Rapid and Adaptive System Acquisition

A Model for IT Acquisition
in the Department of Defense

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Overview

- **Charting the DoD IT Acquisition Landscape**

- Commercial Use of Evolutionary Development

- Adapting and Applying a Progressive Acquisition Model

- Enablers: The Income Tax Model & E2E Testing

The DoD Acquisition Landscape

n "… the Department of Defense acquisition system is simply not well suited to exploit information technology. It is still tied to projecting distant threats and creating programs to acquire major systems that take decades to field. In short, it rewards freezing programs at an early stage and penalizes change."

(Admiral Blair, 2001)

DoD IT Acquisition Needs

The DoD needs IT systems that:

n Maximize IT capabilities

n Achieve high interoperability with multiple systems

n Reach the field rapidly

n Adapt to changing user needs

n Adapt to new technology

The Need for Rapid Acquisition

- **DoD technology growth is dependent on its budget growth (Augustine's Law).**

- **Technology Growth** = 67% / year (Moore's Law)

- **Augustine DoD Growth** = 5-7% / year

- **The difference between Hi-tech & DoD:** growth rates = 60%
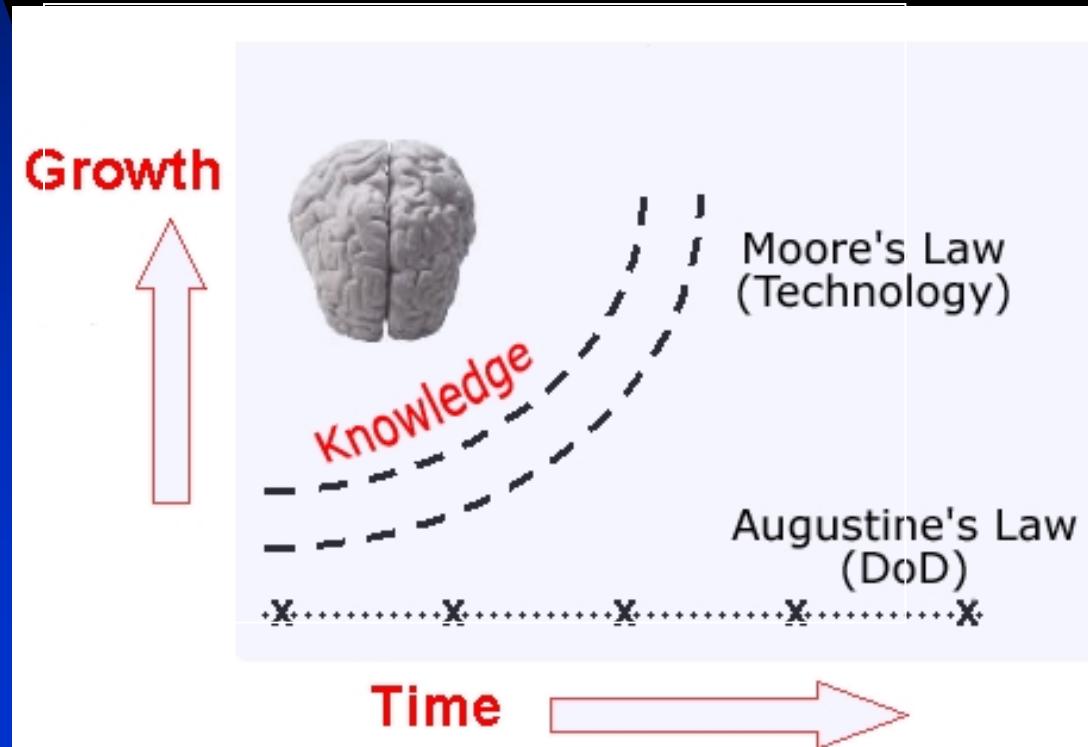
Moore's Law

- **This difference represents growth of obsolescence or risk. It is an exponential growth.**

Risk due to obsolescence

Growth % age

Moore's Law (Technology)

Augustine's Law (DoD)

