Evolutionary Acquisition of the Future Combat Systems (FCS)

FUTURE COMBAT SYSTEMS

FCS

One Team—The Army/DARPA/Industry

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CECOM Software Engineering Center

Software Acquisition Conference

January 27, 2004

Agenda

- What is FCS?

- FCS Capabilities

- Acquisition Challenges

- Traditional Acquisition Methodology vs. FCS

- New Acquisition Methodology

- Many Hats for Government Team
  - Communications link
  - Quality Assurance Team
  - Management Watchdog
  - Fire Rescue Team
  - Program Champion

- Results

- Summary

What is FCS?

§ **Formal Definition (FCS Software Development Plan):**

– "Future Combat Systems is a family of advanced, networked air and ground-based maneuver, maneuver support, and sustainment systems that include manned and unmanned platforms. The FCS systems are networked together via a distributed system architecture that includes networked communications, network operations, sensors, battle command systems, and manned and unmanned reconnaissance and surveillance capabilities to enable levels of situational understanding and synchronized operations heretofore unachievable."

§ **In simple terms…**

– Family of vehicles linked by a unified command and control network
– Sensors and surveillance equipment contribute to a combined operational picture
– Warfighters given unprecedented level of situational awareness
– Commanders have complete control of all available assets for optimized response

FCS Capabilities

What is Future Combat Systems?

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- **FCS** is a highly integrated structure of manned and unmanned, air and ground assets, bound by a ...work to act as ... combat force.

- **FCS** has the full spectrum of combat functions inherent in its capabilities, including embedded training and supportability.

- **FCS** is readily task organized for the mission.

- **FCS** is the basic building block of the Future Force and the Unit of Action (UA).
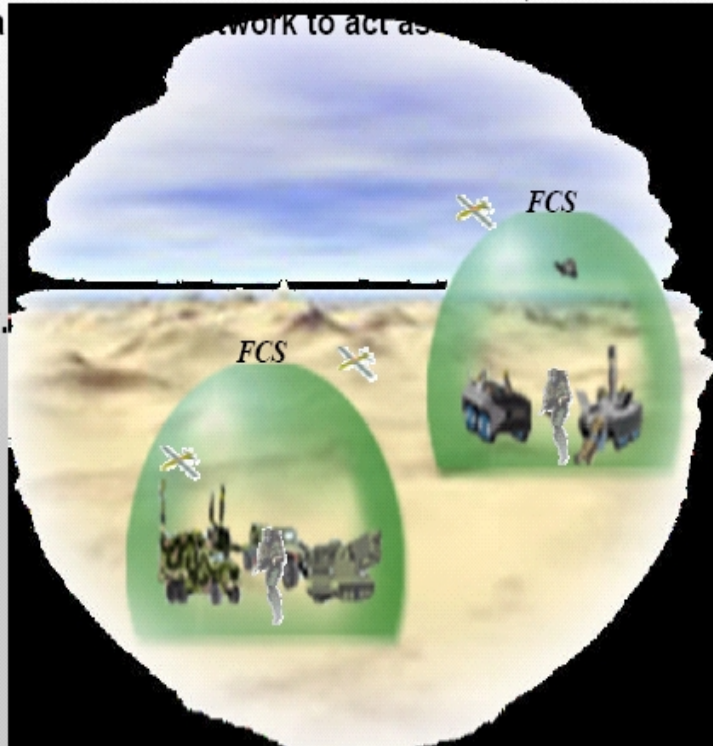
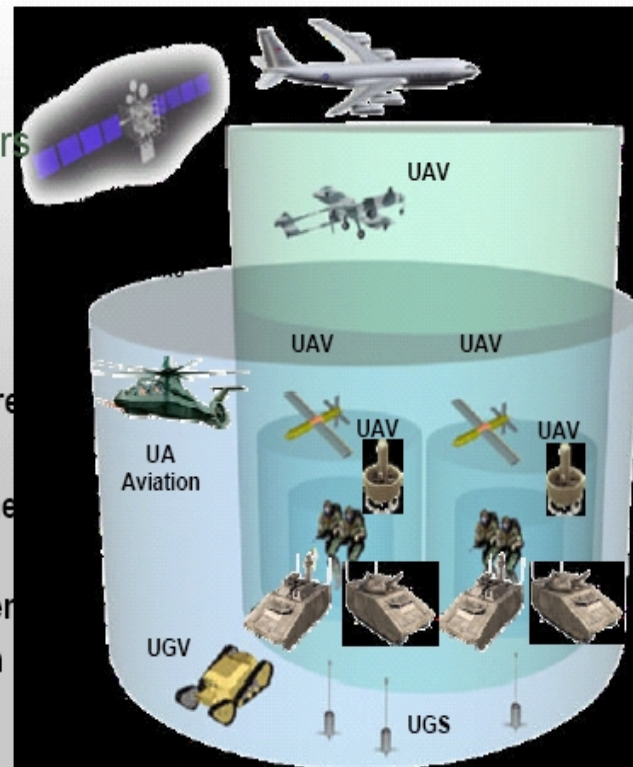*"Approved for Public Release, Distribution Unlimited, Case #42244"*

