NATIONAL DEFENSE INDUSTRIAL ASSOCIATION

STRENGTH THROUGH INDUSTRY & TECHNOLOGY

9th National Security Space Policy & Architecture Symposium

"S&T Ingredients for the Back to Basics Recipe"

DUANE DEAL

The Johns Hopkins University

APPLIED PHYSICS LABORATORY

The right idea …

The right idea …

That's what it's all about!

Overview

- Peeking at what's happened -- the environment
- The right recipe: "Back to Basics"
- A few S&T perspectives & credentials (via a "1-Person Panel")
- Applying S&T capabilities to the end-to-end cycle
- Summary

Theme

If --

“Back to Basics” is the question …

Then --

a government, industry, & lab mix
is the best answer.

9th National Security Space Policy & Architecture Symposium

Peeking at what's happened:

The environment via 20-20 hindsight

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

External environment

The Washington Post

Military Ordered To Trim Budgets

5-Year Plans Must Be Cut By $32.1 Billion

By Renae Merle and Bradley Graham, Washington Post Staff Writer

….

Thus, **the cuts are expected to come at the expense of expensive weapons programs** such as Lockheed Martin Corp.'s F-35 Joint Strike Fighter and the DD(X) destroyer being developed by Northrop Grumman Corp. The military's procurement and research and development programs, from which defense companies most of their profits, are considered vulnerable, **especially those that are behind schedule or over budget.**

DefenseNews

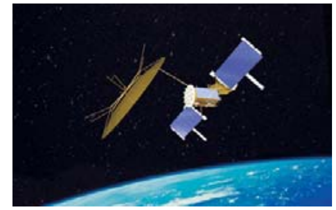
U.S. MDA May Cut $1B Over 5 Years

By Gopal Ratnam

The Pentagon's Missile Defense Agency (MDA) proposes to axe nearly $1 billion from its five-year budget plan to satisfy the Defense Department's budget priorities.

…. the MDA will cut $955 million from its 2007-11 plan to meet Pentagon budget goals set out in an Oct. 19 directive from Gordon England, acting U.S. deputy secretary of defense. England's memo ordered agencies to find $32.1 billion in cuts for 2007-11....

The Space Review
essays and commentary about the final frontier



The US Navy: lost in space?

by Taylor Dinerman

The cost and engineering problems the Air Force is having with their space programs and in trying to train a solid cadre of qualified and effective space personnel are all too familiar. Now it seems that, on a smaller scale, the Navy is stuck with a similar dilemma. This problem could become more serious in the future since, unlike the Air Force, the senior Navy leadership may not even be aware that there is anything wrong.

….

AVIATION WEEK'S AEROSPACE DAILY & DEFENSE REPORT

AF Space Program Woes Hurting Army Capabilities

COLORADO SPRINGS, Colo. -- The commander of the U.S. Army Space and Missile Defense Command expressed concern on Jan. 24 about cost and schedule troubles in Air Force space programs, saying they have a negative effect on Army capabilities and reduce the confidence of Pentagon officials in Army programs.

SPACE NEWS

GAO Says U.S. Air Force Has More Space Than It Can Handle

By JEREMY SINGER
Space News Staff Writer

WASHINGTON – The U.S. Air Force has started more space programs than it can afford, setting itself up for disruptive funding cuts and schedule delays, according to a government audit report delivered to Congress June 23. ….

-Trying to make technological leaps that are too difficult with next generation systems.

….

-Lack of a qualified workforce to support space acquisition programs. ….

SPACE NEWS 19
September 19, 2005

Acquisition Lost in Space

< REP. TERRY EVERETT (R-ALA.) >

Recently, some have suggested that we have done enough to fix the acquisition problems of the Department of Defense; we now must let the roots take hold and wait for it to bear fruit. While it is true that the department started to move in the right direction, enough has not yet been done. Our nation's defense acquisition system is still "Lost in Space."

The nation's acquisition process is in poor shape and nowhere is that more apparent than in the development of our national security space assets. For example, program managers for the National Polar-orbiting Experimental Satellite System recently notified the House Armed Services Committee of its first breach of the Nunn-McCurdy Act, a law that requires congressional reporting for acquisition programs whose costs grow 15 percent, and mandates program recertification for those acquisition programs whose costs grow 25 percent or more.

The Space Based Infrared System-High recently experienced its second breach in as many years, notifying the committee of a cost growth exceeding 40 percent. Additionally, the Evolved Expendable Launch Vehicle and the Advanced Extremely High Frequency programs both experienced breaches over the last 18 months. Further, several intelligence collection satellites are multiple billions of dollars over budget and several years late in fielding their intended capability.

We can and must do more. Our investment in space is far too important for our economic and military well-being to take this lightly. To achieve success, we must continue to focus our attention on four key areas:

- Poor cost estimating and budgeting;
- Lack of systems engineering expertise;
- Lack of investment in acquisition professionals; and,
- Poor subcontractor management.

I will explain the nature of the problem and describe solutions that we must continue to execute.

Poor cost estimating has plagued every new national security space program since the Milstar program. Moreover, acquisition reform during the 1990s included significant manpower reductions, shrinking the acquisition workforce by more than 50 percent and affecting the cost estimators much harder than that. The Air Force went so far as to get rid of the cost estimation duty-specialty for its personnel, subordinating it as an additional duty.

The expertise and knowledge of these professionals were allowed to waste away. As a result, neither industry nor the government has a system of checks and balances to maintain reality in or accountability for their cost estimates.

Secondary consequences allowed the manufacturing of cost estimates for the purposes of winning an industry bid or, in the case of government, getting buy-in to meet larger service budgetary constraints. Programs were destined for significant overruns before they ever started.

The solution: Increase the number of cost estimators, rebuild and reward their skills and expertise, ensure their independence from the program offices, and develop realistic budgets that incorporate the Defense Science Board recommendation to budget at the 80-percent confidence level rather than the current practice of budgeting to the 50-percent confidence level.

The blind pursuit of "faster, better, cheaper" during previous acquisition reform attempts ruined the government's systems engineering, while a lack of a national effort to celebrate math, sciences and the future use of space in our education crimped the pipeline that creates the nation's engineers.

A lack of vision for the future of space failed to inspire the nation's youth to join its ranks. Further, past acquisition reform reduced the number of government engineers and forced those remaining to depend on industry to do their jobs for them.

Again, as in the case of cost estimators, the numbers as well as the knowledge and expertise of our engineers diminished to dangerously low levels, allowing shoddy work and poor quality control. In order to achieve success, engineers faced steep learning curves and unrealistic workloads. They were set up for failure from the beginning.

The solution: Increase the number of engineers, build and reward their skills and expertise, and continue to build and communicate a vision for the future of space, similar to the president's plans for space exploration.

Past attempts at acquisition reform and the culture of the military services have resulted in an underinvestment in Department of Defense acquisition professionals. The drastic downsizing of the acquisition workforce has had far reaching impacts. In the Air Force, despite handling more than 70 percent of the total Air Force budget and developing 100 percent of the weapons systems in use, acquisition professionals are often treated as second-class citizens.

Promotion rates are generally lower than their peers on other career paths. Opportunities for command are often nonexistent. Training and career development for acquisition professionals is inadequate and out of date.

The solution: Make these professionals a priority. Ensure adequate promotion rates and command opportunities for the acquisition workforce, while addressing the shortcomings of the associated training and development of their careers. Establish a culture that values the contributions of these professionals.

Due to the consolidation of the defense industry, only three prime contractors remain to bid on national security space projects. Therefore, a prime contractor must manage anywhere from eight to 12 subcontractors. Unfortunately, sufficient accountability does not exist in today's acquisition system.

Subcontractors and suppliers have been allowed to grow careless with inadequate and unfocused leadership from the prime contractors. Countless horror stories exist about needless contamination of parts, frequent rework of subcomponents, nonexistent communications between and among systems developers, and lack of manufacturing discipline. For example, the prime contractor of a current intelligence collection program experienced four separate problems on the same part before seeking a new subcontractor.

The solution: Create accountability and exert leadership. The prime-sub relationship should be closely managed.

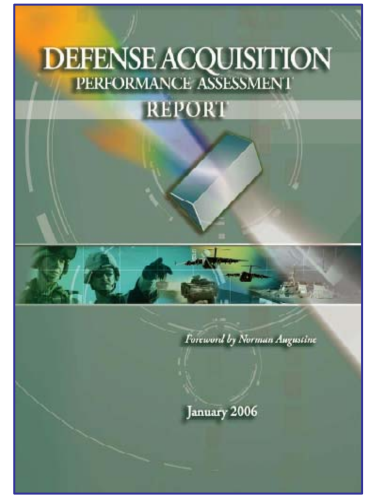
Contracts should be awarded either to the concept with a manageable number of subcontractors or structured to provide sufficient incentives and penalties required to ensure proper performance. Government representation in the contractor factories must once again be instituted in order to ensure quality control and provide oversight.

The acquisition challenges of national security space are critical from both a fiscal and operational context. As such, it is important that we not lose momentum in this endeavor. There is far more work remaining to remedy our acquisition system. These solutions will take us a long way toward that goal.

Rep. Terry Everett represents the 2nd Congressional District of Alabama in the U.S. House of Representatives and is the chairman of the House Armed Services subcommittee on strategic forces and a member of the House Armed Services subcommittee on tactical land and air forces, and the Veteran's Affairs subcommittee on oversight and investigations. He also is vice chairman of the House Permanent Select Committee on Intelligence technical and tactical intelligence subcommittee, and is a member its oversight subcommittee.

Defense Acquisition Performance Assessment (DAPA)

- Cited prominent examples
  - Cost tripled, delays
  - Complex technology … not sufficiently prototyped



- Emphases:
  - Timing as a Key Performance Parameter (KPP)
  - Budget to most realistic cost estimates; contract similarly (or be unexecutable from square one)
  - Choose low risk solution over best value; reward for adhering to schedule versus only paying for performance

