

SYSTEMS ACQUISITION AND INTEGRATION -TUTORIAL FOR INCOSE-

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PRIMARY SOURCE

- MUCH OF THE MATERIAL IN THIS TUTORIAL IS FROM DR. EISNER'S BOOK:
- **“ESSENTIALS OF PROJECT AND SYSTEMS ENGINEERING MANAGEMENT”, 3RD EDITION, JOHN WILEY, 2008**

OUTLINE

- 1. INTRODUCTION – SYSTEMS ACQUISITION
- 2. WHY A PROBLEM?
- 3. SOME OLD APPROACHES
- 4. 5000.1 DIRECTIVE
- 5. 5000.2 INSTRUCTION
- 6. DEFENSE ACQUISITION PERFORMANCE ASSESSMENT (DAPA) REPORT
- 7. CAPABILITY-BASED ACQUISITION

OUTLINE (Cont.)

- 8. AN OVERVIEW OF SYSTEMS INTEGRATION
- 9. TOP FIVE S.E. ISSUES
- 10. TOP SEVEN KEY SOFTWARE ISSUES
- 11. SYSTEMS OF SYSTEMS
- 12. INTEROPERABILITY AND INTEGRABILITY
- 13. TOP DOZEN INTEGRATION LIST
- 14. SUMMARY

INTRODUCTION - SYSTEMS ACQUISITION

- DO WE HAVE A PROBLEM?
- WHAT IS NATURE OF PROBLEM?
- WHAT' S BEEN DONE TO “SOLVE” PROBLEM?
- HAVE SOLUTIONS BEEN WORKING?
- CAN WE POINT TO SPECIFIC REPORTS/RESULTS ON THE ABOVE?
- HOW RELATED TO SYSTEMS ENG' G?

WHY A PROBLEM?

- VIEW OF GAO – MARCH 2005
- HAVE ASSESSED 54 PROGRAMS
- CURRENT DoD PROGRAMS ARE COSTING MORE AND TAKING LONGER
- MOST PROGRAMS HAVE PROCEEDED WITH LOWER LEVELS OF KNOWLEDGE AT CRITICAL JUNCTURES
(TECHNOLOGY, DESIGN, PRODUCTION)
- INSUFFICIENT MATURITY

EXAMPLES OF SYSTEMS REVIEWED (FROM \$800B)

- JOINT TACTICAL FIGHTER
JOINT TACTICAL RADIO SYSTEM
- NATIONAL POLAR-ORBITING OPER-
ATIONAL ENVIRON. SATELLITE SYST.
- TERMINAL HIGH ALTITUDE AREA DEF.
- TRANSFORMATIONAL SATELLITE
COMMUNICATIONS SYSTEMS
- FUTURE COMBAT SYSTEMS

CITED PROBLEM AREAS (GAO)

- 1. OVERALL MANAGEMENT DEFICIENCIES
- 2. RISKS THAT NEED TO BE REDUCED
- 3. COSTS: TOO HIGH OR NOT WELL ENOUGH KNOWN
- 4. SCHEDULES: NOT WORKABLE
- 5. REQUIREMENTS DIFFICULTIES
- (CONTINUED – NEXT PAGE)

CITED PROBLEM AREAS (GAO)

- 6. NEED FOR BETTER PERFORMANCE
- & EFFECTIVENESS MEASUREMENT
- 7. NEED FOR “BEST PRACTICES”
- 8. INVESTMENT DECISION ISSUES
(HOW MUCH, WHEN, ETC.)
- 9. OVERALL FINANCIAL MANAGEMENT
ISSUES
- 10. NEED: SYSTEMS ENGINEERING

GAO – MARCH 2006

- TWO QUOTES OF INTEREST:
- Programs that begin with immature technologies have experienced average R & D cost growth of 34.9 percent; programs that began with mature technologies have only experienced cost growth of 4.8 percent
- DoD often exceeds development costs by approximately 30 to 40 percent and experienced cuts in planned quantities, missed deadlines, and performance shortfalls

GAO – APRIL 2006

SPACE SYSTEM ACQUISITIONS

- **USE GAO SUGGESTIONS**
- **ALLOW S&T COMMUNITY TO BRING TECHNOLOGIES TO MATURATION**
- **USE EVOLUTIONARY DEVELOPMENT**
- **IMPROVE REQ' TS COLLABORATION**
- **CHANGE INCENTIVES**
- **(WILL DoD TAKE ADVICE/INPUTS FROM GAO?)**

