DUSD (S&T)

Software Intensive Systems

25 July 2000

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Outline

- Role of Deputy Under Secretary of Defense for Science and Technology (DUSD(S&T)
- U.S. DoD S&T program
- Challenges/Opportunities for DoD
  - Technology Maturity
  - Software & Systems
- New Acquisition Approach for U.S. DoD
- Software Intensive Systems

U.S. DoD Science &Technology Mission

To ensure that the warfighters today and tomorrow have superior and affordable technology to support their missions, and to give them revolutionary war-winning capabilities.

Role of DUSD (S&T)

Oversight/Assessment of DoD S&T Investment

Software Intensive Systems

Open Systems Joint Task Force

International Collaborations

Office of Technology Transfer

High Performance Computing Program

DoD Modeling and Simulation

Laboratory Management/Security

Revolutionary Capabilities

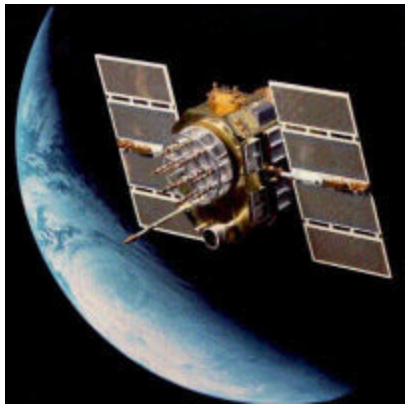
Stealth

Adaptive Optics and Lasers

Night Vision

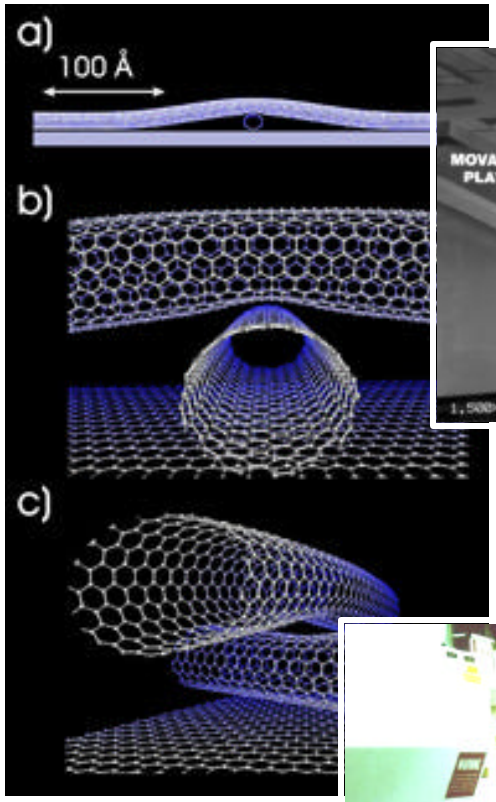
DoD S&T

Phased Array Radar

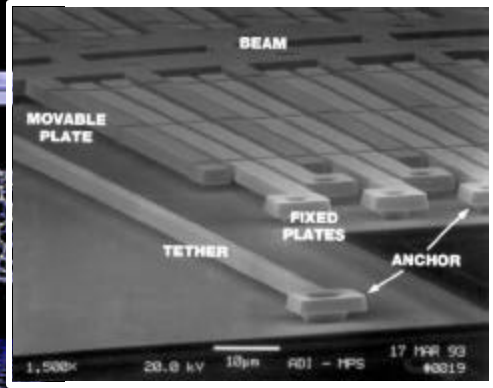


GPS

Current S&T

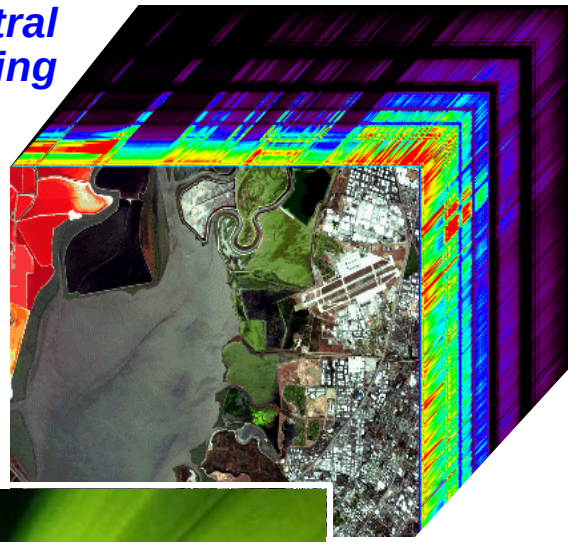


Nanoscience

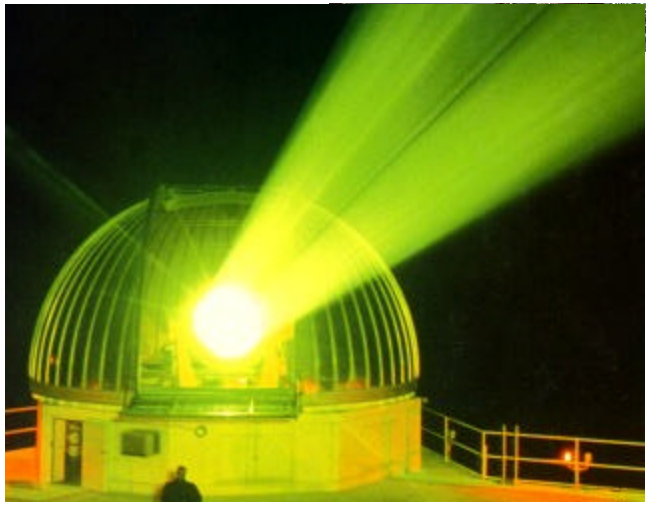


MEMS
microelectromechanical systems

Hyperspectral Imaging