FCS Capabilities: Total Situational Awareness

See First / Persistent ISR

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Distributed/Networked Sensors

- Provides unequaled Situational Awareness down to the Soldier System
- Enhances survivability through knowing and avoiding enemy fire
- Enables precision engagement beyond the effective range of the opponent
- Maintain contact and engagement in detail throughout the mission

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FCS Capabilities: Dominance of Battle Space

Understand First / Act First

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CONUS / Higher HQs En Route Planning Rehearsal

SATCOM

National ISR

Joint ISR

Joint & Coalition Assets

Legend: Interfaces
Intra-FCS
Interoperable

UAV

FCS

Other Objective Force & Coalition Forces

Dismounted Combat Team A

NGO

FCS C2 Subsystem

NLOS Command

Networked Decision aids / "Associates" rapidly evaluates multiple Courses of action and quickly recommend highest payoff solution

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FCS Capabilities: Family of Vehicles and Variety of Platforms

An Integrated Family of Highly Capable Networked Systems (Nodes)

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- Manned Systems
  - ICV
  - C2V
  - Mounted Combat System
  - Reconnaissance and Surveillance
  - NLOS Cannon
  - NLOS Mortar
  - Maintenance and Recovery
  - Medical Treatment, Evacuation

- Unmanned Air Platforms
  - Class I & II
  - Class III
  - Class III & IV III/IVa

- Unmanned Ground Vehicles
  - Armed Robotic Vehicle
  - Small Manpackable UGV
  - Mule

- Unmanned Payloads
- Unattended Ground Sensors
- Unattended Munitions
  - NLOS LS
  - Intelligent Munitions