ACQUISITION, TECHNOLOGY AND LOGISTICS (AT&L) GOALS

- 1. STRATEGIC GOALS IMPLEM. PLAN
- 2. HIGH-PERFORMING, AGILE AND ETHICAL WORKFORCE
- 3. STRATEGIC AND TACTICAL ACQUISITION EXCELLENCE
- 4. FOCUSED TECHNOLOGY TO MEET WARFIGHTING NEEDS
- (CONTINUED ON NEXT SLIDE)

AT&L GOALS (CONT.)

- **5. COST-EFFECTIVE JOINT LOGISTICS SUPPORT**
- **6. RELIABLE AND COST-EFFECTIVE INDUSTRIAL CAPABILITIES**
- **7. IMPROVED GOVERNANCE AND DECISION PROCESSES**
- **8. CAPABLE, EFFICIENT AND COST-EFFECTIVE INSTALLATION**
- **(SEE WWW.ACQ.OSD.MIL)**

DEFENSE PROCUREMENT ACQUISITION POLICY (DPAP)

- 1. WORKFORCE MANAGEMENT
- 2. CONTINGENCY CONTRACTING
- 3. PANEL ON CONTRACTING
INTEGRITY
- 4. ACQUISITION OF SERVICES POLICY
- 5. COST, PRICING AND FINANCE
- 6. STRATEGIC SOURCING

SOME OLD APPROACHES (FROM THE '90s)

- SPEEDING UP THE PROCESS
- COMPETITION
- FAIRNESS
- FARA (FED. ACQ. REFORM ACT-'95)
- FASA (FED ACQ. STREAM. ACT-'95)
- BLUEPRINT FOR CHANGE – '94
- -- FROM PAT ON MIL SPECS AND STANDARDS

“THE ROAD AHEAD”

- J. GANSLER – DUSD, A & T, 2000
- GOAL ONE: FIELD HIGH-QUALITY DEFENSE PRODUCTS QUICKLY; SUPPORT THEM RESPONSIBLY
- GOAL TWO: LOWER THE TOTAL OWNERSHIP COSTS
- GOAL THREE: REDUCE OVERHEAD COST OF INFRASTRUCTURE (A&L)

5000.1 DIRECTIVE (2003)

- PRIMARY OBJECTIVE
- “TO ACQUIRE QUALITY PRODUCTS THAT SATISFY USER NEEDS WITH MEASURABLE IMPROVEMENTS TO MISSION CAPABILITY AND OPERATIONAL SUPPORT, IN A TIMELY MANNER, AND AT A FAIR AND REASONABLE PRICE”

5000.1 DIRECTIVE - 2003

- KEY POINTS:
- 1. TAILOR PROGRAM STRATEGIES
- 2. STREAMLINE AND IMPROVE THE PROCESS
- 3. ADOPT INNOVATIVE PRACTICES
- 4. USE ADVANCED TECHNOLOGIES
- & CONSIDER TECHNOLOGY ALTERNATIVES
- 5. CONSIDER MULTIPLE CONCEPTS
- 6. CONFIRM EVOLUTIONARY ACQUISITION