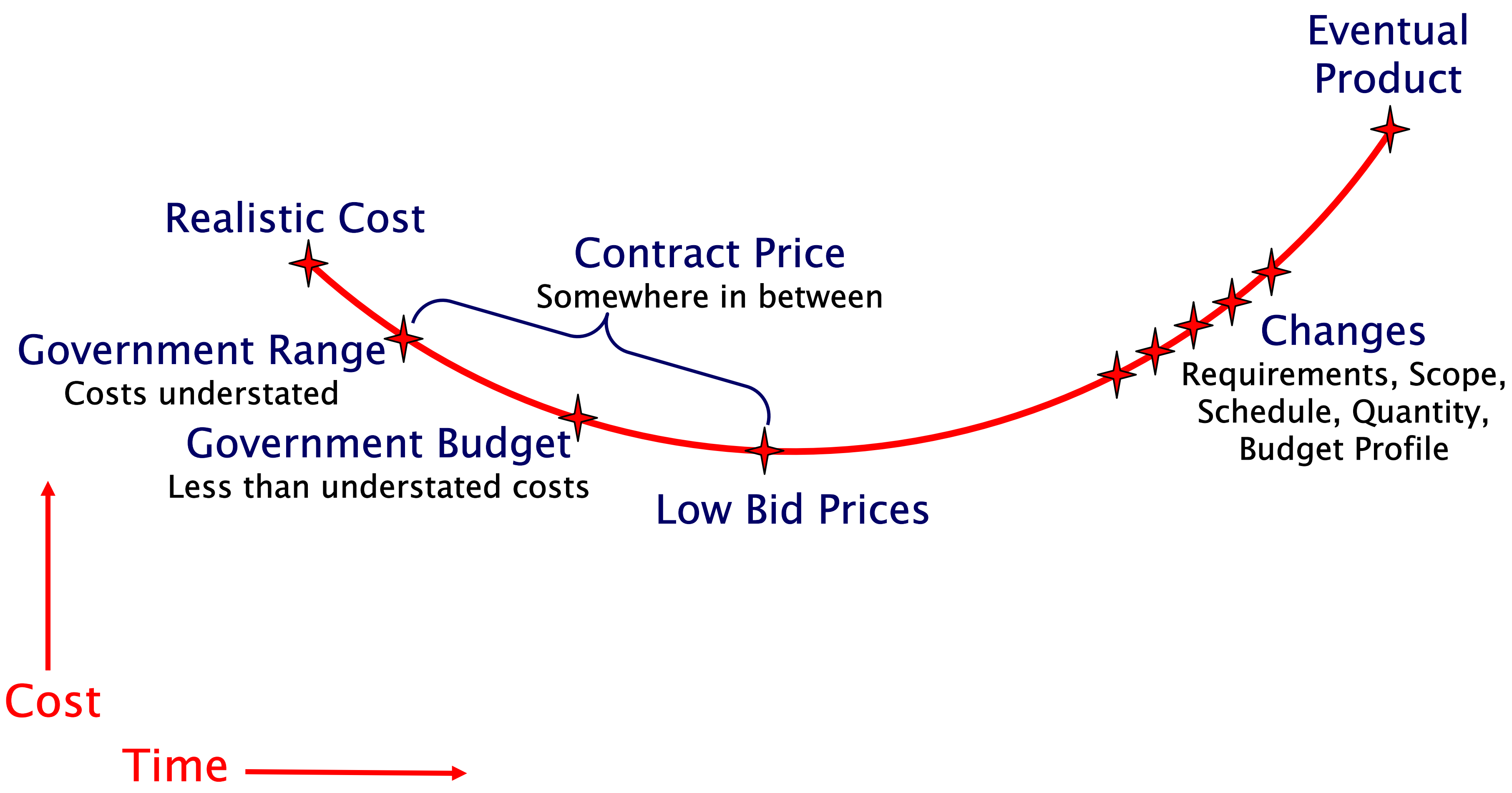
Another independent view

Addressing National Security Space problems

Ref: *"What Went Wrong in National Security Space?,"* remarks to Space Enterprise Council, U.S. Chamber of Commerce, by Loren Thompson, COO Lexington Institute, 13 Sep 05)

- Study revealed not-so-surprising major problems:
  - Unplanned <u>cost growth</u>
  - Excessive/unrealistic performance <u>requirements</u>
  - Poor <u>management</u> practices
  - High <u>workforce</u> turnover
- *NSS Acquisition Policy 03-01*
  - Demands rigorous approach to technical baselines & performance requirements
  - <u>Mandates early testing</u> of critical components

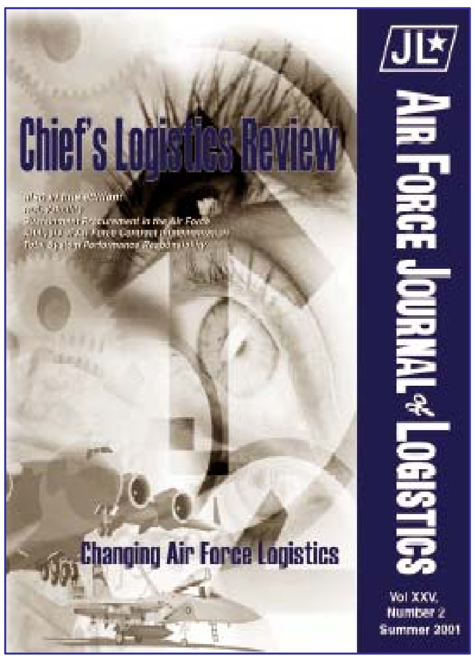
The Cost "Axis of Evil"



The TSPR road

"We expect to achieve greater successes from every person, dollar, and hour we expend to acquire and sustain our current and new weapon systems."

Darleen Druyun
(then) Principal Deputy Assistant Secretary of the Air Force for Acquisition and Management



"The TSPR approach addresses General McPeak's assessment of acquisition and seeks to turn failures into successes …

TSPR is certainly more than a passing catchy phrase or acronym …. "

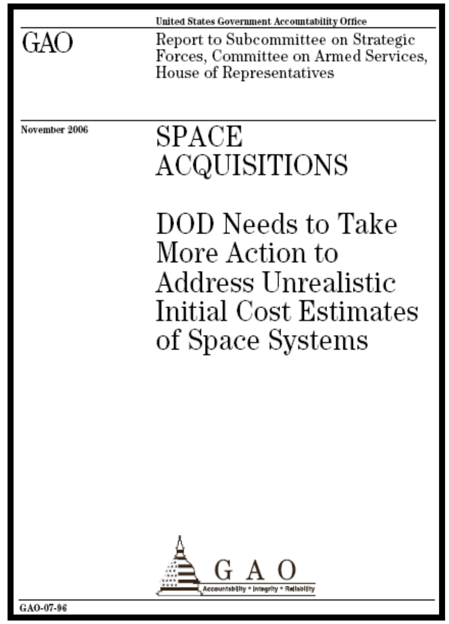
Air Force Journal of Logistics
Summer 2001

The TSPR road dead-ends[1]

Military Aerospace Technology
15 Nov 2004 in Volume 3, Issue 3
Interview with Lt. Gen. Brian A. Arnold
(then) Space and Missile Systems Center Commander

"…. space programs will continue to be challenging by their very nature. As a result of a decade or more of acquisition reform and the Total System Program Responsibility [TSPR] concept, … less government oversight led to less insight, and any initial cost savings due to manpower savings became cost overruns. We have eliminated TSPR as a process."

The TSPR road dead-ends$_2$


United States Government Accountability Office

GAO

Report to Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives

November 2006

SPACE ACQUISITIONS

DOD Needs to Take More Action to Address Unrealistic Initial Cost Estimates of Space Systems

GAO-07-96

November 2006

“Total System Performance Responsibility, or TSPR--was intended to facilitate acquisition reform and enable DOD to streamline a cumbersome acquisition process and leverage innovation and management expertise from the private sector. However, DOD later found that this approach magnified problems related to requirements creep and poor contractor performance.”

"If you do not know where you are going, any road will take you there."

Cheshire Cat in *Alice in Wonderland*

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION

STRENGTH THROUGH INDUSTRY & TECHNOLOGY

9th National Security Space Policy & Architecture Symposium

The Right Recipe: "Back to Basics"

"Preventing recurring nightmares"

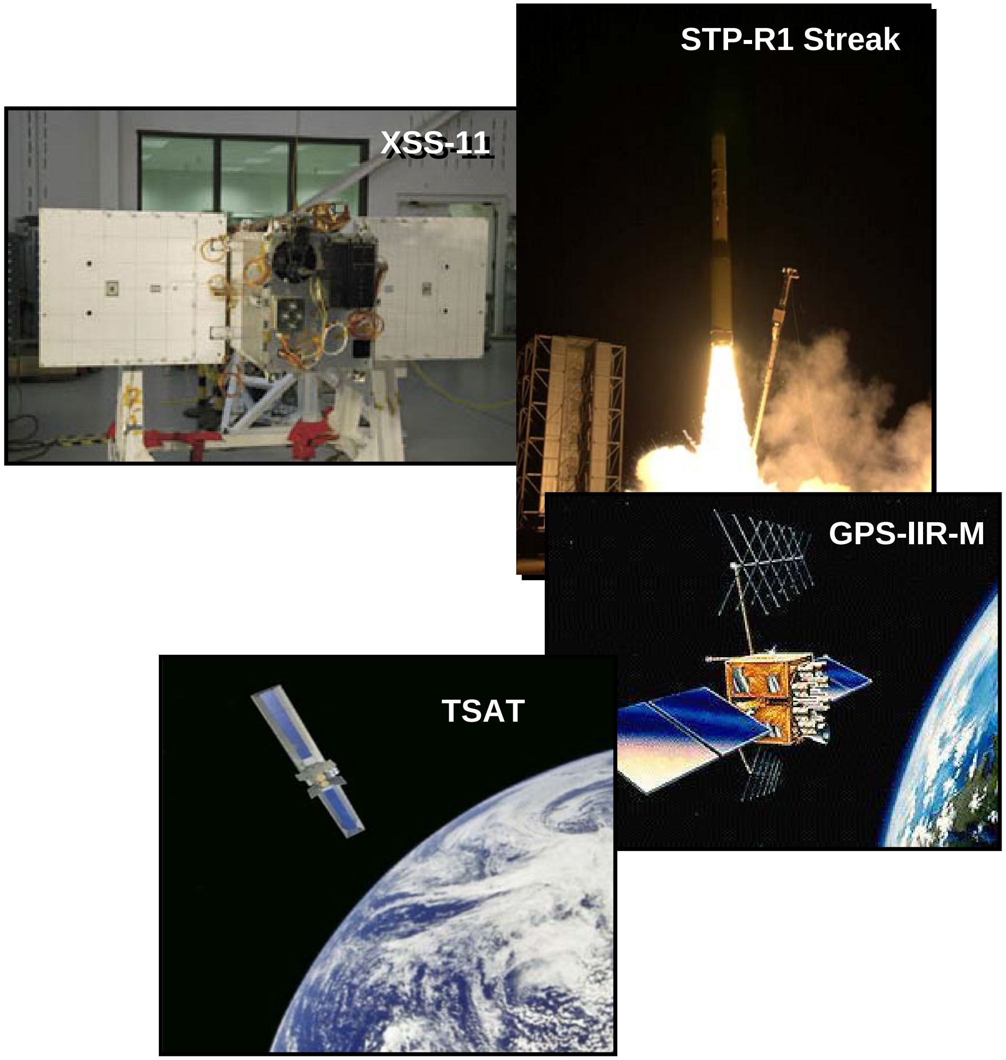
"Change is inevitable.
Growth is optional."

Walt Disney

NOTE: Presented by USecAF Sega,
National Space Symposium, 5 Apr 06
Strategic Space & Defense, 11Oct 06
NDIA Symposium, 1 Feb 07