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FCS Capabilities: FCS vs. External Systems
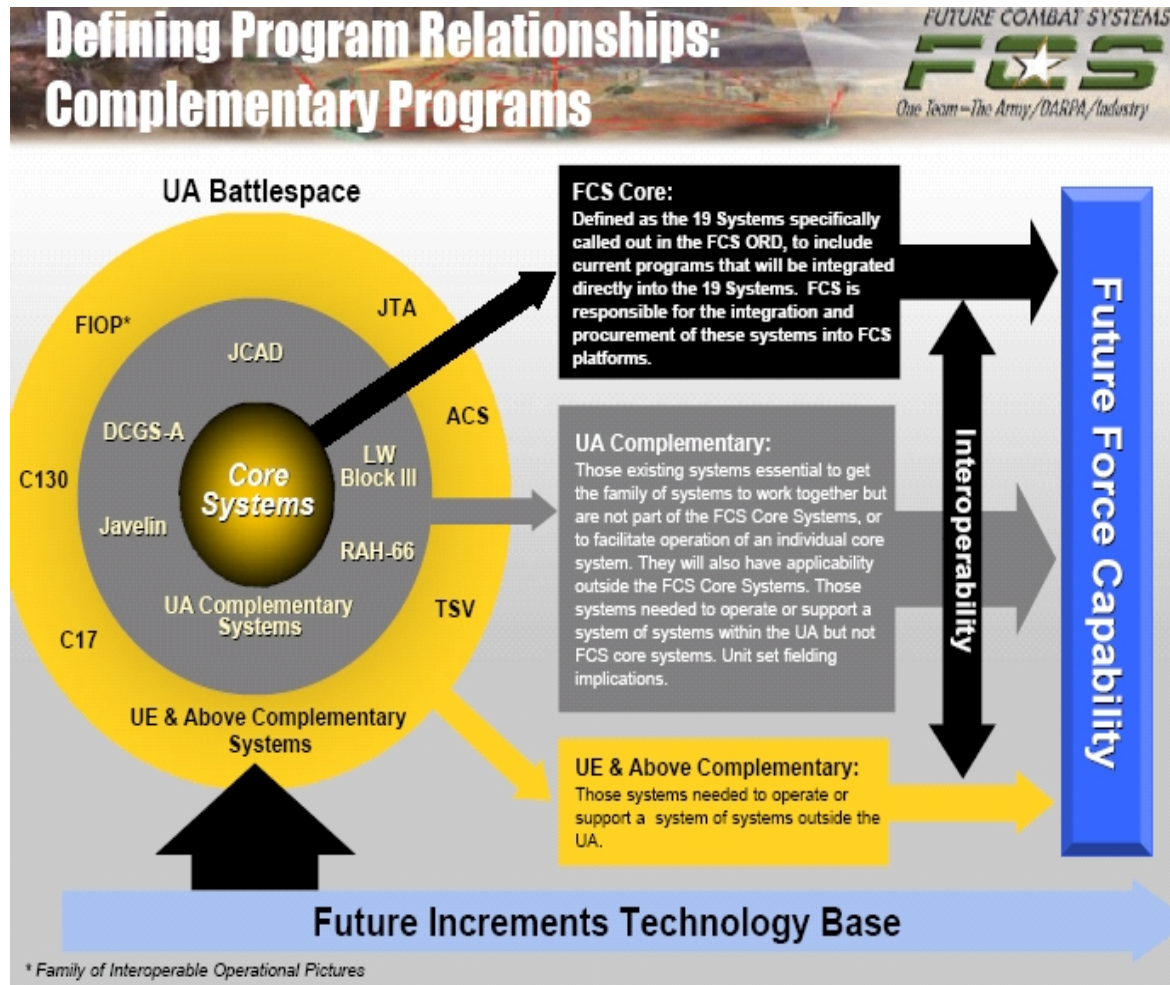
Acquisition Challenges

§ **Unprecedented requirements**
   – **Complete command and control capability over all FCS assets**
   – **Total situational awareness**

§ **Formidable integration issues**
   – **Broad range of integrating diverse systems is daunting**
   – **FCS is intended to operate in a completely seamless manner**

§ **Size of program**
   – **Projected lines of code: 34 million**
   – **Cost: $18 billion**

§ **Extremely aggressive schedule**
   – **Spiral software development model used**
   – **New acquisition methodology: "One Team Concept"**

§ **Technical concerns**
   – **COTS/GOTS software and software reuse**
   – **Meeting interoperability, security, and bandwidth challenges**
   – **Technology insertion**
   – **Evolving operational and technical requirements**

Acquisition Challenge: Long Term Schedule for FCS

FCS Program Way Ahead

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- Transition From CTD Into SDD With Best of Industry Partners
- Continue Capabilities Enhancement through Spiral Development / Technology Insertion
- Continue the Cultural Shift Through Evolutionary Acquisition and System-of-Systems Development Process