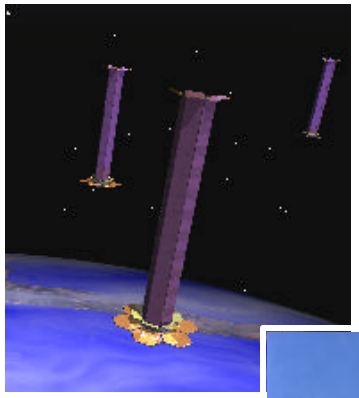


Biolab



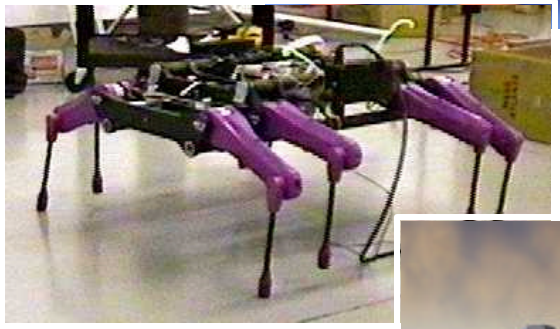
Starfire

Future Revolutionary Capabilities



Microsatellites

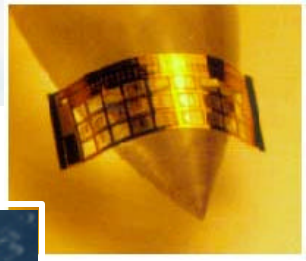
Micro Air Vehicles



Micro Robots

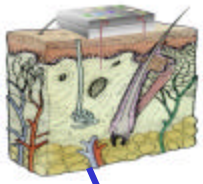
DD-21

Joint Strike Fighter



Flexible Sensor Skins

Augmented Reality



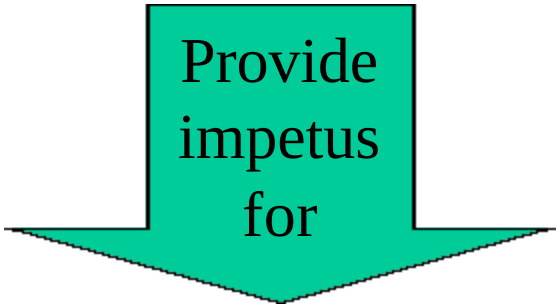
Bio Sensors

Embedded Biofluidic Chips

Challenges and Opportunities

Technology Maturity

Software & Systems



New approaches to development and sustainment of software-intensive systems

Technology Maturity

Government Accounting Office Findings:

- Programs with low technology maturity failed to meet cost, schedule and performance requirements.

- Programs w/ key technologies at high Technology Readiness Level (TRL) 6 to 8 were meeting cost, schedule and performance requirements.

- Successful technologies were managed by S&T organizations to at least TRL 6.

GAO

TECHNOLOGY READINESS LEVELS

1. Basic principles observed and reported
2. Technology concept and/or application formulated.
3. Analytical and experimental critical function and/or characteristic proof of concept.
4. Component and/or breadboard validation in laboratory environment.
5. Component and/or breadboard validation in relevant environment.