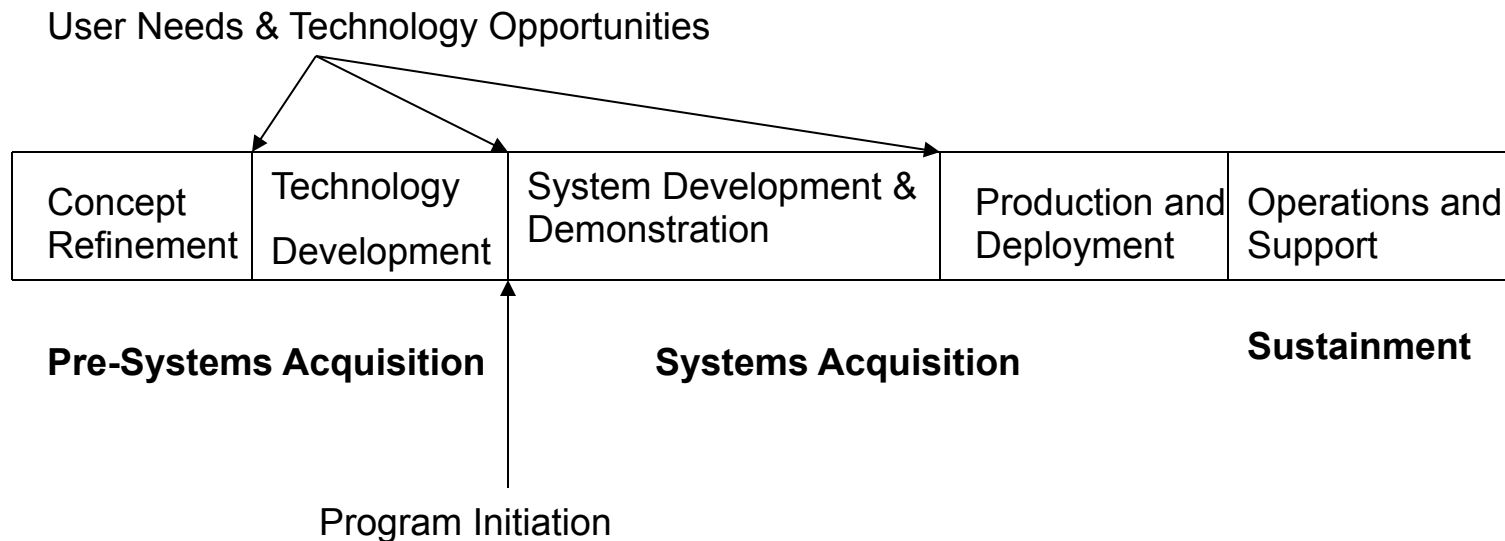
5000.1 DIRECTIVE - 2003

- KEY POINTS (CONT)
- 7. MINIMUM NUMBER OF PARAMETERS FOR PROGRAM
- 8. DECENTRALIZE ACQUISITION
- 9. COMPETITIVE ENVIRONMENT
- 10. COST-EFFECTIVE SOLUTION
- 11. TOTAL “SYSTEMS APPROACH” (!)

5000.2 INSTRUCTION - 2003

- KEY POINTS:
- 1. INTEGRATED ARCHITECTURES, EACH WITH 3 VIEWS
- 2. TAILORED, RESPONSIVE, INNOVATIVE
- 3. INTEGRATED PLANS AND TECHNOLOGY ROADMAPS
- 4. NEW ACQUISITION MANAGEMENT FRAMEWORK (SEE NEXT PAGE)

DEFENSE ACQUISITION FRAMEWORK



Framework Defined in Detail in 2000.2 Instruction - 2003

2000.2 INSTRUCTION - 2003

- KEY POINTS (CONT):
- 5. INITIAL CAPABILITIES DOCUMENT
- (GOALS, CAPABILITIES, TIME-PHASED)
- 6. DOTMLPF (!?)
- 7. ANALYSIS OF ALTERNATIVES (AoA)
- 8. TECHNOLOGY DEV. PHASE
- 9. SYSTEM DEVELOPMENT PHASE
- (!) (Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities)

2000.2 INSTRUCTION - 2003

- KEY POINTS (CONT):
- 10. MINIMUM SET OF KEY PERFORMANCE PARAMETERS (KPPs)
- 11. COST-EFFECTIVE OPERATIONS AND SUPPORT
- 12. EVOLUTIONARY ACQUISITION
- (CAN WE RELATE TO “INCREMENTAL” AND IDENTIFIED “CAPABILITY”?)