2002 2004 2006 2008 2010 2012 2014 2016 2018

DARPA · Technology Insertion

FCS

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Acquisition Challenge: Programmatic Goals for FCS

Key Tenets of the Program

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- Create Opportunity for *Best of Industry* to Participate
- Leverage Government *Technology* Base to Maximum Extent
- *Associate* On-Going Enabling Efforts With LSI-Led Activity
- *Collaborative Environment* from Design Through Life Cycle
- As a Minimum, *Commonality* at Subsystem/Component Level
- Design/Plan for *Technology Integration* and Insertion
- Maintain and Shape *Industrial Base* for the Future
- Retain *Competition* Throughout Objective Force Acquisition
- Appropriate *Government Involvement* in Procurement Processes
- Maintain and Shape *Government Acquisition* Community
- Program *Affordability--Balance* Performance and Sustainment

Always Remember - FCS is a System of Systems Not Individual Pieces

Acquisition Challenge: Distributed Nature of Team

Building "Best of Industry" Team

FUTURE COMBAT SYSTEMS

Legend: C4ISR | UAV (TBD) | UGV | Logistics | Training Support | MGV

General Dynamics
Bloomington, Minnesota
Integrated Computer System
PKG 26

Raytheon Company
Ft. Wayne, Indiana
Battle Command and
Mission Execution – PKG 18

Dynamic Research Corp
Andover, Massachusetts
Training Support Package – PKG 27

Textron Systems –
Wilmington, Massachusetts
Unattended Ground
Sensors – PKG 15

General Dynamics Land Systems
Sterling, MI
MGV

General Dynamics Robotics Systems
Westminster, MD
ANS – PKG 9

iRobot Corp
Burlington, MA
SUGV – PKG 8

United Defense Ground Systems Division
Santa Clara, California
MGV

BAE Systems / CNIR
Wayne, New Jersey
Ground Comm.– PKG 24
Air Comm.–PKG 25

Honeywell Defense & Electronics Systems
Albuquerque, NM
PSMRS – PKG 11

Lockheed Martin Missiles & Fire Control
Grand prairie, TX
MULE – PKG 7

Northrop Grumman Mission Systems
Carson, California
Network Management – PKG 17
LDSS – PKG10

Northrop Grumman Sys Corp
Linthicum, Maryland
Air Sensor Integrators– PKG 14

Computer Science Corp
Hampton, VA
Training Support Package– PKG 27

Lockheed Martin (Orincon) Defense Corp
San Diego, California
Level 1 Fusion – PKG 16

Northrop Grumman InfoTech
McLean, VA
Training Support Package– PKG 27

General Dynamics Decision Systems
Scottsdale, Arizona
Sensor Data Management – PKG 16
Planning and Preparation – PKG 19

Austin Info Systems
Austin, Texas
Situation Understanding
PKG 20

Raytheon Company
Plano, Texas
Ground Sensor Integrators
PKG 12

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Traditional Acquisition Methodology vs. FCS

§ **Qualifying criteria for traditional acquisition approach:**

- Fixed requirements/mature system development
- Extended schedule available
- Development of small, specialized system
- Simplified integration issues
- Waterfall software development

§ **<u>Not</u> conducive to FCS acquisition**

- Evolving requirements
- Extremely aggressive schedule
- Largest Army project in history
- Unprecedented and complex integration issues
- Spiral software development
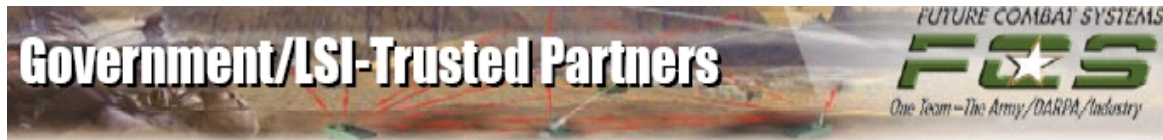
New Acquisitions Methodology