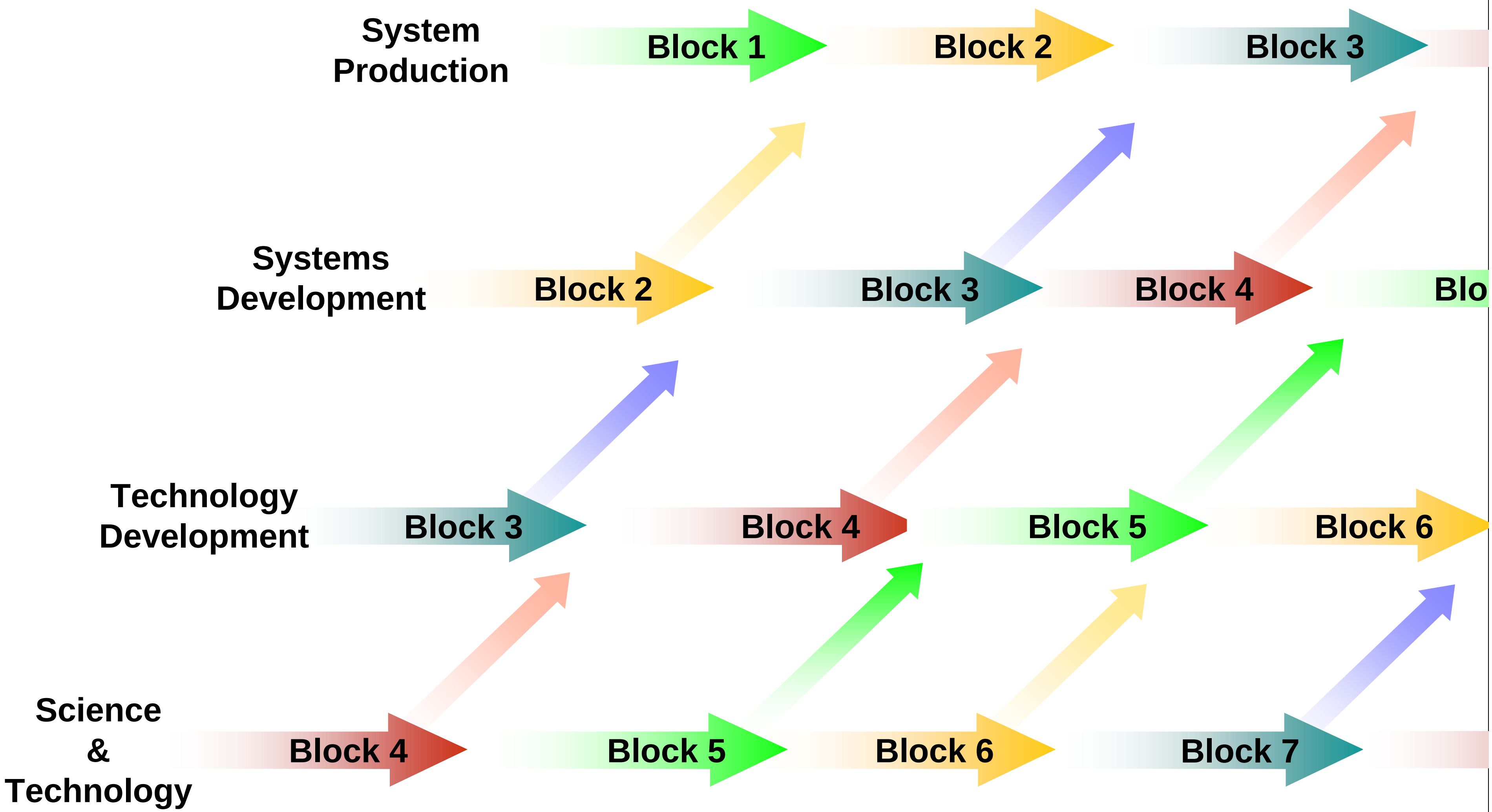
Back to Basics in Acquisition

- Four-stage process
  - System Production
  - Systems Development
  - Technology Development
  - Science & Technology
- Reapportion Risk
  - Lower risk in Production
    - Use mature technology
  - Higher risk in S&T

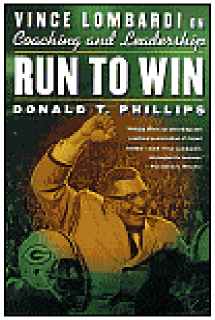


NOTE: Presented by USecAF Sega,
National Space Symposium, 5 Apr 06
Strategic Space & Defense, 11Oct 06
NDIA Symposium, 1 Feb 07

Acquisition Stages—Block Approach



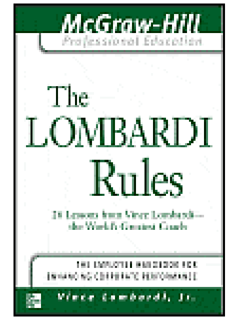
Back to Basics



aka

"Focus on Fundamentals."

Vince Lombardi



- Addresses DAPA concerns
  - Complex technology not sufficiently prototyped … timing … low risk solutions … schedule
- Addresses independent assessments
  - GAO
    - Mature technology, funding stability, requirements, schedules
  - *NSS Acquisition Policy 03-01*
    - Early testing, baselines, requirements, evolutionary acquisition
  - Lexington Institute
    - Risks, schedule, requirements, cost growth
- Confirms "TSPR R.I.P."
- Addresses QDR requirements
  - New acquisition policies, procedures, and processes

9th National Security Space Policy & Architecture Symposium

Mitigating risks, preventing "disasters" --

A few S&T perspectives

"Been there, doing that"

AFRL, NRL, Draper, SDL, & APL

AFRL Space S&T for Risk Reduction

- USECAF Block Approach: vigorous experimentation to reduce risk
- AFRL Space Vehicles Directorate is embracing this philosophy
  - Strong program in space experimentation
  - 8 major flight experiments on docket
- AFRL legacy space S&T for risk reduction -- examples:
  - CRRES – microelectronics & space sensor risk reduction
  - APEX – solar cells and microelectronics risk reduction
- Current AFRL space S&T for risk reduction -- examples:

Major Experiments

- RR-AIRSS – Risk Reduction - Alternate IR Satellite System
- TacSat series – small satellites with tactical utility

Component Technologies

- Solar cells
- IR detectors and read-outs
- Cryocoolers
- Space electronics

Examples of AFRL Space S&T for Risk Reduction

RR-AIRSS: Risk Reduction - Alternate IR Satellite System

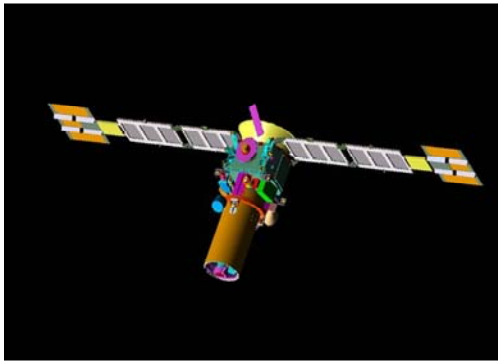
- OSD/AT&L mandated AIRSS program to provide hedge against further difficulties with SBIRS GEO satellites
- SMC & AFRL using USECAF Block Approach to reduce AIRSS risk
- Develop, build, and flight qualify wide-field-of-view, full-Earth staring sensor
- FX-AIRSS flight experiment: investigate data processing & full-Earth backgrounds
  - Seeking FY10 launch to GEO

Wide-Field-of-View

Full-Earth Staring Sensor

TacSats and Operationally Responsive Space

- ORS S&T mandated by Congress
- Mission: timely satisfaction of JFC needs
- S&T goal: mature technology to TRL 7
- ORS S&T Roadmap to guide S&T
- TacSat-2: launched on 16 Dec 06
  - Panchromatic imager
- TacSat-3: launch in 2008
  - Hyperspectral imager



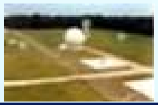
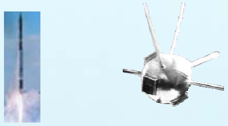
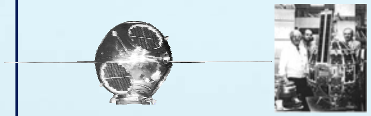
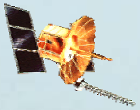
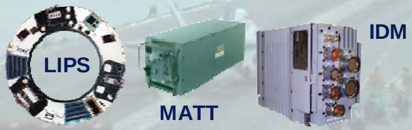
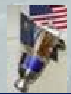
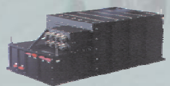
TacSat-2

Naval Research Lab has a Long History Developing New Space Capabilities with Major Operational Impacts

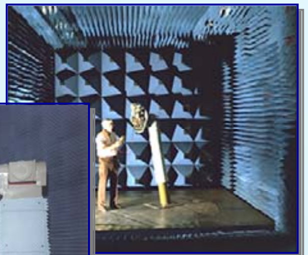
- **NRL Has a Long and Diverse History in Space and Transition to Operations**
  - **90 Satellites and 36 Launches for National, DOD, and Civilian Sponsors**

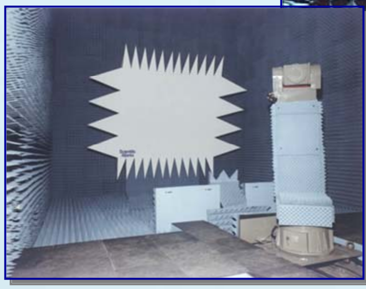
Consistent Record of R&D Prototyping Which Transitions to Industry & Operations

NRL History: *Making Space Tactically Relevant to the Joint Community*

1956	**Blossom Point** "Mini-Track"		1st Satellite Ground Tracking Station, Transitioned to NAVSPASUR
1958	**Vanguard Satellite & Rocket**		Nation's Oldest Orbiting Satellite. Rocket Transitioned to New NASA & Created Foundation for Delta Rockets.
1960	**GRAB / Poppy**		1st U.S. Reconnaissance Satellite & First National ELINT Operational System
1974	**Timation/NTS**		1st Global Positioning System (NAVSTAR GPS) Satellite/Time From Space
1983	**FLTSATCOM** (Early NRL Payloads–Op Sys. for Navy-Not by NRL)		Navy Satellite Systems for Tactical Users (FLTSAT 1 launched 1978). MUOS is Next Generation System in Development for First IOC in ~2010.
1987-1993	**TRAP/TRE**		Global Tactical Broadcast System Lead to TRAP/TRE and IBS
1994	**Clementine**		Multiple Components Developed With Industry and Flown for First Time: Frangibolts, Common Pressure Vessel Battery, etc. Rotary Award for 1st "Faster Cheaper Better" Satellite
1996	**Onboard Processor**		Largest Supplier of Tactical Direct Downlink Reporting
2002	**WindSat**		Wind Vector From Space Transitioned to NPOESS
2004	**TacSat-1**		First ORS TacSat Experiment Completed May 2004 within 1 year (Awaiting Launch). Led to TacSat Series and Broader ORS Efforts.