DEFENSE ACQUISITION PERFORMANCE ASSESSMENT

- DAPA (KADISH) REPORT - 2006
- SIX RECOMMENDATION AREAS:
 - 1. ORGANIZATION
 - 2. WORKFORCE
 - 3. BUDGET
 - 4. REQUIREMENTS
 - 5. ACQUISITION
 - 6. INDUSTRY – see next pages

1. ORGANIZATION

- REALIGN AUTHORITY, ACCOUNTABILITY AND RESPONSIBILITY AT PROPER LEVELS
- STREAMLINE THE ACQUISITION PROCESS
- ESTABLISH 4-STAR ACQUISITION SYSTEMS COMMANDS, AT THE SERVICE LEVEL

2. WORKFORCE

- **REBUILD AND VALUE THE ACQUISITION WORKFORCE**
- **PROVIDE APPROPRIATE LEADERSHIP**
- **CONFIRM AND ESTABLISH, IF NECESSARY, NEW AND UP-TO-DATE INCENTIVES**

3. BUDGET

- TRANSFORM THE PLANNING, PROGRAMMING AND BUDGETING (PPB) PROCESS
- ESTABLISH A DISTINCT AND STABLE FUNDING ACCOUNT
- CREATE A “MANAGEMENT RESERVE”
- CONFIRM 80% CONFIDENCE AT COMPLETING ON OR BELOW ESTIMATED COST

4. REQUIREMENTS

- REPLACE JCIDS WITH JOINT CAPABILITIES ACQUISITION AND DIVESTMENT PLAN
- ESTABLISH 2 YEAR PROCESS TO PRODUCE ABOVE PLAN
- ADD AN “OPERATIONALLY ACCEPTABLE” TEST EVAL. CATEGORY
- ALLOW PROG. MGRS TO DEFER NON-KEY PERFORMANCE REQUIREMENTS

5. ACQUISITION

- ADOPT A RISK-BASED SOURCE SELECTION PROCESS
- SHIFT TO TIME-CERTAIN DEVELOPMENT PROCEDURES
- MAKE SCHEDULE A KEY PERFORMANCE PARAMETER
- MANDATE TIME START AND END DATES – CLEARLY DEFINED

6. INDUSTRY

- OVERCOME CONSEQUENCES OF REDUCED DEMAND BY SHARING LONG-RANGE PLANS AND RESTRUCTURING COMPETITIONS FOR NEW PROGRAMS
- REQUIRE GOV' T INSIGHT & FAVOR FORMAL COMPETITION WHEN LEAD SYSTEM INTEGRATOR IS PURSUED

DEFENSE ACQUISITION GUIDEBOOK – 11 CHAPTERS

- 1. DOD DECISION SUPPORT SYSTEMS
- 2. DEFENSE ACQUISITION PROGRAM GOALS AND STRATEGY
- 3. AFFORDABILITY AND LIFECYCLE RESOURCE ESTIMATES
- 4. SYSTEMS ENGINEERING (!)
- 5. LIFECYCLE LOGISTICS
- 6. HUMAN SYSTEMS INTEGRATION

DEFENSE ACQUISITION GUIDEBOOK – (CONT)

- 7. ACQUIRING INFORMATION TECHNOLOGY AND NATIONAL SECURITY SYSTEMS
- 8. INTELLIGENCE, COUNTER-INTELLIGENCE, & SECURITY SUPPORT
- 9. INTEGRATED TEST & EVALUATION
- 10. DECISIONS, ASSESSMENTS, AND PERIODIC REPORTING
- 11. PROGRAM MGMT ACTIVITIES
- ([HTTP://AKSS.DAU.MIL/DAG](http://AKSS.DAU.MIL/DAG))

CAPABILITY-BASED ACQUISITION (CBA)

- INITIAL CAPABILITY IS PLANNED AND BUILT (PART OF A LARGER SYSTEM)
- PROVIDED TO THE WARFIGHTER “IMMEDIATELY”
- THIS BASELINE IMPROVED THROUGH INCREMENTAL ENHANCEMENTS
- EACH INCREMENT ADDS CAPABILITY, OR NEW CAPABILITY, FILLS GAPS
- TECH. INSERTION STILL “KEY”

JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM (JCIDS) - 1

- **COLLABORATIVE ENVIRONMENTS**
- **POTENTIAL REDUNDANCIES**
- **CAPABILITY GAPS**
- **EXISTING vs NEW CAPABILITIES**
- **SUPPORTABLE INNOVATIVE
SOLUTIONS**
- **KNOWLEDGE MANAGEMENT**

JCIDS - 2

- HIGHLY NETWORKED OPERATIONS
- INTEROPERABILITY
- COORDINATION AMONG COMPONENTS
- TECHNOLOGICALLY SOUND
- AFFORDABLE
- INCREMENTS OF CAPABILITY