§ **One Team Concept**
  – Integration of functions between the Government and contractors
  – Appointment of primary contractor as Lead Systems Integrator (LSI)
  – Integrated Product Teams (IPTs) formed to build functionality
  – LSI as IPT lead and Government co-lead of important IPTs

§ **System of Systems Development Environment**
  – Spiral software development (4 major builds)
  – Requirements development, software design and implementation performed concurrently
  – Creating Common Operational Environment to simplify implementation process (spare software suppliers from unnecessary details)
  – LSI instrumental in difficult integration issues
  – Reduce risk and meet aggressive schedule

New Acquisition Methodology:
One Team Concept

Government/LSI-Trusted Partners

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Army/DARPA
DARPA

The Army's LSI

TEXTRON Systems
iRobot   Raytheon
GENERAL DYNAMICS
United Defense   A|S
Honeywell   CPC   BAE SYSTEMS
NORTHROP GRUMMAN   DRC

Best of Industry

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New Acquisition Methodology: PM FCS Management
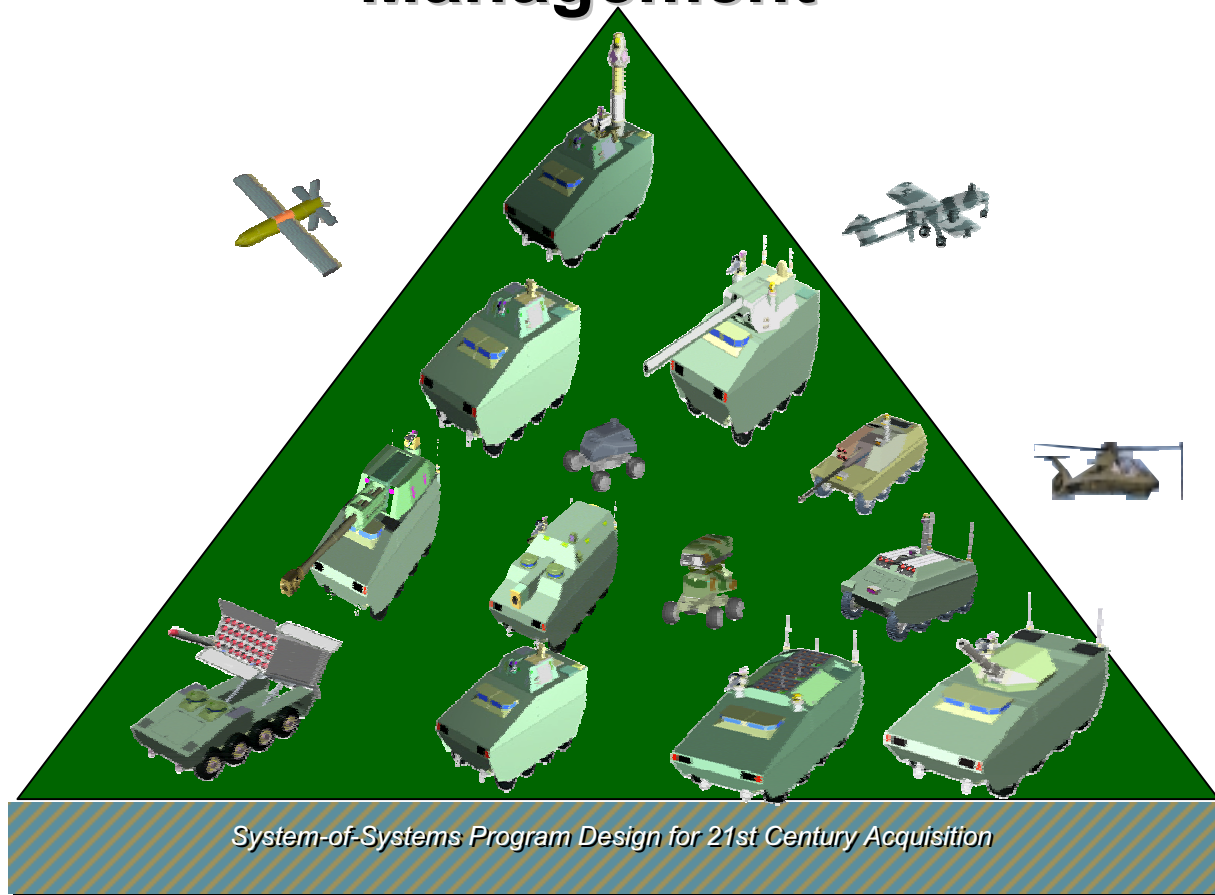
System-of-Systems Program Design for 21st Century Acquisition