Time
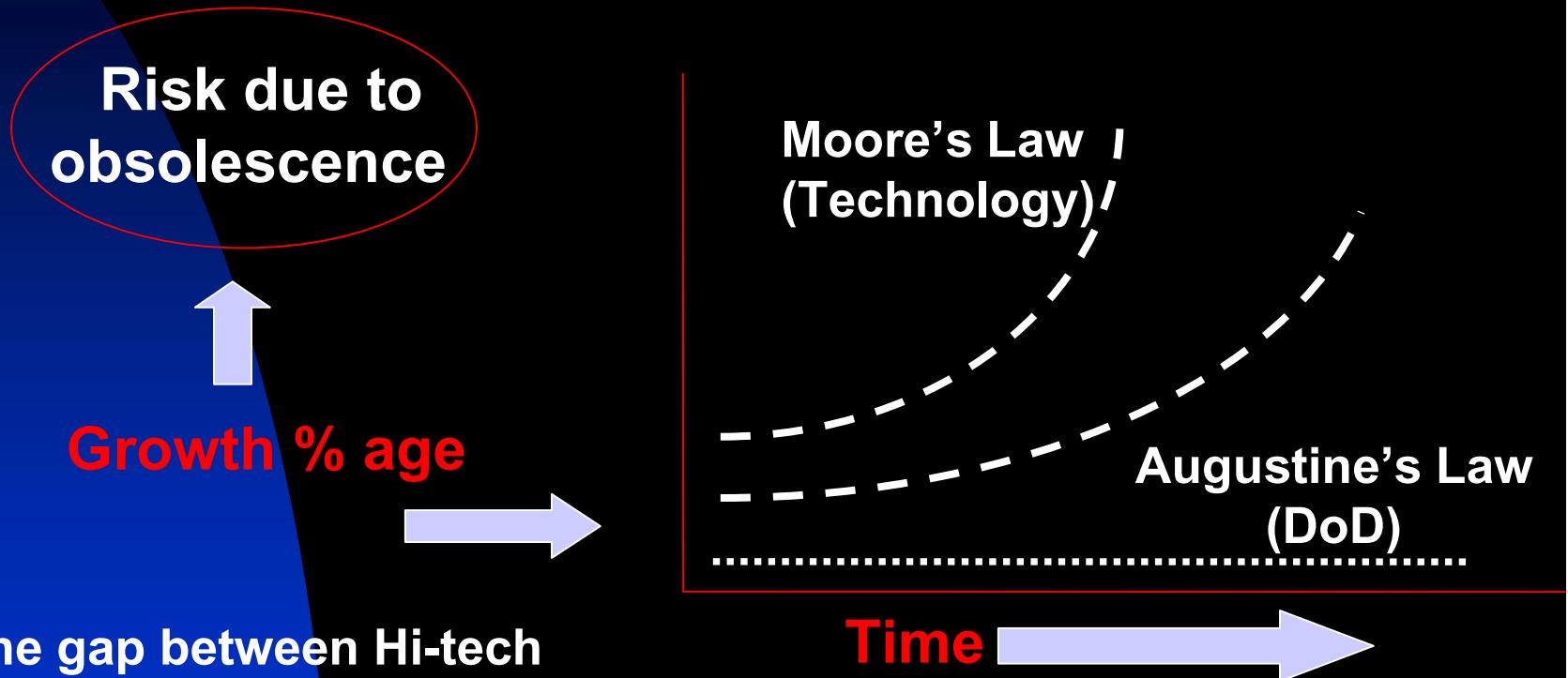
- **The gap between Hi-tech Moore growth and Augustine DoD growth is an exponentially growing function. We shall call it "The Widening Chasm Effect".**

Fiscal and Process Oversight

DoD IT acquisitions must also comply with oversight from the:

- Office of the Secretary of Defense
- Office of Management and Budget
- General Accounting Office
- U.S. Congress
- U.S. Taxpayers
- Clinger-Cohen Act of 1996

The Combined Challenge

- Increase the speed of developing and fielding IT systems…
- While maintaining and improving system effectiveness…
- Through a process that meets fiscal and process requirements.

Looking Forward

n "I do not know what all our warfighting requirements in the 21st century will be. However, if we have an adaptive system that can bring new technology into the field quickly, addressing today's needs, we will have a system that meets the missions of the future as they become clearer."

(Admiral Blair, 2001)

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Comparing Two Approaches

- Incremental Development (ID)
- Evolutionary Development (ED)
- The DoD is increasingly encouraging the use of ED.
- In practice, however, the ID approach is more common.