TECHNOLOGY READINESS LEVELS

6. System/subsystem model or prototype demonstration in a relevant environment.

7. System prototype demonstration in an operational environment.

8 Actual system completed and “flight qualified” through test and demonstration.

9. Actual system “fight proven” through successful mission operations.

RECOMMENDATIONS

- SECDEF Adopt a disciplined and Knowledge-Based method for assessing technology maturity.
- Establish a place where requirements and technology maturity meet before committing to development.
- S&T organizations play a greater role in maturing technologies.
- Empower development managers to say No.

GAO

DoD Action: Rewrite Acquisition Regulations - the 5000 Series

- Develop a new acquisition model that reduces cost and cycle time while delivering improved performance
- Move DoD closer to a commercial-style approach
- Implement Congressional recommendations
- Implement other reports and key initiatives, e.g. GAO Reports
- Further streamline the acquisition process

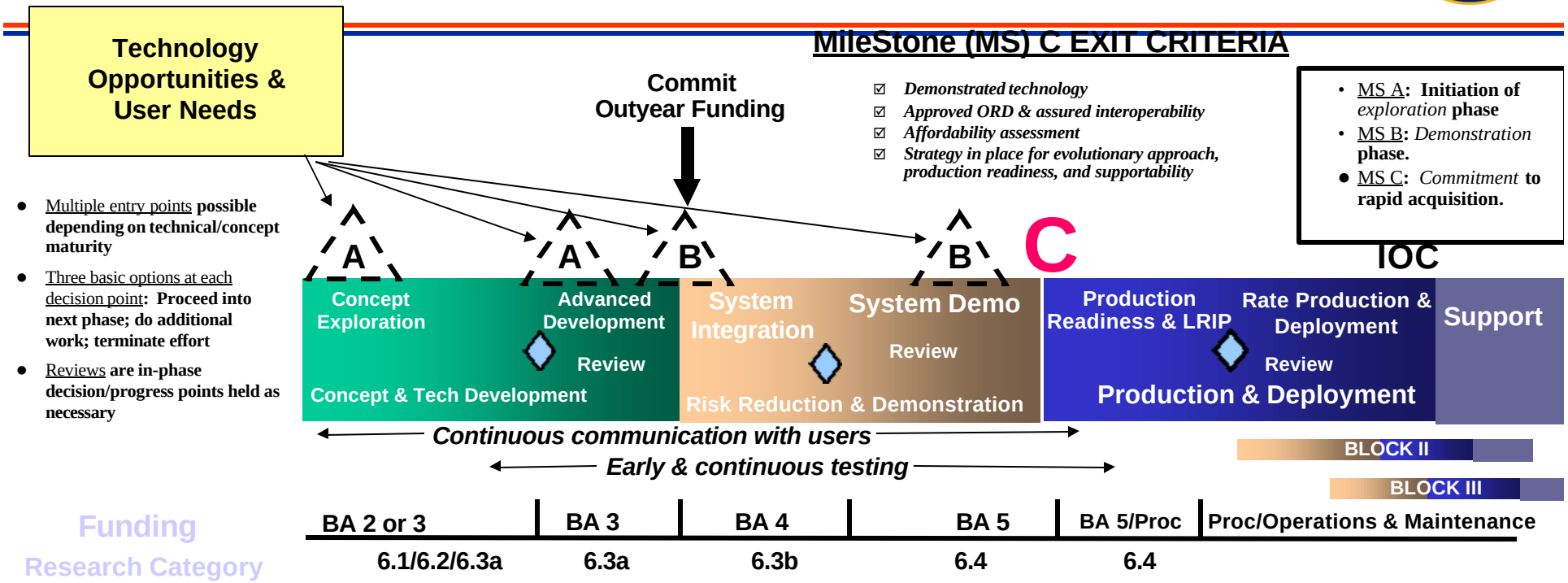
Codify above changes in a new version of DoD 5000 series documents

PROBLEMS WITH CURRENT POLICY

- Treats technology demos, and other innovations, as “non-traditional” excursions
- Treats evolutionary block approaches as “non-traditional” excursions
- Endorses tailoring but provides no amplifying guidance to assist strategy development
- Provides no institutionalized path for demonstration and accelerated development of innovative design and employment concepts