NRL's Integration, Test, & Operations Capability





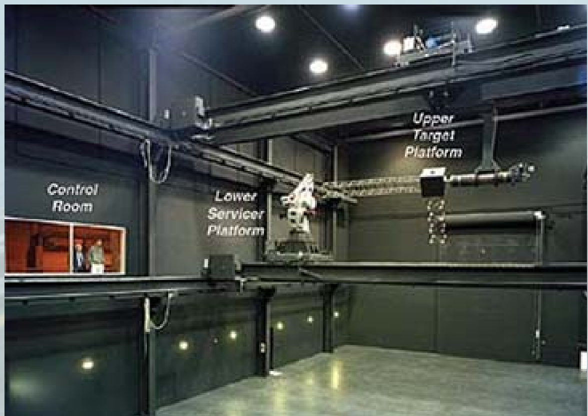
EMI/EMC/RF Ranges

Thermal Manf. & Application

Spin Balance

Blossom Point Ground Station

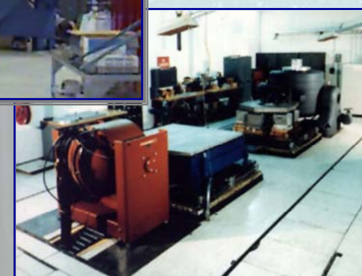
7 DOF Robotics Lab



Class 100 to 100,000 Clean Rooms

Propulsion AI&T

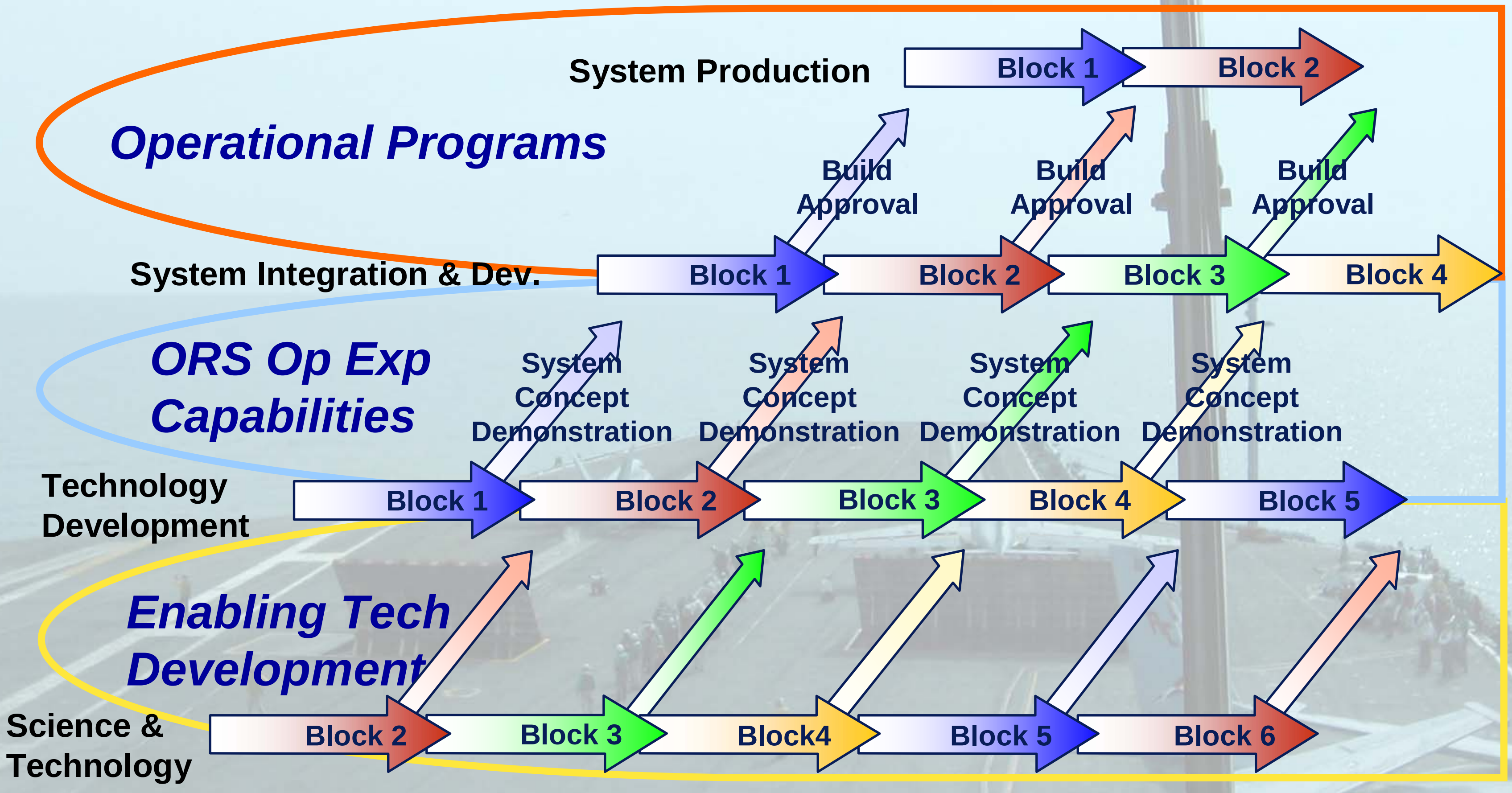
TVAC Including 15 foot Chamber



Vibration & Acoustic

NRL has the Full Range of Facilities for Assembly, Integration, Test, and Flight Operations. Personnel are Experienced from Many Programs and Constant Use.

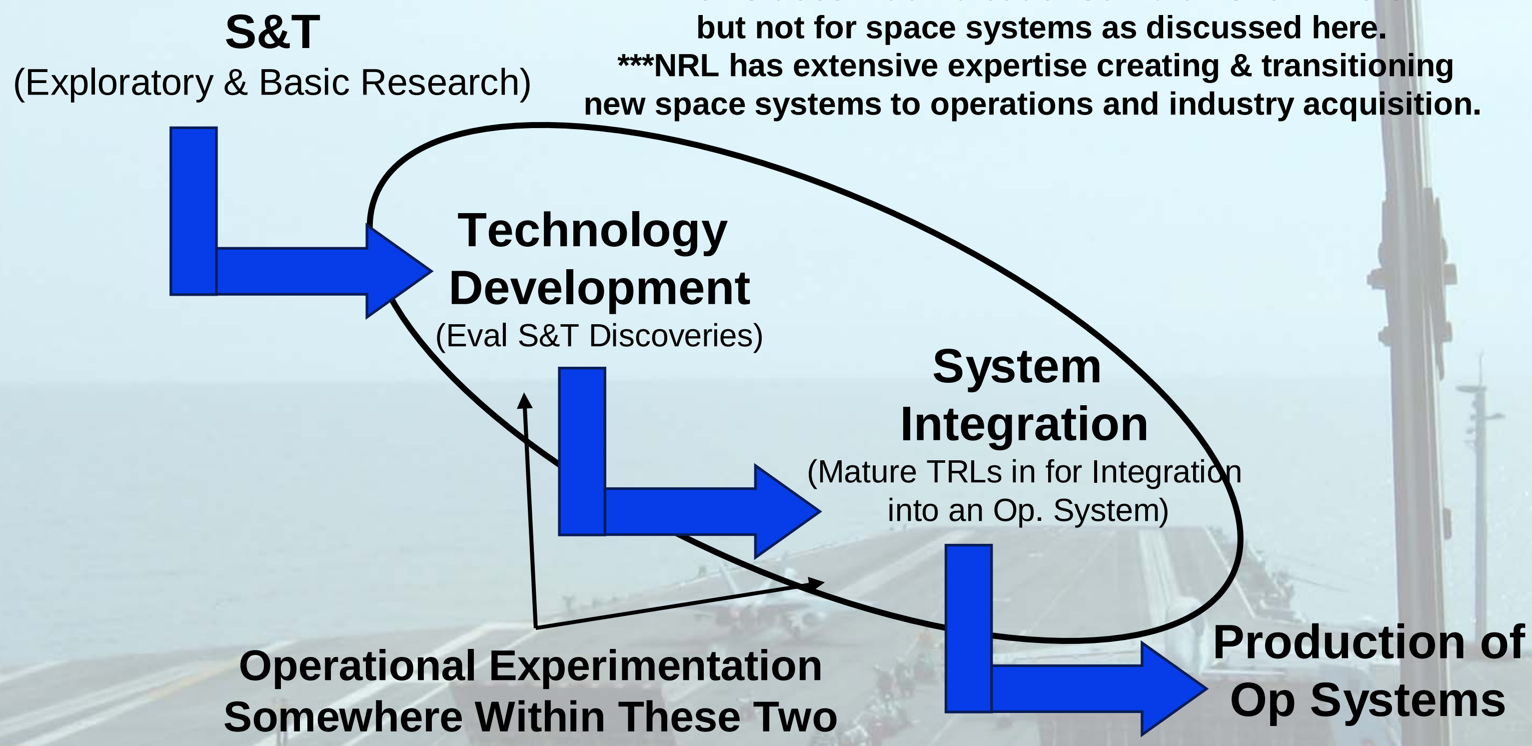
ORS in "Back-to-Basics" Construct is Useful for Articulating Strengths (1 of 2)



ORS in "Back-to-Basics" Construct is Useful for Articulating Strengths (2 of 2)

ONR/NRL*** Strength & Focus**

****ORS does much broader S&T than shown here but not for space systems as discussed here.**
*****NRL has extensive expertise creating & transitioning new space systems to operations and industry acquisition.**



- **This construct is generally space systems development and acquisitions oriented so operations, for example, is not a specified component of this construct**
  - **NETWARCOM probably best fits between tech dev & system integration in this construct, but fundamentally not the best construct to explain their role**
  - **OPNAV needs/gaps assessments & rqmts guide tech dev and system integration; SPAWAR performs system integration & production for MUOS/UFO**
  - **TENCAP supports some tech development but mostly focuses on exploiting on-orbit production systems**

Draper Laboratory Role in Space System S&T

- **An independent, not-for-profit corporation dedicated to solving the nation's most challenging problems by *…***
  - **Helping our sponsors clarify their requirements and conceptualize innovative solutions to their problems**
  - **Demonstrating those solutions through the design and development of fieldable engineering prototypes**
  - **Transitioning our products and processes to industry for production and providing follow-on support**
- **An acquisition strategy that utilizes national labs as development partners & trusted agents can reduce development risk for first-of-a-kind systems**
  - **Labs support design, early prototype and initial production**
  - **Provides proven non-proprietary design**
  - **Transitions mature design to Industry for production**

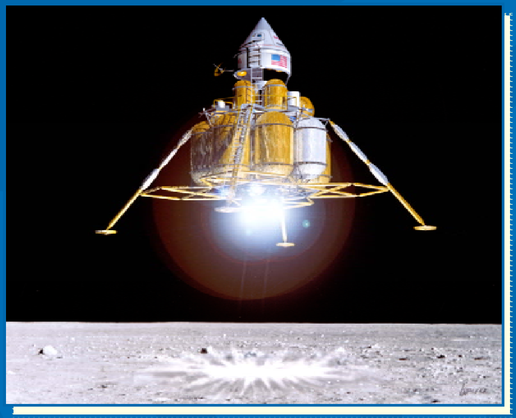
An objective engineering resource linking research to production

DRAPER LABORATORY

Draper Lab Risk Reduction Examples

Shuttle/ISS Large Space Structure Control

NASA/JSC



Assured Landing & Hazard Avoidance

JSC/LaRC/JPL

NASA Design Team for ARES Upper Stage Avionics

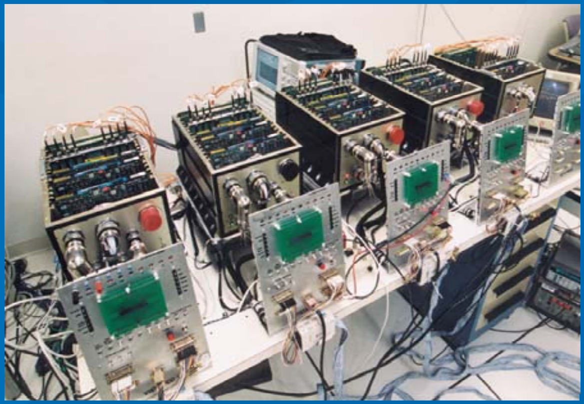
NASA/MSFC

Inertial Pseudo Star Reference Unit

34 nRad Jitter Stabilization

Inertial Stellar Compass on TacSat-2

3 kg Stellar Inertial System



X-38 Fault Tolerant Parallel Processor

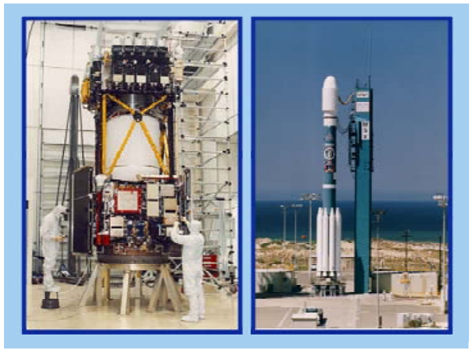
2-Fault Tolerant Flight Computer

SPACE DYNAMICS LABORATORY

A not-for-profit corporation owned by Utah State University

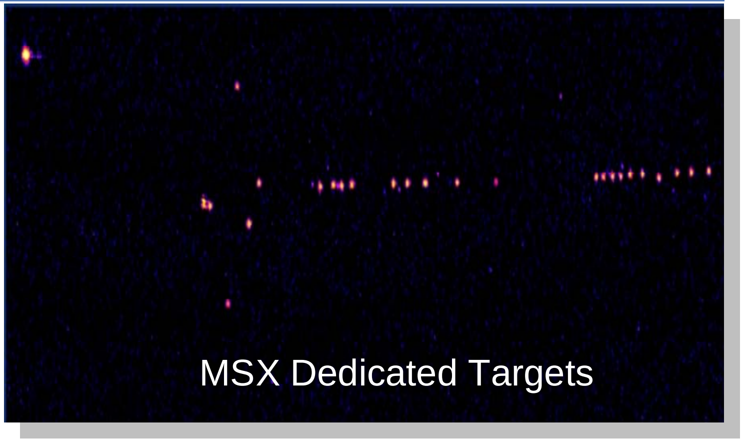
- Founded in 1959
- 350 employees
- 500+ successful missions
- 200,000+ ft^2 of state-of-the-art facilities
- DoD designated UARC with the following core competencies:

1. Electro-optical sensor systems research and development
   - Innovative sensor components and systems
   - Cryo-systems, thermal design, development, and handling
   - Data processing, handling, and analysis
   - Sensor calibration, characterization, test and evaluation
2. Ground, airborne and space rated instruments and payloads development, test and evaluation, integration, validation and operations
3. Data compression/decompression and data visualization for sensor analysis, data exploitation and data fusion
4. Phenomenology measurements, modeling, and simulation
5. Sensor modeling and simulation
6. Small/micro satellite sensor systems and components.