Incremental Development

"Top-Down"

§ *Complete* set of requirements written first

§ Developed in multiple phases

§ *Possible* intermediate deliverables

Evolutionary Development

"Spiral"

§ Broad goals and *some* requirements written first

§ Developed in multiple phases

§ *Multiple* intermediate deliverables, which reflect changed and refined requirements

Potential Benefits of ED

- Provides quality feedback on intermediate products
- Allows for early risk avoidance and error correction
- Reduces the overall cycle time

Potential Problems with ED

- Unnecessary overhead if the complete requirements are well-known at the start of the project.

- Loss of focus/confusion due to:
    - A developer involved with multiple, concurrent ED projects
    - A split development team attempting to produce multiple spirals at the same time

Will ED Work in the DoD Setting?
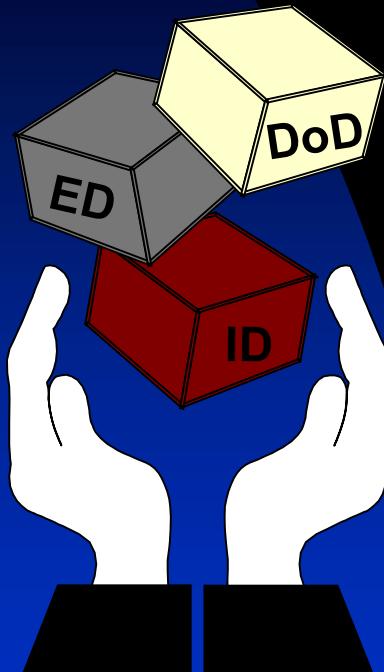
- Even if DoD makes greater use of ED, the process will differ from commercial ED.

- There will be differences in the process because there are inherent differences in the DoD and commercial environments.

DoD vs. Commercial Acquisition

n   DoD is involved with more oversight organizations.

n   DoD is subject to acquisition laws and guidelines.

n   Rate of requirements change is greater in the commercial world than in the DoD.

n   Most ED projects have users and developers at the same site – this is not always feasible for the DoD.

Additional ED Challenges

- Much time/effort are needed to:
  - Communicate requirements
  - Monitor progress
- If in-house and contractor teams develop different parts of the system, problems may result with versioning, interface, interoperability, and architecture mismatch.

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Proceed with Caution…

ED offers many potential benefits.

- However, by adopting greater use of ED, DoD acquisition problems may not go away.

- It is possible that in some areas, we may get into even larger problems.

Issues to Consider

- Securing/planning for funding
- Defining requirements
- Determining spirals
- Determining cycle time
- Writing the contract
- Testing the IT product
- Providing sponsorship

Funding an ED Project

n ED is well suited to small initial budgets, with additional funding approved only when the current phase is successful. This:

  u Ensures that only the most essential features are developed

  u Promotes a quality product at each development phase

  u Allows unsuccessful projects to be cancelled with relative ease

Funding Issues for DoD

- DoD funding is approved by Congress annually.
- If the full project is not funded at the outset, how can we know that funds will not be cut off due to lack of money rather than lack of progress?
- How would we determine the appropriate amount of funding?
- Which organization would approve or cancel a project?

ED Requirements Definition

n ED involves a tight feedback circle between users and developers

    u Preferably on site

    u Preferably meeting once a week (or at least once a month)

Requirements Issues for DoD

- Cost of requirements definition and oversight will not be low due to constant interaction between users and developers.

- What happens if users and developers are not located near each other?

- Can teleconferencing address this issue completely?