New 5000 needs to facilitate tailoring by providing guidance on alternative acquisition strategies

New Acquisition Process

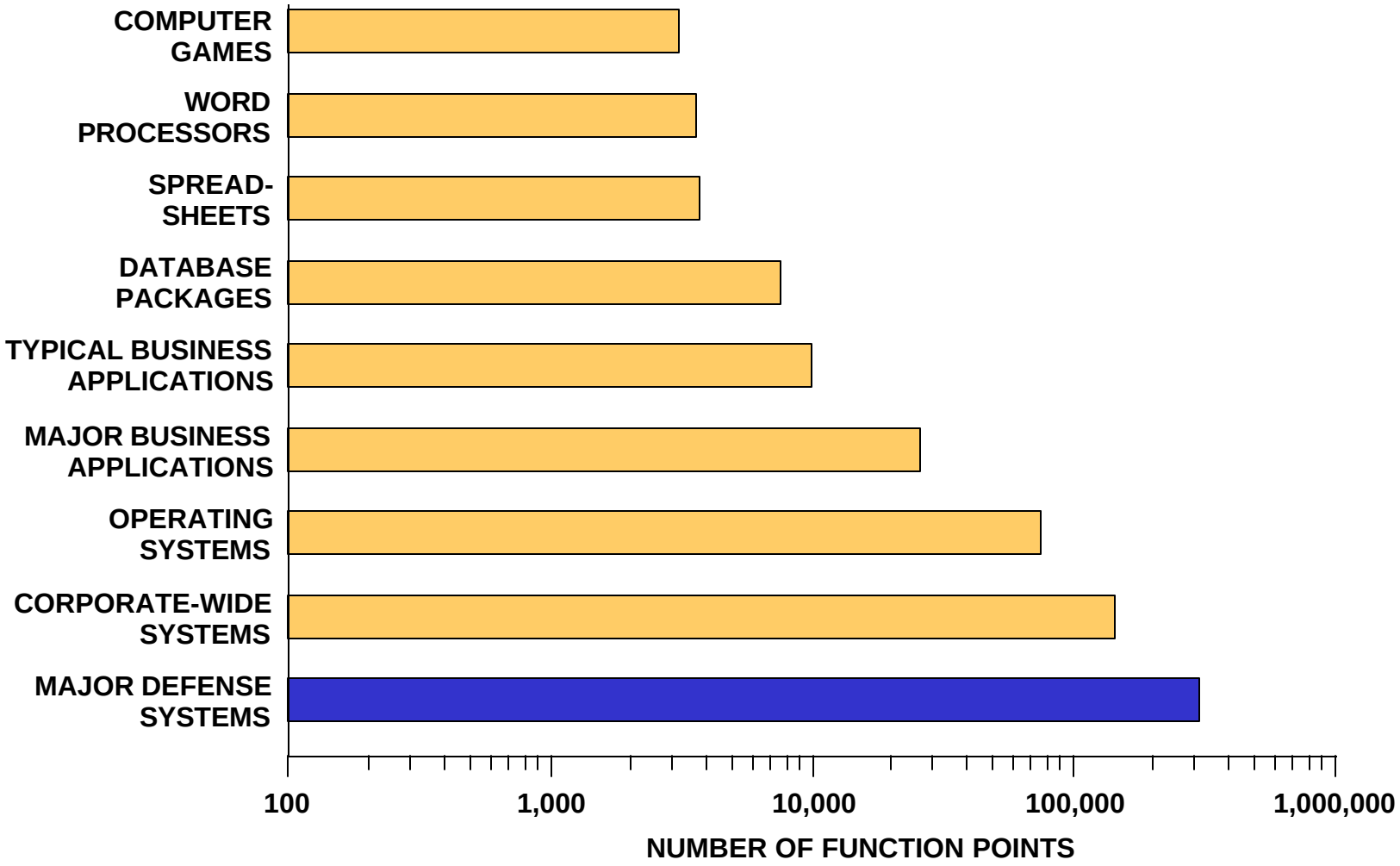


Features of the New Approach

- ***Multiple process paths*** **- not just one way of entering the acquisition process**
- ***Evolutionary acquisition*** **is the preferred approach**
- **Focus on *technology development* and *risk reduction* <u>prior</u> to program commitment**