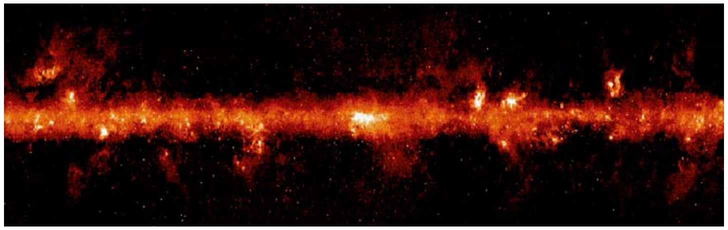


SDL: Provider of Space Technologies

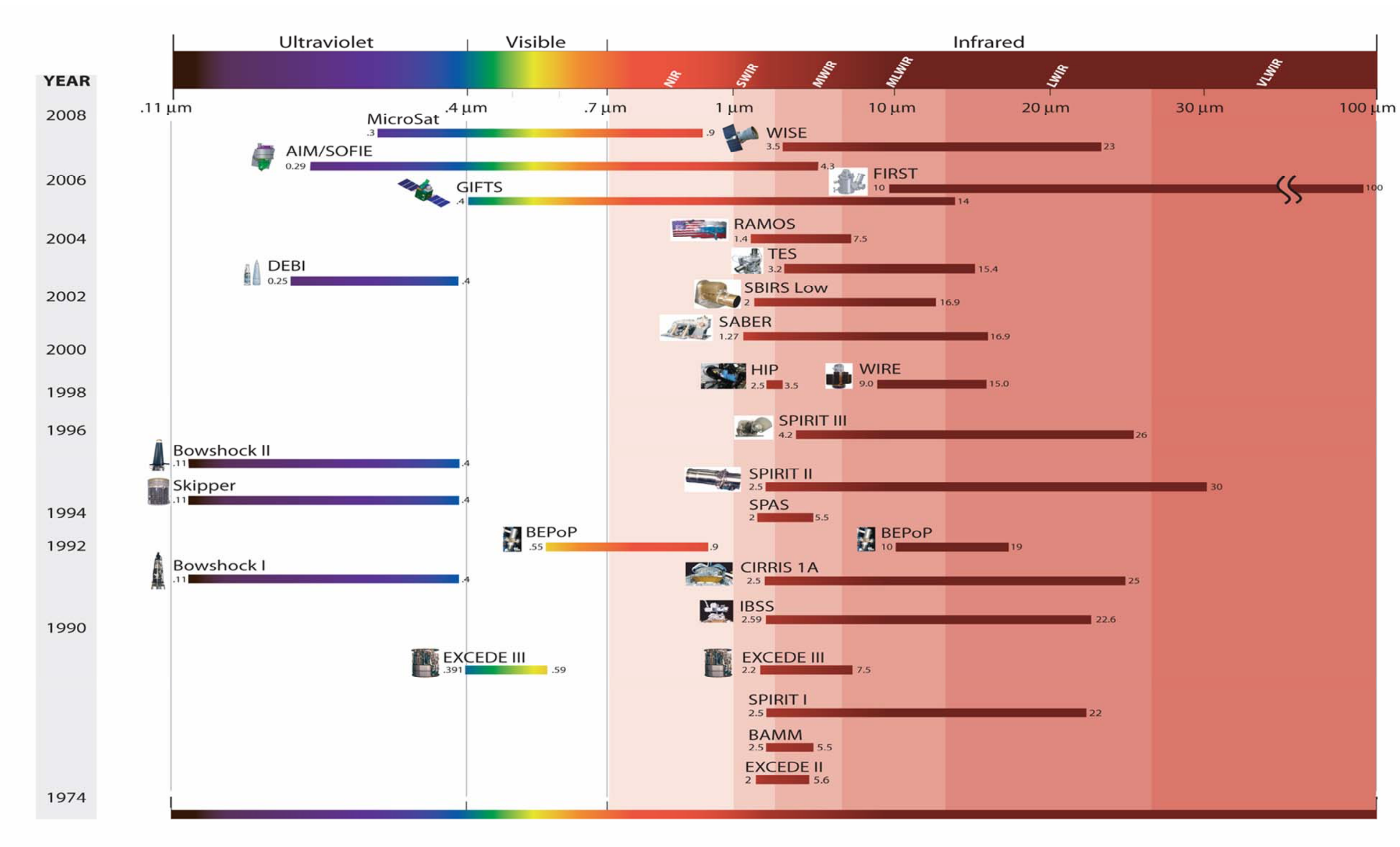
- Extensive sensor systems experience
  - Design, development, and prototyping
  - Performance assessments
  - Modeling and simulation
- Expertise, equipment, and facilities to calibrate and characterize electro-optical sensors
  - Internationally recognized for expertise in calibrating complex sensor systems, analyzing calibration data, and disseminating calibration information
- Proven ability and flexibility to work with the customer in addressing real world challenges
- Technology transfer to Government and Industry
- Opportunity to help shape the future by training undergraduate through post-doc students. Industry and Government staff can advance their education while working at a UARC



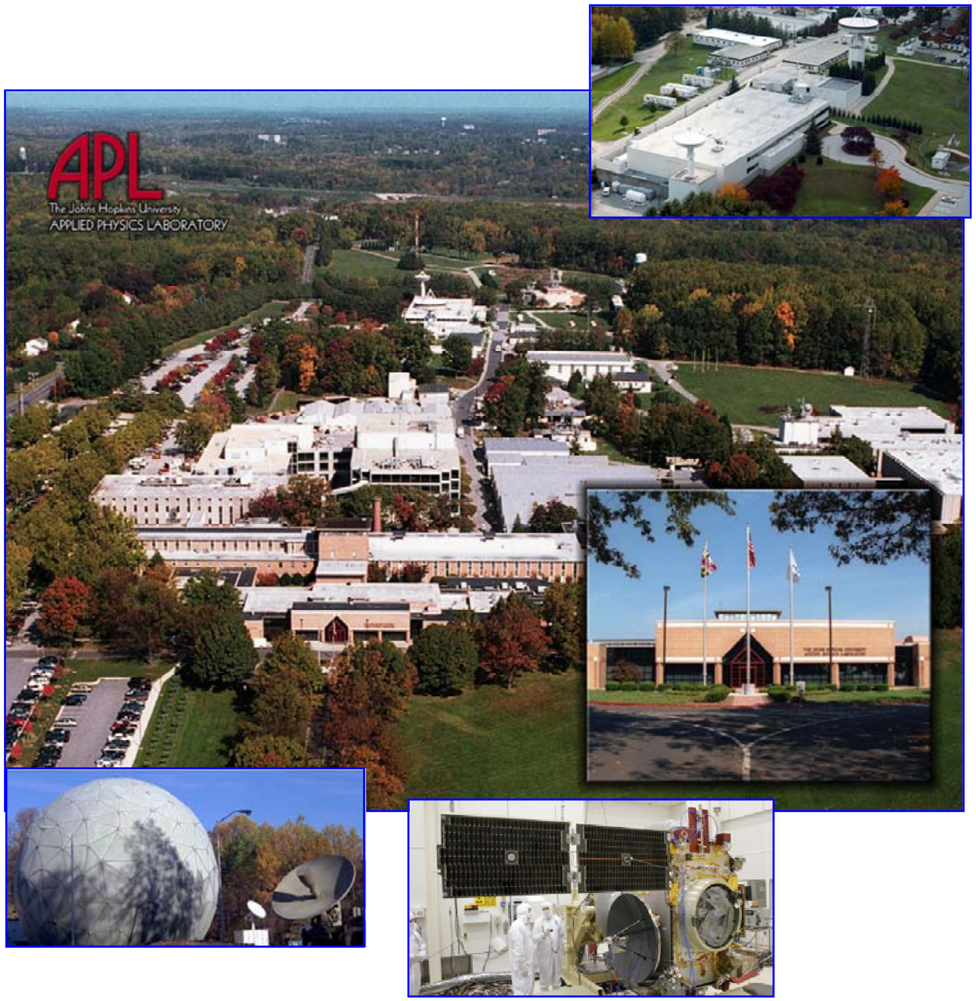
MSX Dedicated Targets



Representative SDL Sensor Programs



The Johns Hopkins University
APPLIED PHYSICS LABORATORY



- **Not-for-profit University-Affiliated Research Center**
- **Staff: 4,000+ employees**
  (70% scientists & engineers)
- **Business areas:**
  - **Air & Missile Defense**
  - **Biomedicine**
  - **Civilian Space**
  - **Homeland Protection**
  - **Infocentric Operations**
  - **National Security Space**
  - **Precision Engagement**
  - **Science & Technology**
  - **Strategic Systems**
  - **Undersea Warfare**
  - **Warfare Analysis**

APL Space -- in the news

SPACE NEWS
Nov 13, 2006

DMSP satellite

U.S. Air Force's DMSP Launched By a Delta 4

The U.S. Air Force successfully launched a military weather satellite Nov. 4 from Vandenberg Air Force Base, Calif., aboard a Boeing Delta 4 rocket. The Defense Meteorological Satellite Program (DMSP) F-17 satellite, built by Lockheed Martin Corp., is the second satellite in Block 5D-3 series of upgraded platforms featuring more computing and battery power than previous models, Lockheed Martin said in a Nov. 4 press release.

"We have a healthy satellite on orbit that will carry out its vital mission of supporting our warfighters," Michael O'Hara, Lockheed Martin DMSP program director, said in a prepared statement. The Air Force typically maintains two DMSP satellites in near-polar orbit to collect meteorological, oceanographic and other data on a global scale in support of U.S. military planning and operations.

Now in its fourth decade, the DMSP program is managed by the Air Force Space and Missile Systems Center at Los Angeles Air Force Base. Three DMSP 5D-3 satellites are in storage at Lockheed Martin awaiting launch.

The launch was the seventh for the Delta 4 since its introduction in November 2002, and the third in the medium-class configuration, Boeing Integrated Defense Systems of St. Louis said in a Nov. 4 press release.

SPACE NEWS
Oct 30, 2006

NEWS BRIEFS

NASA's STEREO Solar Observation Mission Begins

A pair of solar observation satellites was successfully launched into orbit Oct. 26 by a Boeing-built Delta 2 rocket. The nearly identical Solar Terrestrial Relations Observatory (STEREO) will generate the first near real-time, 3-D images of the Sun.

STEREO's main mission is to image coronal mass ejections, immense eruptions from the Sun that spew high-energy particles that can pose a radiation hazard for astronauts and satellites, as well as interfere with power and communications systems on Earth.