Spirals & Cycle Time
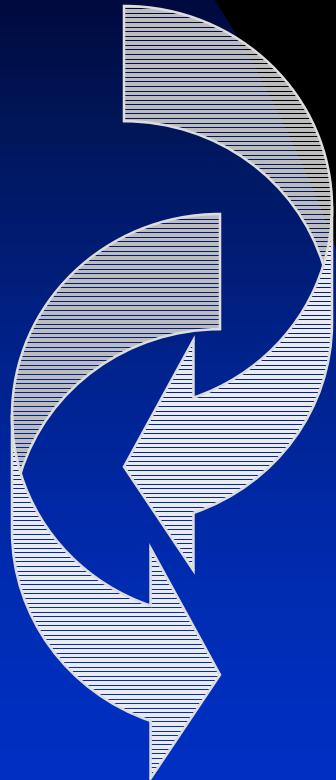
n   What is the appropriate number of spirals, and what is the appropriate cycle time for each?

n   Who makes this determination?

n   Too many spirals = costly overhead

n   Too few spirals = losing the benefits of ED

Contracting Issues
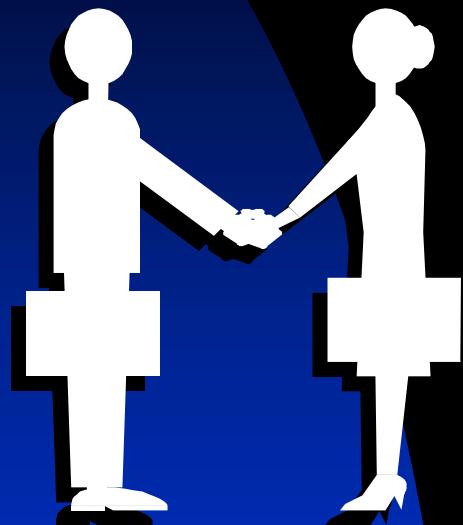
n How can we negotiate a contract with the developer given that we do not have the final requirements and requirements will change during the development process?

Testing the ED Product

n Testing will be more important.

   u Each intermediate product must be high quality.

   u Each change must be subject to regression testing, and changes will be often and extensive

   u Testing will take place throughout the development cycle, because it will be used from the first cycle to the last.

Testing Issues for the DoD

n Each deliverable must meet I-9 and safety requirements.

n End-to-end testing is important because of interoperability and legacy system concerns.

n Test scenarios should be requirements-driven, understandable, easy to change, and available online at all times during the system life cycle.

Sponsorship

n   Each project must be sponsored.

n   Commercial projects often fail if they have no sponsor, or if the sponsor leaves the organization during development.

n   Parties involved in the project may change; however, the business case for a project should serve as a sponsor.

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Key Goals for Acquisition Reform

- Make the acquisition process flexible, dynamic and adaptive
- Reduce the acquisition engineering development cycle time

Candidate Approaches (1)

- Support both ID and ED through technology and process streamlining.

- Make oversight minimally invasive by making several milestone reviews online or requiring simplified data.

Candidate Approaches (2)

- Devise a way for end users to interact with developers during the entire development and maintenance process.

- Give end users more autonomy in making IT acquisition decisions.

Candidate Approaches (3)
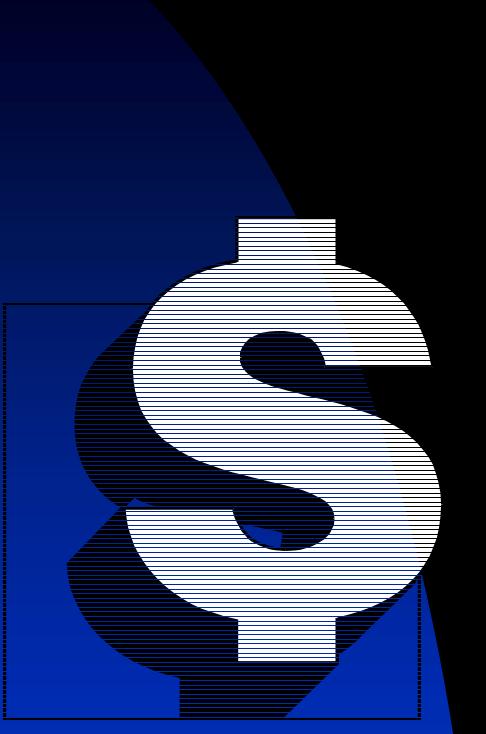
n   Devise a way to fund ID/ED projects when complete requirements are not known at the beginning.

n   Measure IT spending effectiveness based on mission performance and improvement, rather than just the delivery of systems.

n   Measure effectiveness of IT projects based on the total life cycle cost, including operations and maintenance.