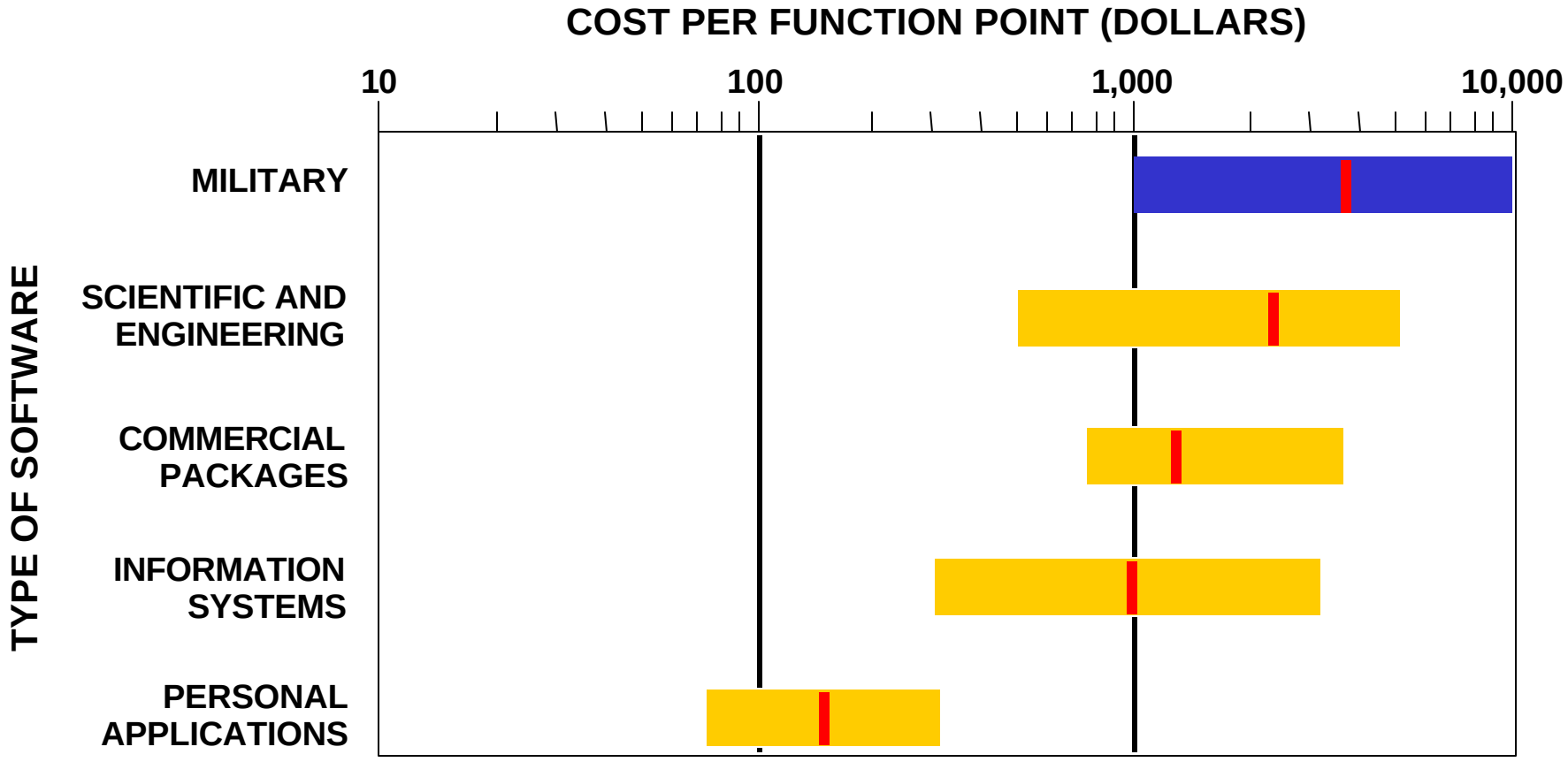
The other aspect...Software Is Everywhere

Software Function Points



Scientific American: Sizing Up Software, Capers Jones, Dec 1998

Function Point Costs



Scientific American: Sizing Up Software, Capers Jones, Dec 1998

What has changed in last 5 years?

- **Increased awareness and use of process and process improvement**
- **Increased ability to deliver single systems on time and within budget..but**
- **More and more dependency on software**
- **More use of COTS**
- **More emphasis on reuse and interoperability**
- **Software development problems traced to integration and system/software engineering problems**

Front Page Headline

Another Avoidable Mistake For NASA

Mars Craft Felled By Missing Line of Code, Probe Finds

The Washington Post, March 29, 2000

"The likely fate of the lost Mars Polar Lander was a 50 mph impact with the planet's frozen surface caused by a missing line of code- part of a pattern of avoidable errors that have left the U.S. Mars program a shambles…."