New Acquisition Methodology:
LSI Defined and Its Importance

What the LSI Does/Does Not Do...

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- **Why a Lead Systems Integrator (LSI)...**
  - The Army's first large scale "system of systems" development, integration across many platforms and disciplines, requires a robust / dedicated organization experienced in large scale systems integration to be successful

- **What the LSI does...**
  - Trusted Industry member of the FCS Team (DARPA / ARMY / LSI / Best of Industry) that has total systems integration responsibility ("top down" development)
  - Provides the Team a "general contractor" for resource allocation, subcontract implementation and coordination, and programmatic responsibilities
  - Provides the vital link to the "Best of Industry" including domestic / foreign contractors, Government programs / Labs, and educational institutions

- **What the LSI does not...**
  - Does NOT provide hardware solutions to subsystem / element requirements

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New Acquisition Methodology:
Roles of PM FCS and LSI

The Program Manager for the FCS has System of Systems responsibility for cost, schedule, and performance.

The LSI is beyond the normal "general contractor" and is instead the actual systems integrator for the program

There are overlaps in these roles and thus, need for mutual cooperation ("one team" approach).

New Acquisition Methodology: Addressing Challenges

Facilitating the Future

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......How to "Get There" from here......

- Unprecedented "Partnership"

- Spiral Development / Technology Insertion

- Integrated Simulation & Test

- Revolutionary / Evolutionary Acquisition Approach

- "Best of Industry" Business Approach

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New Acquisition Methodology: System of Systems (SoS) Definition

• Is A family of advanced, networked air- and ground-based maneuver, maneuver support, and sustainment systems that will include manned and unmanned platforms.

• Is Networked via a C4ISR architecture, including networked communications, network operations, sensors, battle command systems and training that enables improved situational understanding and operations

– Provides improved ISR, battle command, real time sensor-shooter linkages, and increased synergy between echelons and within small units.

– Provides the Unit of Action (UA) the ability to connect to UE, joint capabilities, and national assets making these capabilities available to the small units of the UA.

Intent: Field FCS-Equipped Units of Action With Threshold Objective Force Capability by the End of the Decade

New Acquisition Methodology: Obstacles to the System of Systems Approach

History shows it's tough to get "buy-in" to the System of Systems scenario

- It's a new paradigm; "…not business as usual…"
- Seen as a threat to a person's area of responsibility (and control)
- Some pay "Lip Service" to the program, seeming to support it while their interests lie elsewhere
- What is the highest priority … ?
    It all depends...
- PM and IPT Co-Leads are competing for the highest-qualified functional personnel and other scarce resources, creating possible turmoil

New Acquisition Methodology: Summary of Challenges

§ **Culture between Government and contractor must be "reinvented"**
  - Overlap of roles/"blurring" of responsibilities
  - Government maintains traditional oversight responsibilities

§ **"One Team" Concept requires "cultivation"and "nurturing"**
  - Open and honest communications
  - Team members must think about project first

§ **"System-of-Systems" Software Development requires trust**
  - "Stove pipe" processes and "protecting turf" not allowed
  - Subteams must "trust" each other that requirements are incorporated
  - Application software not allowed access to operating system directly

§ **Bottom line:** "New" methods must be used or FCS will not succeed!