An Income Tax Model for ED

An acquisition process based on the income tax model may be beneficial:

- Gives flexibility/autonomy to users
- Assures oversight capabilities to the OSD and GAO
- Makes extensive use of technology

INCOME TAX MODEL

IRS

§ Taxpayer reports gains and losses.

§ Taxpayer files annual income tax report.

§ IRS may choose to audit the taxpayer for a specific reason.

§ IRS may audit the taxpayer as one of several random selections.

TAXPAYER

GAINS

LOSSES
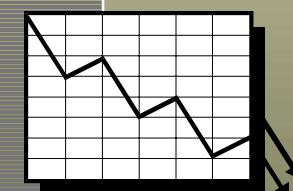
Acts with autonomy to generate income (jobs, investments, etc.)

APPLYING THE INCOME TAX MODEL

OSD

§ User and contractor report activities to the OSD, mostly via the Internet using OSD-designed forms and templates.

§ User and contractor meet with the OSD for annual audit of project progress.
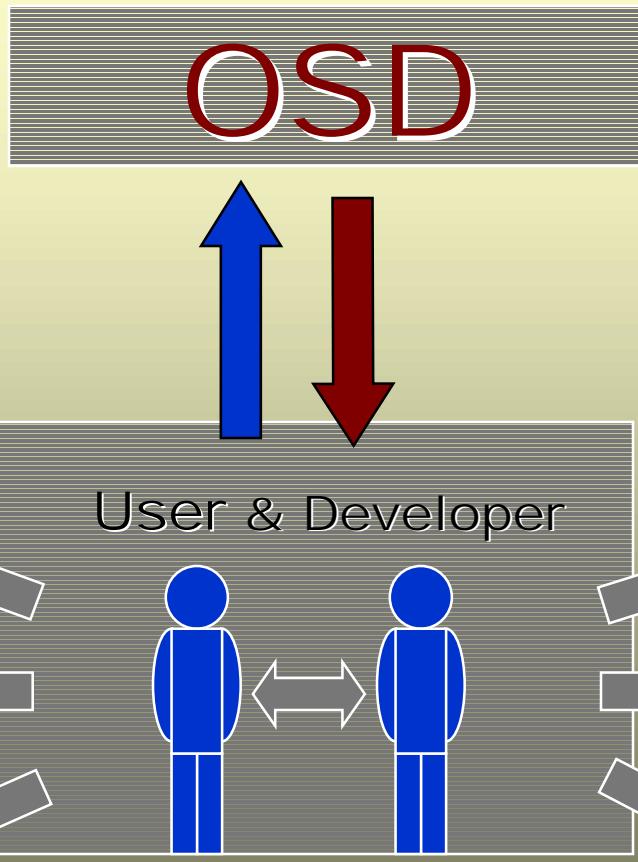
§ OSD may request additional meetings if questions arise regarding project process.

§ OSD may re-direct the project if the user or contractor fail to answer OSD concerns.

User & Developer

Cost/Funding

Requirements

Proceed or Terminate

Length of Cycles

Technical Approach

Number of Spirals

User and contractor follow ED guidelines, but make autonomous project development decisions.

Key for Cycle Time Reduction

- From both commercial (Extreme Programming and Agile methods) and military IT development experience (Adm. Blair), we know that IT cycle time can be reduced if
  - Constant and frequent interaction between users and developers, so that developers understand the requirements, and user can provide frequent evaluation and feedback.
  - Frequent and extensive testing during the entire process including intermediate deliverables.
  - Use a flexible and loosely coupled design to allow changes to be made quickly.

Key for Cycle Time Reduction
(continued)

u   To get cycle time reduction, it is essential that the acquisition process should encourage and support interaction between developers and users, while at the same time allowing appropriate oversight to be conducted properly. The Income Tax model encourages the interaction between developers and users, while allowing oversight to be conducted via filling up forms like filling up income tax forms. This model gives the _maximum freedom_ to users and developers to make their decisions (including requirements, design, budget, and life cycle decisions) without consulting to OSD, and thus _minimize all the unnecessary bureaucracy_. The freedom allows users and developers to make _rapid_ and _timely_ changes during the acquisition process to meet the ever changing requirements or to take advantages of emerging technologies.