Obviously another software error...

But, Read on…page 14, Col 1

…"The "most probable cause" of the Mars Polar Lander's loss was the generation of "spurious signals" when the lander's legs were deployed during its controlled descent. These signals falsely indicated to the onboard systems that the spacecraft was safely on the surface. This would have prompted the braking thrusters to shut down at an altitude of about 130 feet...Spurious signals of this type are a familiar phenomenon, and routine systems testing should have exposed the potential…"One line of code" would have fixed the problem…"

Recent events in DoD that focus on software

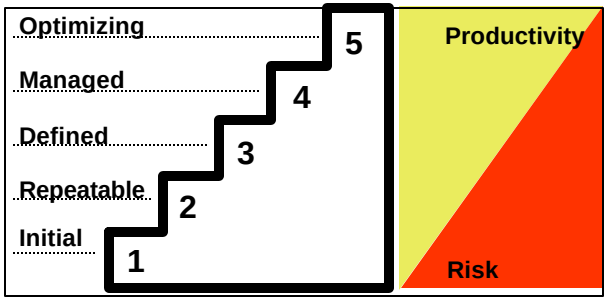
Service Acquisition Executive meeting

- **Name senior software focal points to a Software Intensive Systems Steering Group chaired by Dr. Etter**

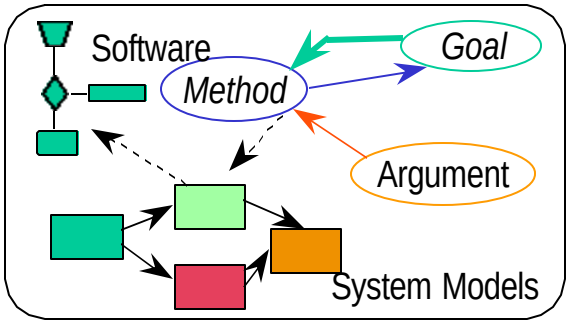
DSB Task Force on Software

- **Initiate independent expert reviews of major programs**
- **Strongly weight past performance and process maturity**
- **Build a disciplined cadre of technical managers**
- **Collect, disseminate and implement best practices**
- **Restructure and strengthen contract incentives**
- **Increase and ensure a strong and stable research program**

Software Intensive Systems Directorate



Discipline
Leverage Lessons Learned



Science & Technology
Stable, focused research

Improved Software Intensive Systems

Collaborate

DoD Software Engineering Organizations

Career Development
Trained & Experienced Staff

Evolutionary Acquisition

Actions underway-1

Established a Software Intensive Systems Steering Group:

- **Delores Etter - DUSD(S&T) Chair**
- **Henry Dubin - Army**
- **Mike O'Driscoll - Navy**
- **Don Daniel - Air Force**
- **Margaret Myers - ASD(C3I)**

Actions underway-2

Improve the discipline of developers and acquirers of software intensive systems.

- **DoD Software Evaluation Policy**
- **Integrated Capability Maturity Models for Systems and Software Engineering - the CMMI Project**
- **Develop a CMMI-Acquisition model**

Institutionalize independent reviews of major software intensive programs

- **Tri-Service Assessment Initiative now sponsored by DUSD(S&T)**

…and on the measurement front

Efforts currently underway in OSD

- **Program Analysis and Evaluation (PA&E) proposing a core set (size, cost, schedule, quality) for independent cost estimation**
- **Chief Information Officer (CIO) formed an IPT to establish common software metrics collection using the 8121 Registration Database**
  - **Quality** - **Standards (JTA, DII COE)**
  - **Interoperability** - **Staff skills**
  - **Architecture** - **Performance**
  - **Complexity** - **Competitiveness**
  - **Development Process** - **Security**
  - **Best Practices** - **Size, schedule, effort**

Challenges and opportunities for measurement

Technology

- **Technology maturity (systems and software)**

Evolutionary Acquisition and Spiral Development

- **Progress, risk, user needs**

Development and sustainment paradigms

- **Object oriented development**
- **COTs and reuse**
- **Product Lines**
- **Technology refresh**

Measures of effectiveness for all of the above