Many Hats for Government Team: Serving as Bridge between Old & New

§ **The Government must smooth transition between old and new ways**
- – Foster paradigm shift to new ways to doing business
- – Must emphasize that "business as usual" will lead to failure

§ **PM, FCS and LSI must instill new culture of "one team" approach**
- – Both Government and contractors are "all part of us"
- – "Us vs. them" mentality must be banished
- – Limited time and effort must be spent on project
- – Avoid "turf wars" and "blame games"

§ **"System-of-systems" discipline must be maintained**
- – Honor all reasonable needs of the user
- – Avoid tendency for implementation teams to "go their own way"
- – PM and LSI must foster comprise and negotiations between users

§ **Bottom line:** Government must drive "new thinking" to avoid failure!

Many Hats for Government Team: Dilemma of Change

§ __Dilemma:__ How can Government personnel instill dramatic shift in culture without sacrificing project requirements in an environment with limited time and resources?

§ __Answer__: By wearing many different hats and by acting in an honest and open manner…

Many Hats for Government Team:
Need for Playing Multiple Roles

§ **Reasons for Government playing multiple roles**
  – Insufficient number of Government personnel
  – Need for an "integrated view" to provide guidance
  – Government involvement required on all fronts
  – Ensure that "ball does not get dropped"
  – Broad involvement emphasizes importance of FCS

§ **Absence of multi-level commitment will "derail" FCS**
  – Need of role model for LSI and other contractors
  – Broad oversight needed to ensure processes in place

§ <u>**Bottom line:**</u> **Broad, active, and multi-level Government involvement required for FCS to succeed!**

Many Hats for Government Team: Communications Link

§ <u>Purpose</u>: Serve as a direct link between the user and the contractors to channel vital information to where it is needed.

§ Needs addressed:

- Implementation of user requirements
- Horizontal and vertical integration
- Sharing of system resources (e.g. bandwidth allocation)
- Addressing Army policies (e.g. required user access levels)
- Determine project status and making required administrative changes

§ <u>Example</u>: The Government team helps the LSI understand and implement TRADOC operational policies into workable software solutions.

Many Hats for Government Team: Quality Assurance Team

§ **Purpose**: To make certain that technical standards are being met

§ **Needs addressed:**
- Provides LSI with validation of their efforts
- Independent assessor of technical work keeps LSI "honest"
- Helps resolve potential technical issues between the team
- Additional protection against contractor errors
- Brings integrity to process with need of independent Government approval

§ **Example**: The Government team reviewed a large volume of software documents, offered constructive comments, and ensured that this documentation was of best quality possible.

Many Hats for Government Team: Management Watchdog

§ **Purpose: To monitor scheduling and programmatic progress.**

§ **Needs addressed:**

- **Monitor project progress to avoid serious pitfalls down the road**
- **Independent assessor of schedule and budget keeps LSI "honest"**
- **Serve as independent arbiter of disputes for resources**
- **Validates LSI requests for additional time, money, or people**
- **Brings integrity to process with need of independent Government approval**

§ **Example: Programmatic changes keep a maj on track.**

Many Hats for Government Team: Fire Rescue Team

§ **Purpose: To help resolve unexpected problems.**

§ **Needs addressed:**

– **Provide direction during true crises (e.g. reduction in funding).**

– **Acts as honest broker during potential disagreements between team members.**

– **Make tradeoffs between competing needs**

– **Validates LSI efforts to resolve difficult problems**

– **Brings integrity to process with need of independent Government approval**

§ **Example: Government team gives credibility to emergency requests from the contractor and issues are resolved quickly.**

Many Hats for Government Team: Program Champion

§ **Purpose**: To help gain approval for additional resources and continued political support.

§ **Needs addressed:**

– Government team has "links" to cut red tape.

