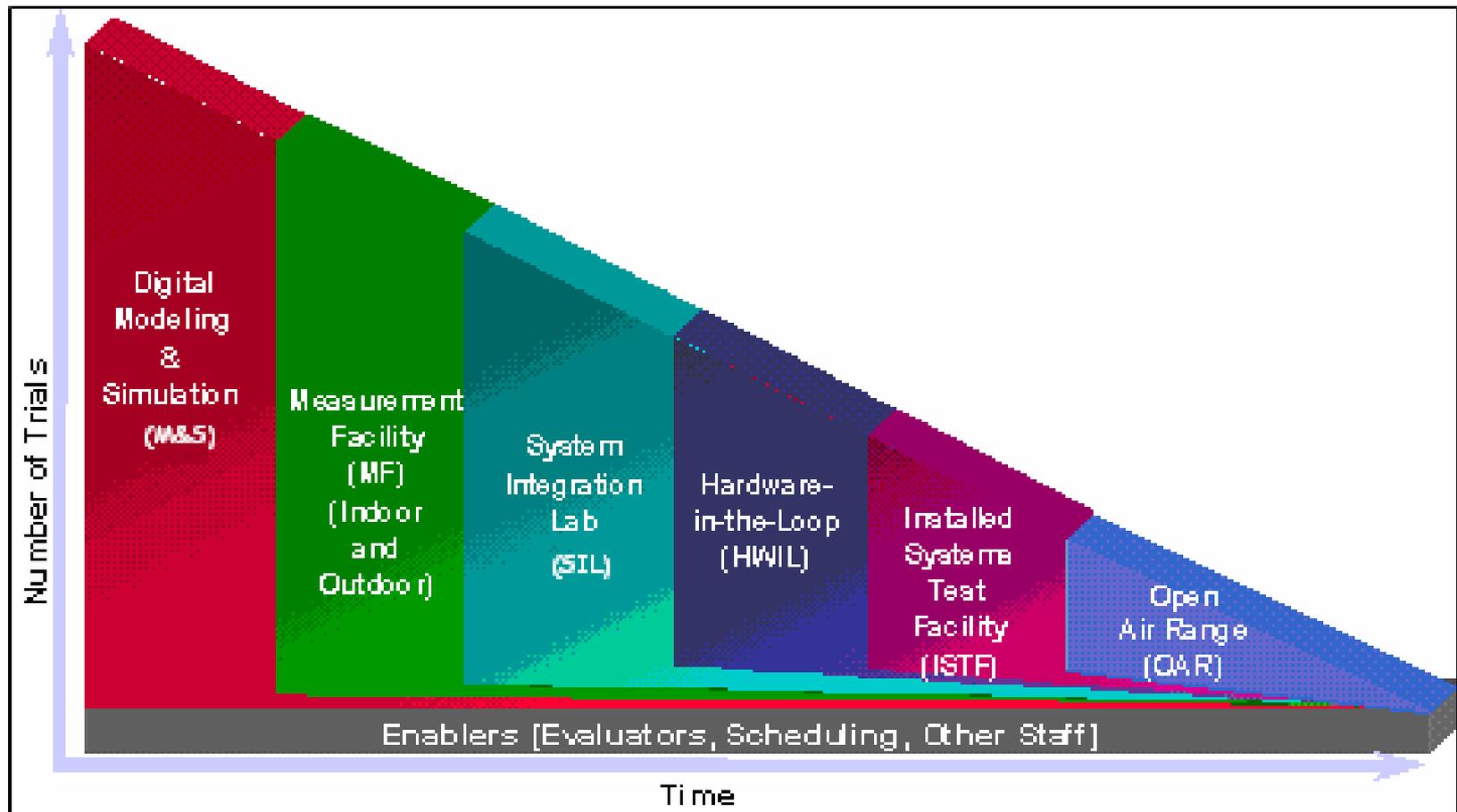
## Self-Initiated Studies

*Some of the memorable ones.....*

- *T&E Board of Directors Infrastructure Study (1994)*
- *Vision 21 (1996)*
- *Proposed Realignment of Air Force Test and Evaluation Facilities (2008)*
- *CBA on Test Facilities for the U.S. Army Test and Evaluation Command (2009)*
- *Tri-Service Electronic Warfare Test Capabilities Study (2010)*
- *USD(AT&L) Comprehensive Review of the T&E Infrastructure (2012)*

***Infrastructure is expensive to maintain and modernize!  
Do we need more BRACS; more studies?  
Preserve the Air, Land, Sea and Space “Space”***

## The T&E Process: Infrastructure Aligned with Testing Needs



## The Process

**Test designs are improving as we learn and apply more effective design tools (e.g., *Experimental Design, Reliability Growth planning*)**

**And we are using the infrastructure more effectively (e.g., *distributed LVC network across the six Test Resources Categories.*)**

### **Data collection:**

***Incredible amounts of data are generated during testing. How much of it do we really need? Can we (should we) reduce testing?***

- *How many times we test (the frequency)*
- *Where we test (fewer locations)*
- *More testing may not always be better; we may just get more bad data.*
- *Maybe less (expensive) testing and more reliance on analytics.*

### **Do we need the separate fiefdoms of DT&E and OT&E?**

- *We have tried “integrated T&E” .....*

## Skills and Competencies

***Recall the “4 Math Questions” from the beginning of the presentation.***

***Have Operations Research-type and technology-type competencies deteriorated?***

***Impacts:***

- ***If we do less testing, can we compensate by using more analytics?***
  - ***More efficient and effective test design***
  - ***Emphasize analysis in the evaluation process***
- ***More modeling and simulation (i.e., constructive)?***
  - ***How confident are we in our VV&A techniques?***

***New domains (e.g., Cyberspace) bring an additional set of concerns***

# The Cyber Domain

*What is needed to accelerate our preparation for testing in the Cyber Domain?*

## Policy

- *We have a lot of policy already.....*
- *Kratznicki's Law: Compliance with policy is inversely proportional to the amount of policy to be complied with.*

## Methodology

- *Adapt/translate from the traditional domains into the Cyber Domain, but.....*
- *Operations in Cyber Space do not translate well from conventional operations.*
  - *The avenues of approach for an adversary are wide.*
  - *In conventional operations, we can study the terrain and know where the enemy can and can't go.*
  - *Not so in Cyber Space: if the terrain exists, it is passable.*

**Infrastructure (e.g., the National Cyber Range)**

**Skills and Competencies**

## The Academic Contribution: Understanding the “physics” of system/network intrusion

- Behavior of systems (hardware software, people) in networks has a rich mathematical foundation.
  - Modeling the human
  - Statistical techniques applied to stochastic processes
  - Current University-level research using:
    - Variable Length Markov Models (VLMMs)
    - Hidden Markov Models (HMM)s
    - Partially Observable Markov Decision Processes (POMDPs)
    - Bayesian Networks
  - All help provide better insight into pattern recognition; in predicting attacks and their outcomes, assessing the probability of penetration and determining the risk of disruption or destruction of the system.

## The Bottom Line

- *Shrinking budgets and cost-cutting initiatives will continue.*
- *The T&E enterprise must be a willing partner in the inevitable reduction of its footprint.*
- *Operations Research/technology skills and competencies should be significantly increased in the workforce as more emphasis must be given to analytics in the design and evaluation processes.*

***Bold initiatives must be taken in order to keep T&E relevant and effective in the acquisition process.***

# The Art of Creating PowerPoint Charts: *The Result*