OVERVIEW

SYSTEMS INTEGRATION

- SYSTEMS ENGINEERING
- PLUS
- SOFTWARE ENGINEERING
- PLUS
- PROGRAM/PROJECT MANAGEMENT

TOP-LEVEL DEFINITION SYSTEMS INTEGRATION

- The process of bringing together a variety of (possibly disparate) functional elements, subsystems, and components into a larger (meta) system, or system of systems, to provide a highly interoperable and cost-effective solution that satisfies the customer's needs and requirements, while at the same time managing the overall process and the delivery of products in a highly effective and efficient manner

SYSTEMS INTEGRATION

- ALSO, OFTEN INVOLVES:
- -- SYSTEMS OF SYSTEMS
- -- INTEGRATED SOLUTIONS
- ----LEGACY STOVEPIPER
 - ----UPGRADES TO LEGACY STOVE.
 - ----COTS and NDI
 - ----RE-USED “COMPONENTS”
 - ----NEW SUBSYSTEMS

NDIA TOP 5 SYSTEMS ENGINEERING ISSUES - 2003

- 1. LACK OF AWARENESS OF IMPORTANCE OF S.E. IN PROGRAMS
- 2. INADEQUATE QUALIFIED RESOURCES
- 3. INSUFFICIENT TOOLS & ENVIRONMENTS FOR S.E. EXECUTION
- 4. INADEQUATE REQ' TS ENGINEERING
- 5. POOR INITIAL PROGRAM FORMULATION

KEY SOFTWARE ISSUES DEFENSE-ORIENTED WORKSHOP – DUSD (A&T), 2006

- 1. REQUIREMENTS ENGINEERING (!)
- 2. SW ENGRS NOT PARTICIPATING IN SYSTEMS ENGINEERING
- 3. INEFFECTIVE PLANNING & MGMT BY ACQUIRERS & SUPPLIERS
- 4. NOT ENOUGH SW.E. EXPERTISE
- 5. VERIFICATION METHODS INADEQUATE
- 6. CANNOT VALIDATE EXECUTION IN DISTRIBUTED ENVIRONMENTS
- COTS/NDI IMPACTS ON COST & RISK

NATIONAL SOFTWARE SUMMIT REPORT – STRATEGY (2005)

- **IMPROVE SOFTWARE
TRUSTWORTHINESS**
- **EDUCATE AND FIELD A SOFTWARE
WORKFORCE**
- **REENERGIZE SOFTWARE RESEARCH
AND DEVELOPMENT**
- **ENCOURAGE INNOVATION WITHIN
U.S. SOFTWARE INDUSTRY**

THINKING ABOUT SYSTEMS INTEGRATION

- TASK: TO INTEGRATE “STOVEPIPES”
- -- 5 ARE EXISTING STOVEPIPES
- -- 2 EXIST BUT NEED UPGRADING
- -- 3 ARE COMPLETELY NEW, BASED UPON NEW FUNCTIONAL CAPABIL.
- **WHAT IS THE “GOAL”?**
- **WHAT SHOULD BE DONE AND IN WHAT SEQUENCE?**

SYSTEMS OF SYSTEMS-1

- **SUGGESTED STRUCTURE:**
- **1. INTEGRATION
ENGINEERING**
- **2. INTEGRATION
ENGINEERING**
- **3. TRANSITION MANAGEMENT**

SoS STRUCTURE – cont.

- 1. INTEGRATION ENGINEERING
- -- REQUIREMENTS
- -- INTERFACES
- -- INTEROPERABILITY
- -- IMPACTS
- -- TESTING
- -- SOFTWARE V & V
- -- ARCHITECTURE DEVELOPMENT

SoS STRUCTURE – cont.

- 2. INTEGRATION MANAGEMENT
- -- SCHEDULING
- -- BUDGETING/COSTING
- -- CONFIG. MGMT
- -- DOCUMENTATION
- 3. TRANSITION MANAGEMENT
- -- TRANSITION PLANNING
- -- OPERATIONS ASSURANCE
- -- LOGISTICS PLANNING
- -- PRE-PLANNED PRODUCT IMPROVEMENT

INTEROPERABILITY

- OLD AREA OF EMPHASIS, RE-EMPHASIZED TODAY
- APPROPRIATE AS WE SHARE DATA & INFORMATION
- APPROPRIATE AS MORE NET-CENTRIC, HORIZONTAL FUSION AND TRUSTED
- CAN WE BEGIN TO MEASURE?