– Helps program compete for scarce funding.

– Provides political cover to LSI for potentially unpopular decisions.

– Validates LSI efforts to resolve difficult problems

– Brings integrity to process with need of independent Government approval

§ **Example**: Government team allows LSI to focus on "real work" of FCS.
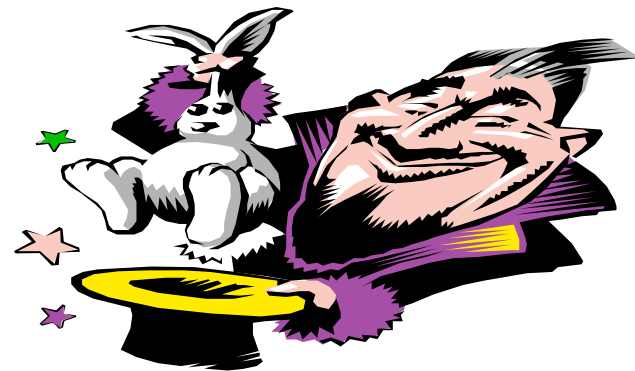
Many Hats for Government Team: Juggling All Roles Harmoniously

The Trick: Government members need to know when to play which role when and also allow the contractors to do their jobs free of interference.
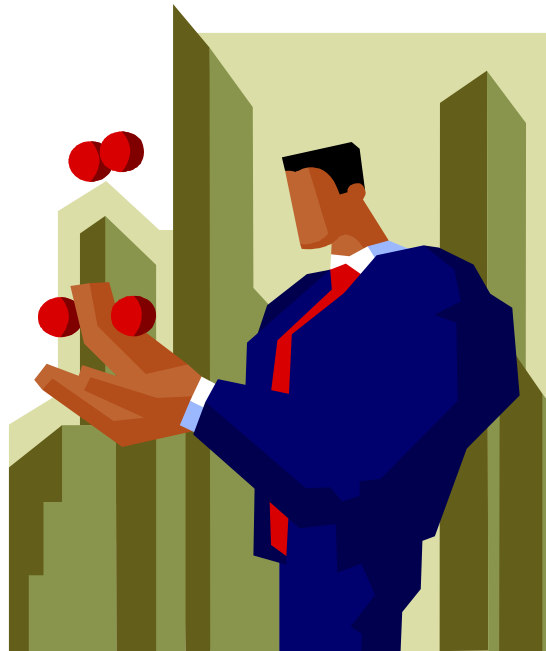
Results to Date

§ **Build 0 for FCS middleware (SOSCOE) completed on time and within budget**
- Prototypical build with core services was successful
- Culture of one team concept team instilled
- Government and LSI members worked harmoniously
- Basic foundation for system-of-systems architecture initiated

§ **Successful support of Net Fires Demo in Redstone Arsenal with SOSCOE**
- Limited interoperability testing with external systems conducted
- Software execution of FCS middleware (SOSCOE) was seemingly flawless

§ **Build 1 successfully initiated**
- Suppliers recently under contract to provide domain services
- Formal architectural design underway; working with implementation teams

§ **Next Steps**
- Current efforts will draw upon build 0 lessons learned
- Suppliers provide their requirements to LSI and Government team
- Systems-level issues currently under study (e.g. bandwidth allocation, security, etc.)

§ **Bottom line:** While results to date have been impressive, considerable amount of work remains to be done.

Summary

§ Revolutionary nature of FCS requires "new" acquisition methods

§ "One team" concept helps Government and LSI share work and responsibilities

§ "System-of-Systems" software build method streamlines integration effort

§ Next Steps
  – Basic team infrastructure has been established
  – Successive software build increments continue along same path
  – Assess effects of process on periodic basic to allow for readjustments

§ <u>Bottom line</u>: FCS cannot be built with traditional acquisition methodologies and instead depends on a trusting, flexible, and innovative ways to satisfy the Warfighter'