Engineers at the Johns Hopkins University's Applied Physics Laboratory built the STEREO spacecraft for NASA, and will oversee the $550 million mission.

SPACE NEWS
Nov 13, 2006

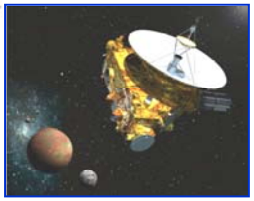
NEWS BRIEFS

AFRL Picks 3 to Do Space Surveillance Sensor Designs

The U.S. Air Force Research Laboratory (AFRL) recently awarded three contracts worth $1 million each for initial design work on a prototype space-based surveillance sensor that could keep tabs on objects in geostationary orbit, according to an AFRL spokesman.

Johns Hopkins Applied Physics Laboratory, Ball Aerospace and Technologies Corp., and Goodrich Aerospace won the Lightweight Electo-Optical Space Sensor contracts (LEOSS), according to Michael Kleiman, an AFRL spokesman.

Follow-on work could include a flight demonstration, according to a Johns Hopkins news release issued on Nov. 8, but Kleiman said in a Nov. 9 e-mail that the Air Force is still defining the extent of the work that could follow those three contracts.



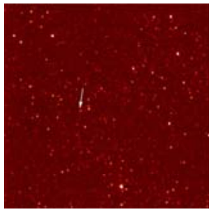
BEST OF WHAT'S NEW

Dec 2006

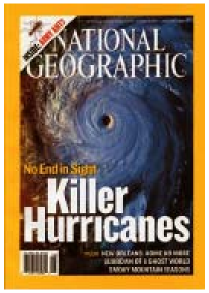
SPACEFLIGHT NOW The leading source for online space news

Nov 28, 2006

New Horizons probe makes its first Pluto sighting

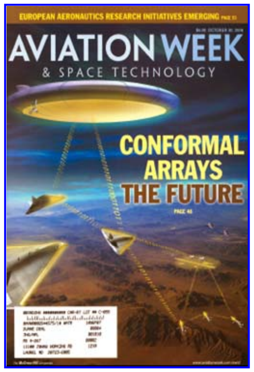


A white arrow marks Pluto in this New Horizons Long Range Reconnaissance Imager (LORRI) picture. Seen at a distance of about 4.2 billion kilometers (2.6 billion miles) from the spacecraft, Pluto is little more than a faint point of light among a dense field of stars. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute



APL-generated image from the Advanced High Resolution Radiometer (AVHRR) on the NOAA polar-orbiting satellites

AIAA
Cover story
Nov 2006

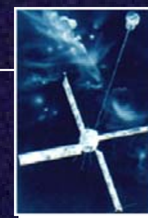


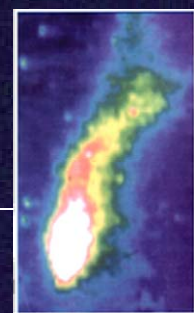
Oct 30, 2006

APL

A tradition of “Firsts” in space since 1958

1958 Satellite Navigation System
1961 Nuclear-powered spacecraft
1963 Gravity gradient stabilization
1967 Color picture of the full Earth
1972 Drag-compensated satellite
1975 Pulsed plasma thrusters
1982 Autonomous satellite navigation with GPS
1984 Artificial comet
1986 Intercept of a thrusting target in space
1988 Autonomous target acquisition and track
1996 Hyperspectral Imager in space (MSX)
1996 Invention of Polymer Battery
2001 Landing on an asteroid (NEAR)
2003 Re-Configurable Self-Repairing Processor (on FEDSAT)
2004 Orbital Mercury exploration mission launched (MESSENGER)
2006 Mission to Pluto (New Horizons)



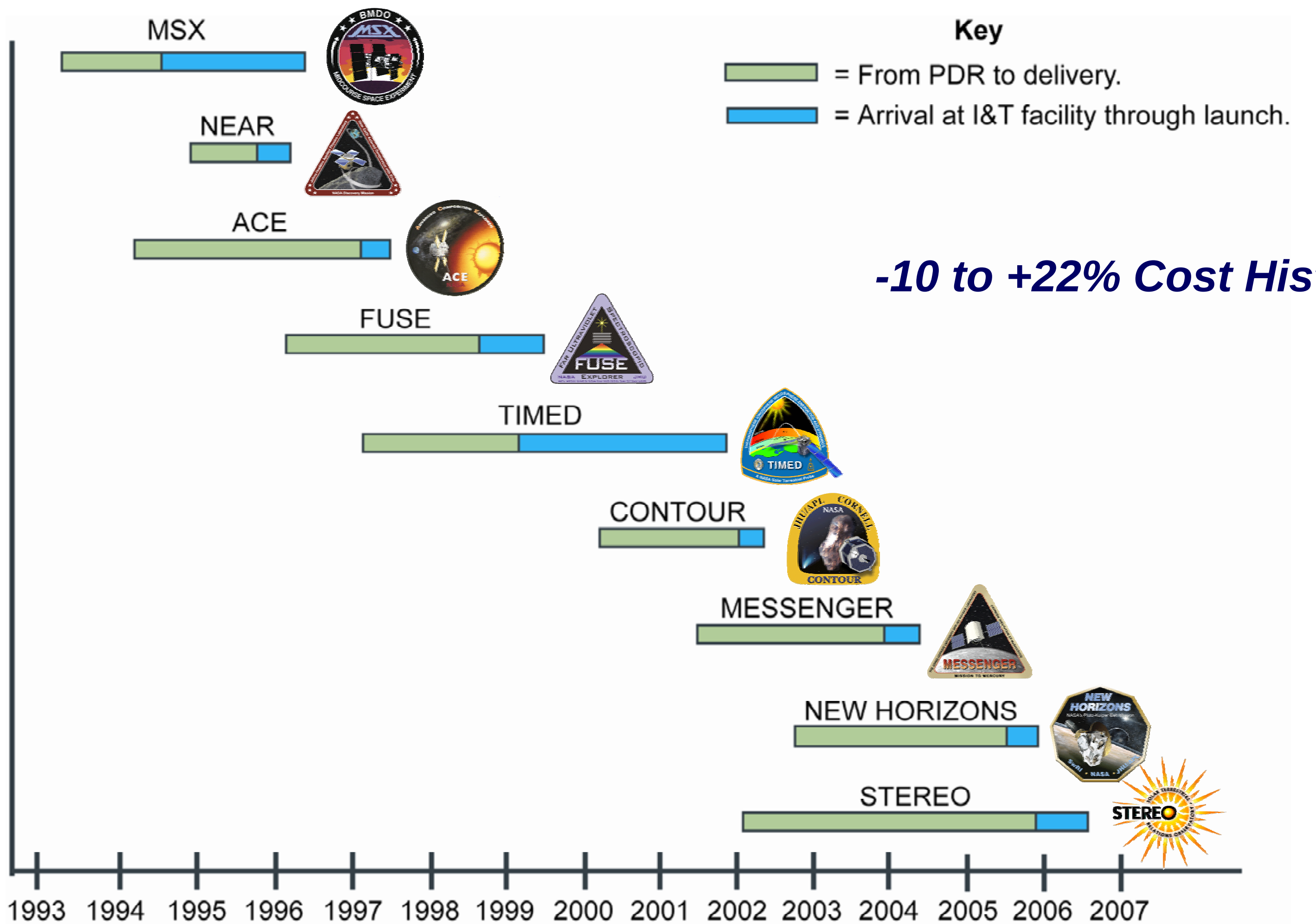



APL's "Space Portfolio" …
developing new space capabilities

- APL -- 64 spacecraft, 150+ payloads since 1958
- Produce operational prototypes
  - e.g., TRANSIT to Midcourse Space Experiment (MSX)
- National Security Space roles
  - Technical Direction Agent
    - Studies and analyses, technology advice
    - Data analyses, decision aids
  - Advanced Technology Development
    - S&T components
    - Sensors
  - Implement Space Missions
    - Mission Design
    - Build spacecraft, integration, T&E, operations
    - Applications

Unique bridge between NASA space and DoD/IC needs

APL spacecraft – 1996-2006



-10 to +22% Cost History

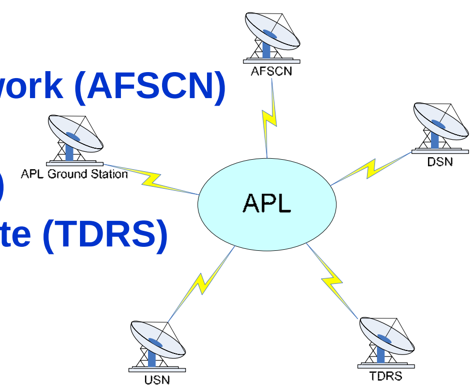
Ground segment experience –
APL actively operates 6 spacecraft

MSX

TIMED & STEREO (x2)

MESSENGER and New Horizons

Connectivity:
- **Air Force Satellite Control Network (AFSCN)**
- **Deep Space Network (DSN)**
- **Universal Space Network (USN)**
- **Tracking and Data Relay Satellite (TDRS)**



Decades of hands-on operational experience

Recurring theme

If --

"Back to Basics" is the question …

Then --

a government, industry, & lab mix
is the best answer.

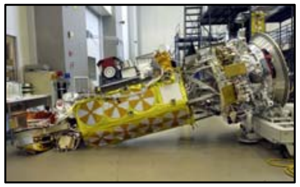
NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

9th National Security Space Policy & Architecture Symposium

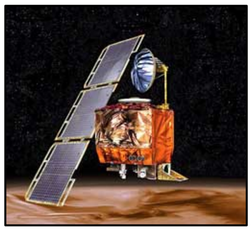
Applying S&T capabilities to the end-to-end cycle

"Ready, willing, and *quite* able"

Choose your (preventable) "disaster" …



Satellite toppling



Mars Climate Orbiter

Sago Mine

Genesis

Enron

Pipeline leak

Comair 5191

USS San Francisco

Katrina

Challenger

Mars Polar Lander

Denver highway beam

Refinery fires

USS Greeneville

Tank versus road

Car versus fighter

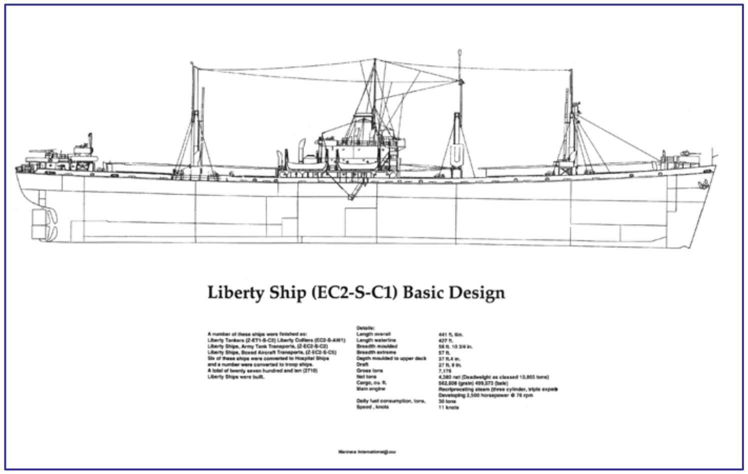
The Big Dig

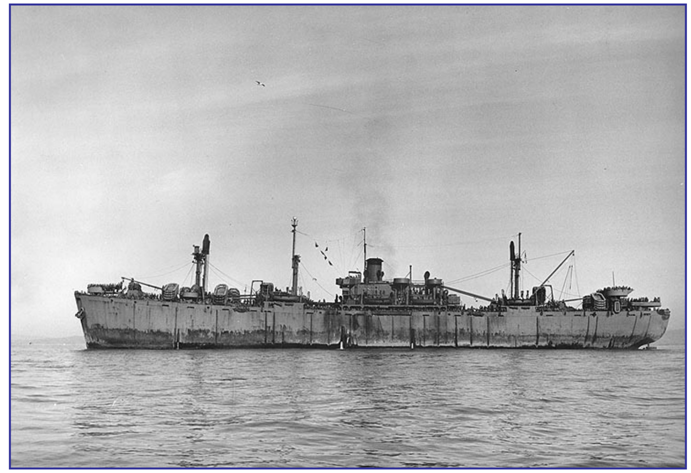
9/11

Columbia

Concorde

Developing "crack stoppers"