Key for Oversight Management

- *Give the Combatant Commanders and Services increased autonomy*
- In return, the Services must:
  - Report their activities in writing
  - Participate in periodic and _random_ audits

Testing in the New Approaches

- Evolutionary development emphasizes:

  - **Incremental delivery** - each deliverable fully tested, functional, and ready for deployment.

  - **End-to-end system capabilities** - not just testing individual systems, but continuous evaluation of operational scenarios, interoperability, thread analysis, integration, and information assurance.

  - **Regression testing** – as requirements change during ED, E2E provides an economical process to select and run the extensive test cases to ensure that changes do not create adverse effects.

Definition

PIR is the gathering, review, analysis and reporting of warfighter/user comments and details on how well the respective fielded (post Milestone C) IT system is operating/performing and supporting the mission requirements it was expected and designed to do.

"Does it do what it is designed and expected to do!"

The Strategy

- A Three Phased Approach

- Garner CINC Involvement

- Leverage Existing Exercises and Operations

- Make PIR process Family of Systems Centric

- Link JFCOM's Requirement Reviews with PIR assessments

Phased Approach

n **Phase I**

  u **On-site C3I support**

    « **Create PIR Process**

    « **Garner Process approval from OSD stakeholders, CINCs, and Service Acquisition Communities**

    « **Develop short and long term funding strategy**

  u **Coordinate with JFCOM and CENTCOM/SOCOM**

    « **Gain approval for on-site support**

    « **Develop MOU between CIO and CINC sites**

n **Phase II**

  u **Develop five year POM requirement for CINC sustainment**

  u **Coordinate approval for on-site support for:**

    « **USFK, EUCOM, and PACOM in that order**

    « **CIO surge support**

n **Phase III**

  u **Develop Increase POM request**

  u **Coordinate approval for on-site support for:**

    « **SOUTHCOM**

    « **SPACECOM**

PIR's Answer the Warfighter's Concerns

n **Does it do what it was designed and expected to do?**

n **Did we get what we paid for?**

n **Has it been integrated? (DOTMLPF)**

- u **Doctrine**
- u **Operations**
- u **Training**
- u **Material**
- u **Leadership**
- u **Personnel**
- u **Facility**

"System value and performance must be gauged by the actual users in the real-world, doing real-world activities and actions!"

n **Are there any interfacing and/or interoperability issues?**

n **What are the recommendations for product improvements?**

USJFCOM – DoD CIO Partnership

USER Satisfaction

Get Requirement Right 3170 & 6212 (IER / KPP)