INTEGRABILITY

- DEGREE TO WHICH STOVEPIPES CAN BE INTEGRATED
- IF NOT COST-EFFECTIVE, SHOULD NOT BE INTEGRATED
- CAN WE BEGIN TO TAKE MORE SERIOUSLY?
- CAN WE BEGIN TO MEASURE (SERIOUSLY)?

TOP DOZEN INTEGRATION LIST - 1

- 1. WHEN INTEGRATING STOVEPIPES, DO NOT ACCEPT 100 % INTEGRATION AS AN A PRIORI GOAL
- 2. ALWAYS ARCHITECT A SET OF ALTERNATIVES FROM WHICH TO SELECT THE PREFERRED ARCHITECT.
- 3. INSIST ALL HAVE SKILLS IN AT LEAST ONE OF S.E. OR PROG. MGMT

TOP DOZEN INTEGRATION LIST - 2

- 4. THINK OF REQTS THAT CAN, AT TIMES, BE SUBJECT TO TRADEOFFS
- 5. ACCEPT TECHNOLOGY INSERTION AS KEY DRIVE FOR ARCHIT/DESIGN
- 6. ASSURE RISK ANALYSIS AND MITIGATION DISCIPLINE
- 7. ACCEPT EVOLUTIONARY “CHUNK-ING” OF CAPABILITIES

TOP DOZEN INTEGRATION LIST - 3

- 8. CONFIRM SUFFICIENCY OF SCHEDULES AND BUDGETS, FROM START
- 9. ADOPT RE-USE METHODS, WHENEVER POSSIBLE
- 10. ACCEPT/IMPLEMENT K.I.S.S. CONCEPTS WHENEVER POSSIBLE
- 11. ACCEPT ACQUISITION PRINCIPLES

TOP DOZEN INTEGRATION LIST - 4

- 12. UTILIZE ALL PREFERRED PRACTICES AND PROCESSES
- -----
- IS THERE A “SILVER BULLET”?
- YES – CITED BY NORMAN AUGUSTINE:
- **“THE DIFFICULTY RESIDES IN HAVING THE WILL TO DO ANYTHING ABOUT THESE PROBLEMS”**

SUMMARY – 1 of 4

- PROBLEM AREAS PERSIST:
- REQUIREMENTS
- COSTS
- SCHEDULES
- RISKS
- BEST PRACTICES
- IMMATURE TECHNOLOGIES
- NEED FOR BETTER SYSTEMS ENG' G

SUMMARY – 2 of 4

- 5000.1 and 5000.2: GOOD GUIDANCE
- ADVANCED TECHNOLOGIES
- ALTERNATIVES
- EVOLUTIONARY ACQUISITION
- MINIMUM # PARAMETERS/KPPs
- COST-EFFECTIVE SOLUTIONS

SUMMARY – 3 of 4

- SYSTEMS APPROACH CALLED FOR
- INTEGRATED ARCHITECTURES, PLANS AND ROADMAPS
- CAPABILITY-BASED ACQUISITION
- SMALLER “CHUNKS” TO THE WARFIGHTER→ SHORTER SCHEDULES→ AFFORDABLE

SUMMARY – 4 of 4

- SYSTEMS INTEGRATION: COST-EFFECTIVE SOLUTIONS vs MAXIMUM LEVEL OF INTEGRATION
- SOFTWARE ENGINEERING/TRUSTED SYSTEMS
- INTEROPERABILITY & INTEGRABILITY: NEED TO MEASURE
- ALTERNATIVES; SIMPLIFY
- THE “SILVER BULLET”

Dr. Eisner

Overview of Background

- 30 Years in Industry; Engineer & Executive
- President of 2 High-Tech Companies
- Sr. Executive of ORI & Atlantic Research
- At GWU Since 1989
- Currently Distinguished Research Professor & Professor, Eng. Mgmt/Sys. Eng. Department
- Four Books: 2 on SE, One on Reengineering, One on Thinking Outside the Box
- Life Fellow of IEEE; Fellow of INCOSE
- BS-CCNY, MS-Columbia, DSc - GWU