Per Mr. Payton, DUSecAF:

- Liberty ships' structural failures – "crack stoppers" saved the day
- Common thread between space disasters & other disasters
- Root causes similar, identifiable – and can be *mitigated*
- Acquisition problems are disasters
  - National security capabilities absent/diminished/delayed
  - ~$12B remediation impacts other areas (= Space Pearl Harbor?)
- Need to stop those "cracks" to deliver what's promised
  - Technical/schedule risks, cost estimates, requirements

Labs as “crackstoppers”

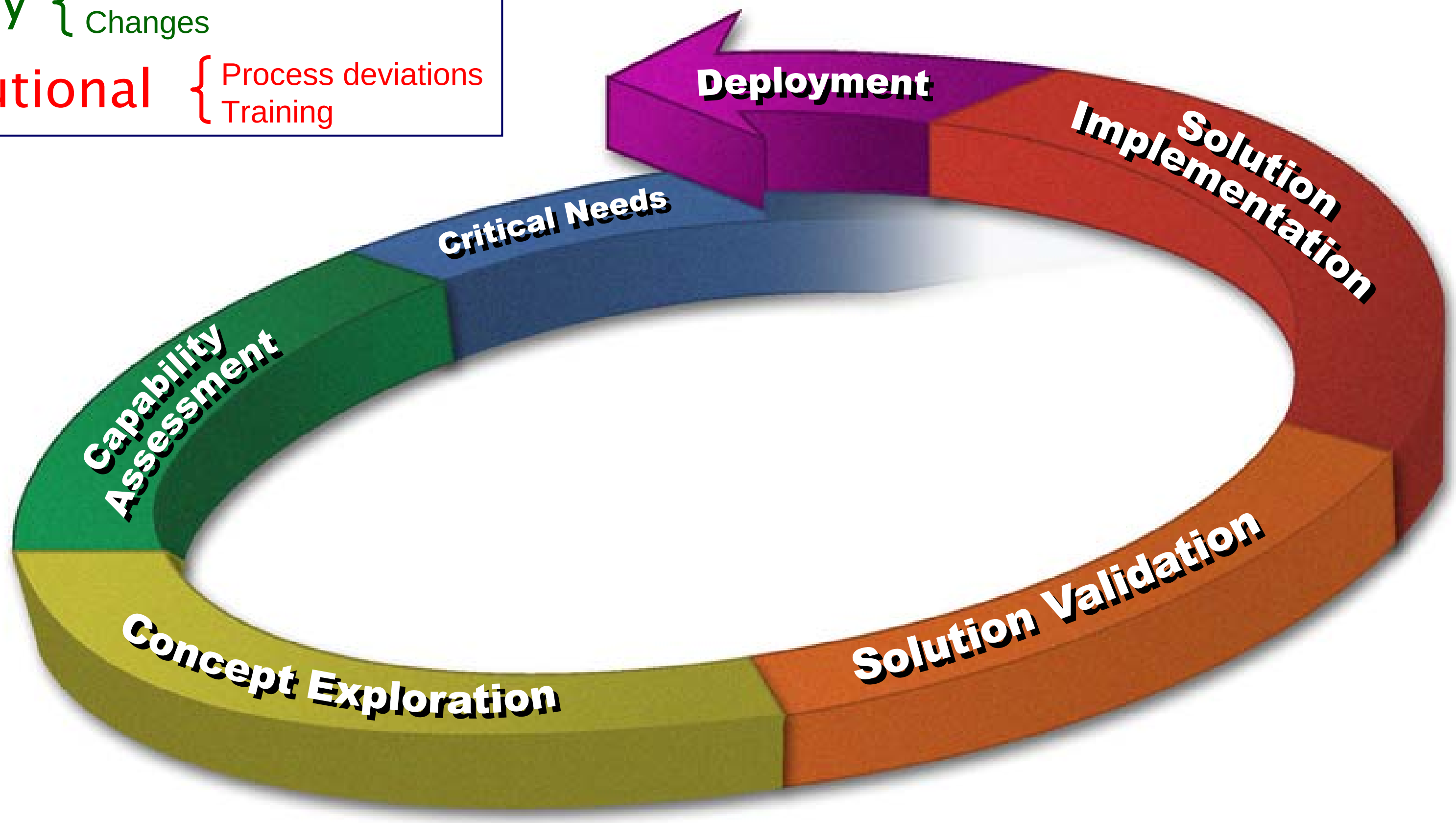
- **Four-stage process**
  - **System Production**
  - **Systems Development**
  - **Technology Development**
  - **Science & Technology**
- **Reapportion Risk**
  - **Lower risk in Production**
    - **Use mature technology**
  - **Higher risk in S&T**

Labs’
“Sweet spot”

Assume mission-oriented, end-to-end development …
A Systems Approach

Managing Risks:

- Program { Schedule, Cost, Scope
- Technical { Performance, Drawings
- Quality { Non-conformances, Changes
- Institutional { Process deviations, Training



Critical Needs

Defining Requirements

Capabilities Improvement Needs Definition

Managing Risks:

- Program: Schedule, Cost, Scope
- Technical: Performance, Drawings
- Quality: Non-conformances, Changes
- Institutional: Process deviations, Training

Capability Assessment

Capability Assessment

Data Collection

Mission Performance Analysis

Managing Risks:

- Program { Schedule, Cost, Scope }
- Technical { Performance, Drawings }
- Quality { Non-conformances, Changes }
- Institutional { Process deviations, Training }

Concept Exploration

Develop Enabling Science & Technology

Hypothesis, Concept Development Trade-offs, & Critical Experiments

Modeling and Simulations

Managing Risks:

- Program { Schedule, Cost, Scope
- Technical { Performance, Drawings
- Quality { Non-conformances, Changes
- Institutional { Process deviations, Training

Solution Validation

Managing Risks:

- Program: Schedule, Cost, Scope
- Technical: Performance, Drawings
- Quality: Non-conformances, Changes
- Institutional: Process deviations, Training

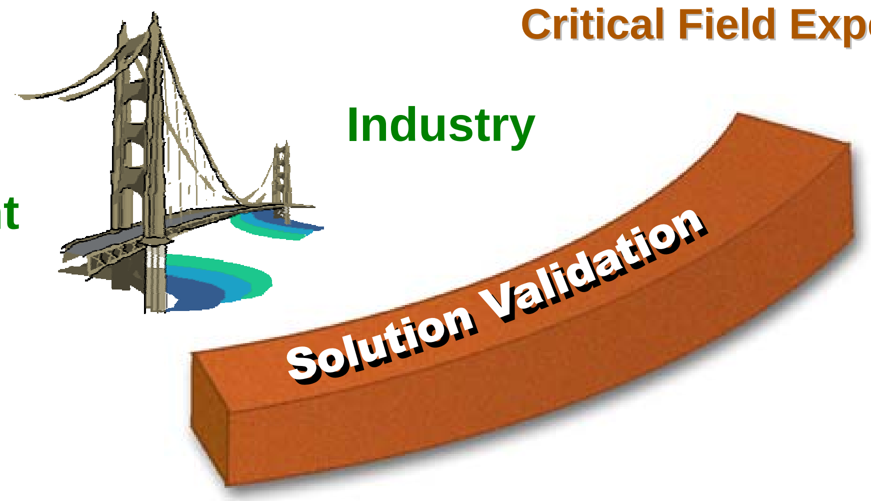
Prototype Development

Performance Demonstration

Critical Field Experiments

Industry

Government



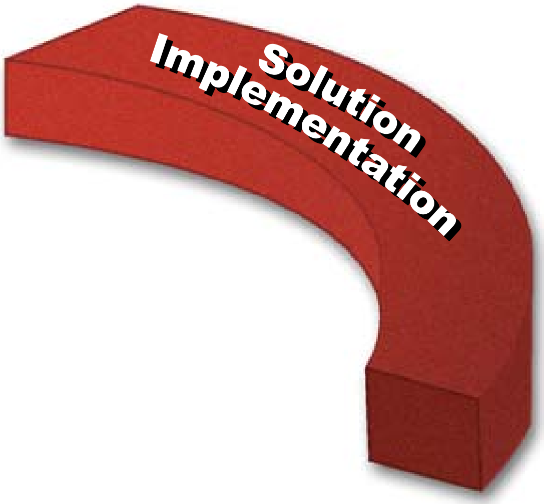
Technology Knowledge Transfer (*NLT this step*)

Solution Implementation

Product Development & Production

Test & Evaluation

Performance Verification



Managing Risks:

- Program { Schedule, Cost, Scope
- Technical { Performance, Drawings
- Quality { Non-conformances, Changes
- Institutional { Process deviations, Training

Deployment

Operational Data Collection

Lessons Learned

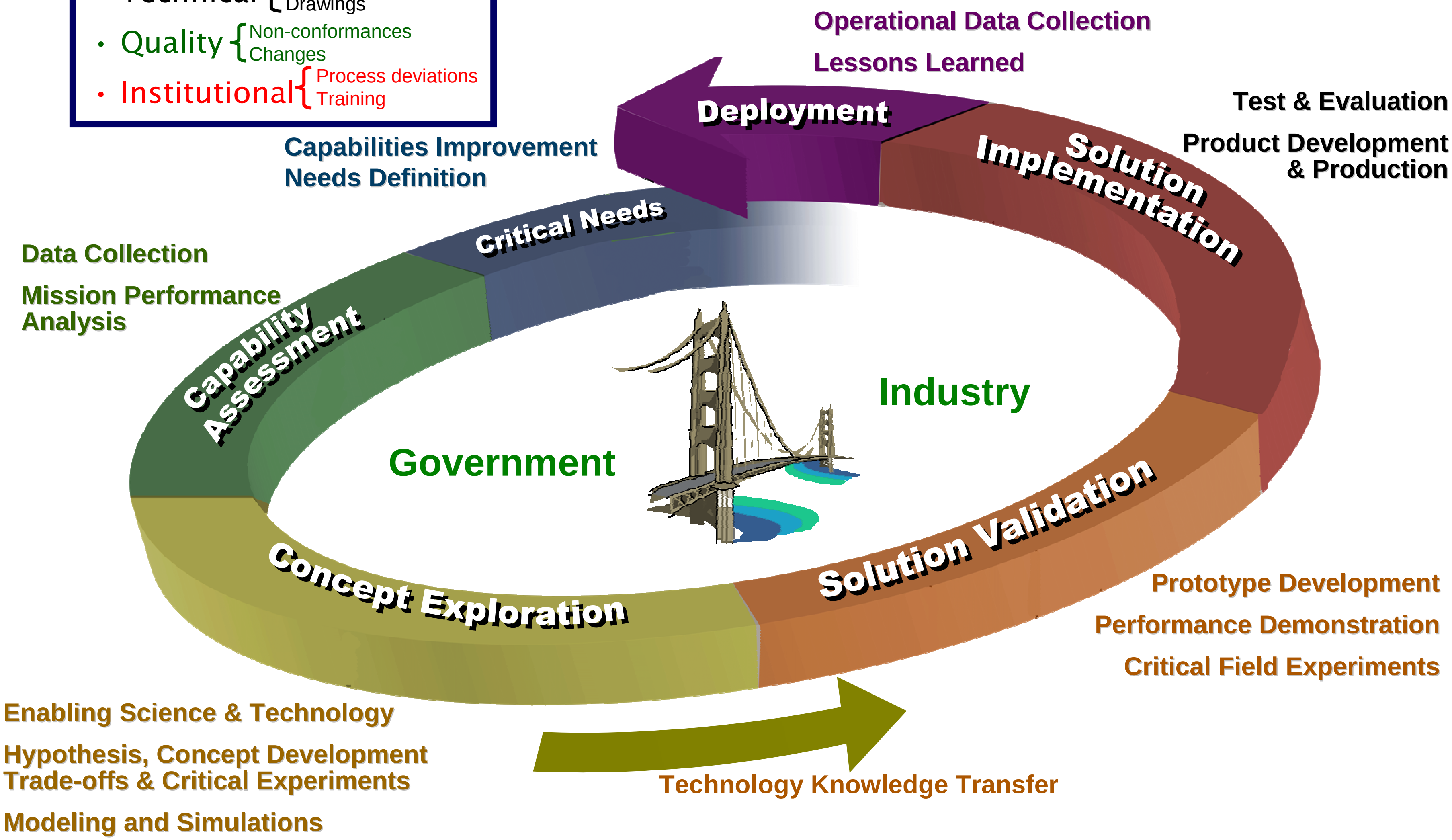
Managing Risks:

- Program
  - Schedule
  - Cost
  - Scope
- Technical
  - Performance
  - Drawings
- Quality
  - Non-conformances
  - Changes
- Institutional
  - Process deviations
  - Training

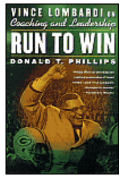
Assume mission-oriented, end-to-end development …
A Systems Approach

Managing Risks:

- Program { Schedule, Cost, Scope
- Technical { Performance, Drawings
- Quality { Non-conformances, Changes
- Institutional { Process deviations, Training

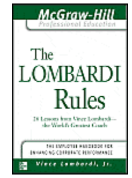


One R_X



"Focus on Fundamentals."

Vince Lombardi



Interactive Government / Industry / Lab *partnership* to:

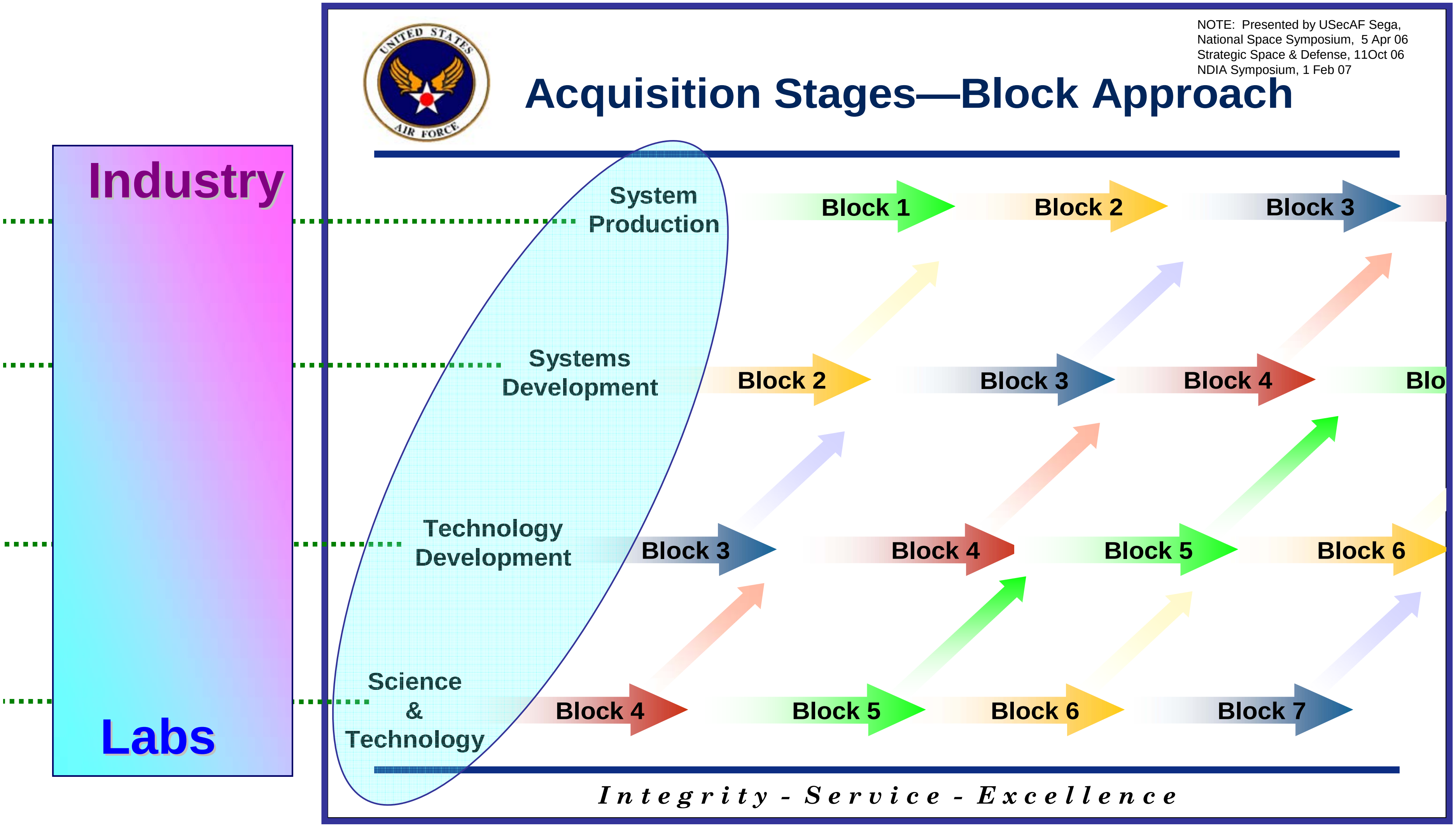
- Freeze requirements (minimize ECPs)
- Make rigid, realistic schedule start to launch (target XX months)
- Shape external environment during program (level funding)
- Small multi-expert, experienced, collocated team
- Team authority to do the missions
- Spacecraft and instruments designed to cost
- Minimize low TRL components / TRL maturation
- Get long lead items early
- Use lead engineer and method for all subsystems
- Design in reliability and redundancy
- Have R&QA engineer reporting directly to project manager
- Have single agency manager to interface with contractor

9th National Security Space Policy & Architecture Symposium

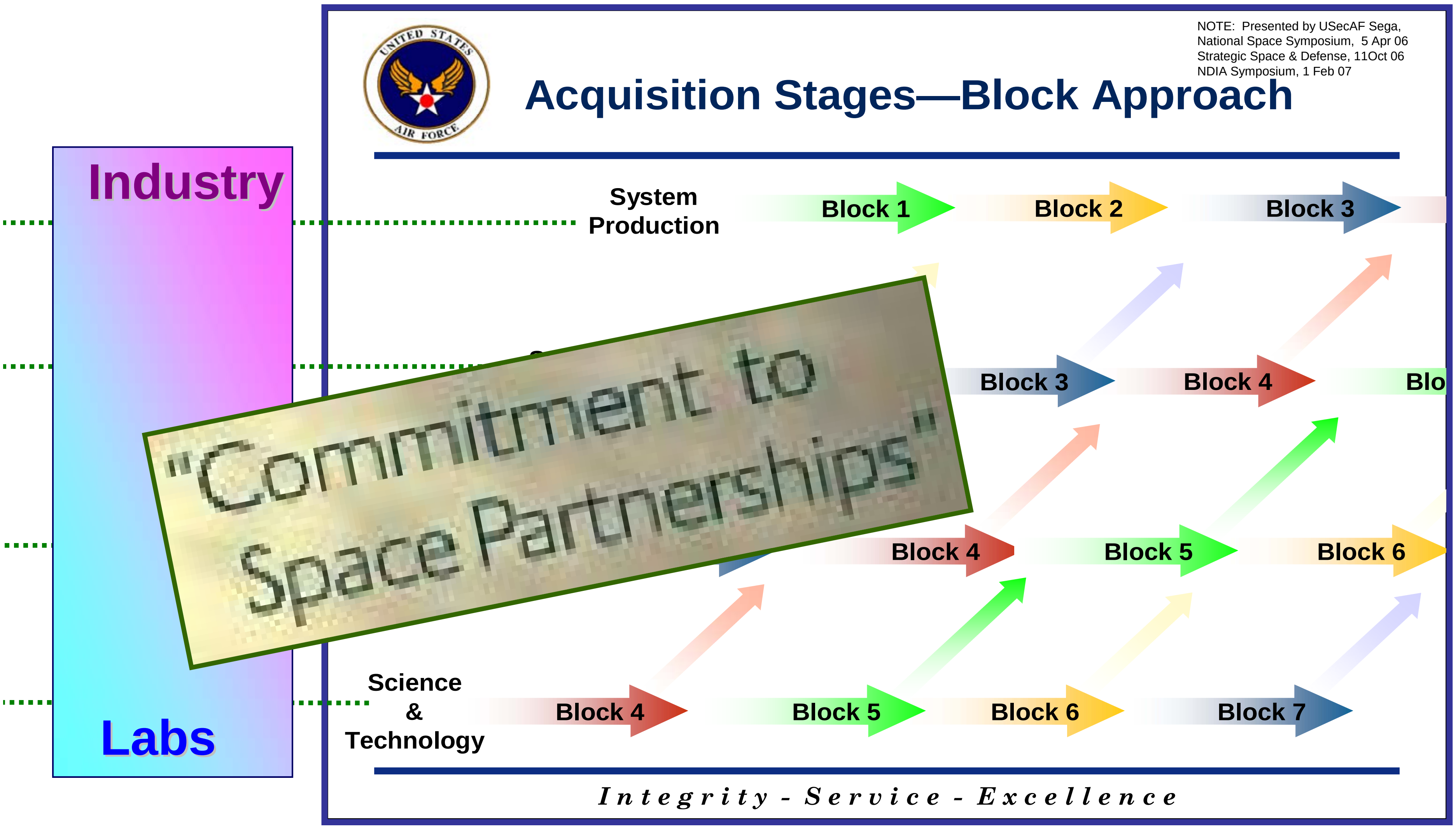
Summary

"<u>Committing</u> to space partnerships"

USecAF2


NOTE: Presented by USecAF Sega,
National Space Symposium, 5 Apr 06
Strategic Space & Defense, 11Oct 06
NDIA Symposium, 1 Feb 07
Acquisition Stages—Block Approach
Industry
Labs
System Production
Block 1
Block 2
Block 3
Systems Development
Block 2
Block 3
Block 4
Blo
Technology Development
Block 3
Block 4
Block 5
Block 6
Science & Technology
Block 4
Block 5
Block 6
Block 7
Integrity - Service - Excellence

USecAF2


Industry
NOTE: Presented by USecAF Sega, National Space Symposium, 5 Apr 06
Strategic Space & Defense, 11Oct 06
NDIA Symposium, 1 Feb 07
Acquisition Stages—Block Approach
System Production
Block 1
Block 2
Block 3
Block 3
Block 4
Blo
"Commitment to Space Partnerships"
Block 4
Block 5
Block 6
Science & Technology
Block 4
Block 5
Block 6
Block 7
Labs
Integrity - Service - Excellence

Theme

If --

"Back to Basics" is the question …

Then --

a government, industry, & lab mix
is the best answer.

9th National Security Space Policy & Architecture Symposium

Thanks.