PIR Feed Back
REQ ↔ MOE

JFCOM

Implementation Award

DoD CIO

Traceable Thread from Requirement to Implementation
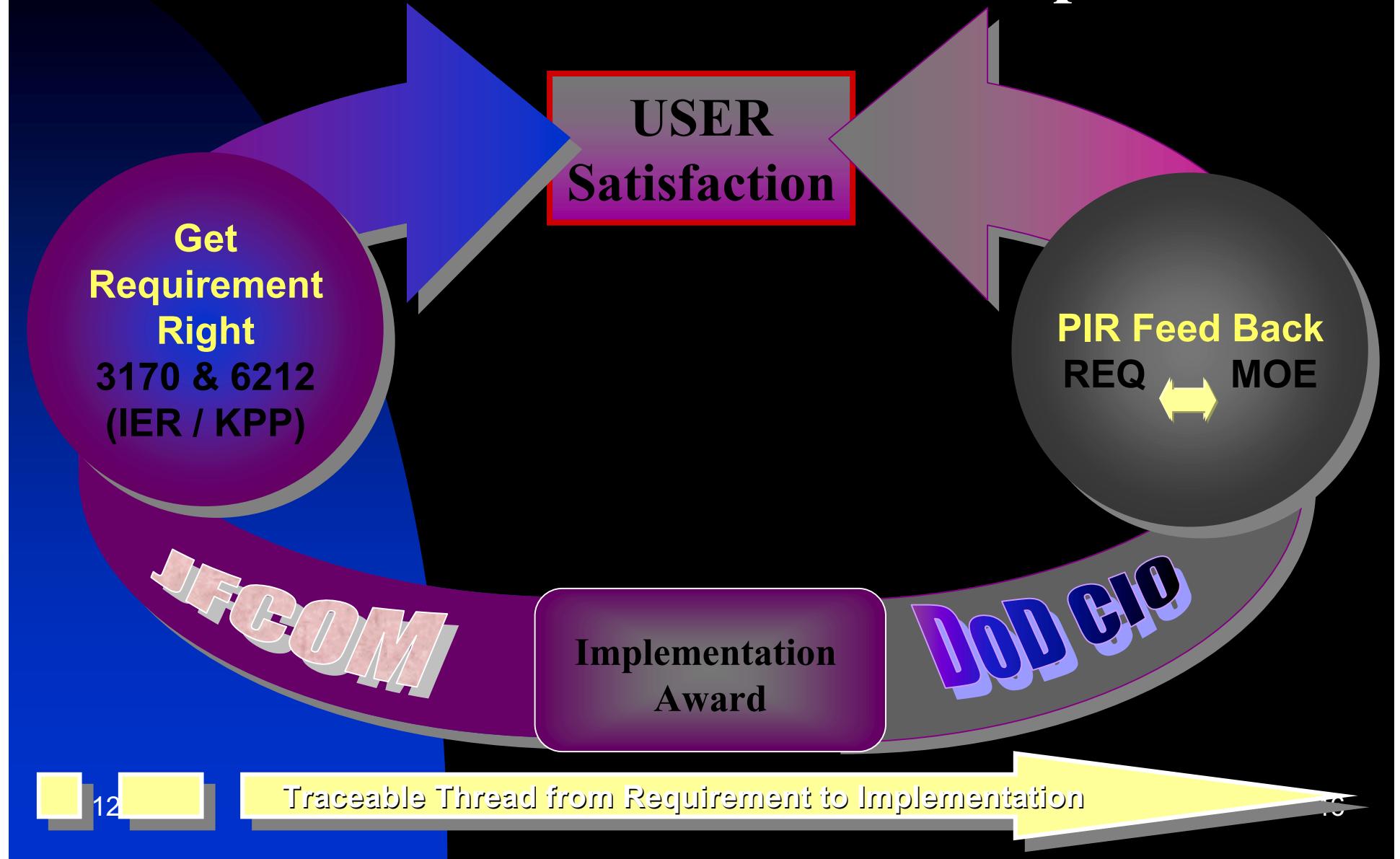
CINC Partnership Added Value

- n **Support CINCs in establishing evaluation requirements within their Joint Exercises and Operations to assess newly fielded systems**

- n **CIO has a direct path and insight into the CINCs Joint Mission Area Criteria**

- n **Move the PIR process from a system-centric focus to a Family of System/Mission centric focus required by the Clinger-Cohen Act**

- n **Help CINCs filter evaluation results and Warfighter/user concerns to the Joint requirements community**

- n **Provides a Reach Back Capability**
  - u **Government Action Officers**
  - – **Contractor Analysts/Engineers/Developers**
  - – **Testing/Experience**

- n **Allows JFCOM and C3I to link requirements with users.**

PIR Added Value

n **Results support decisions for funding product improvements.**

n **System improvement responsive to user needs.**

n **Demonstrates IT system oversight mechanism.**

n **Demonstrates concern to the Warfighters/users as to the IT systems provided to meet their mission needs.**

n **System development to deployment would be made quicker.**

Just makes good business sense!

The Way Ahead
The Short Term

Take Strategy to ASD/C3I Leadership

   u **Take Briefing to AT&L**

   u **Refine Briefing for JFCOM**

Develop Funding Requirement for On-site Support to Implement Phase I of Strategy

The Way Ahead

n Applying ED to the DoD IT acquisition process, directly as used in the commercial world, is not the solution.

n A more careful, customized approach, based on the income tax model, holds much promise for meeting acquisition objectives:

　u A flexible, shorter acquisition process

　u The production of effective warfighting technology for the 21st century.

References & Resources

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n [DoD 2001] Department of Defense, Office of the Assistant Secretary of Defense for Command, Control, Communications & Intelligence (Investment and Acquisition), *End-to-End Integration Testing Guidebook*, 2001.

n [Tsai 2001a] W.T. Tsai, X. Bai, R. Paul, W. Shao, V. Agarwal, T. Sheng, and B. Li, "End-to-End Integration Testing Design," *Proceedings of IEEE COMPSAC,* 2001.