Software-Intensive Acquisition Programs: Productivity and Policy

Naval Postgraduate School Acquisition Symposium

11 May 2011

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| 1. REPORT DATE | MAY 2011 |
| 2. REPORT TYPE | |
| 3. DATES COVERED | 00-00-2011 to 00-00-2011 |
| 4. TITLE AND SUBTITLE | Software-Intensive Acquisition Programs: Productivity and Policy |
| 5a. CONTRACT NUMBER | |
| 5b. GRANT NUMBER | |
| 5c. PROGRAM ELEMENT NUMBER | |
| 6. AUTHOR(S) | |
| 5d. PROJECT NUMBER | |
| 5e. TASK NUMBER | |
| 5f. WORK UNIT NUMBER | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) | Naval Surface Warfare Center Dahlgren Division, Dahlgren, VA, 22448 |
| 8. PERFORMING ORGANIZATION REPORT NUMBER | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | |
| 10. SPONSOR/MONITOR’S ACRONYM(S) | |
| 11. SPONSOR/MONITOR’S REPORT NUMBER(S) | |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT | Approved for public release; distribution unlimited |
| 13. SUPPLEMENTARY NOTES | Presented at the Naval Postgraduate School’s 8th Annual Acquisition Research Symposium, 10-12 May 2011, Seaside, CA. |
| 14. ABSTRACT | |
| 15. SUBJECT TERMS | |
| 16. SECURITY CLASSIFICATION OF: | |
| a. REPORT | unclassified |
| b. ABSTRACT | unclassified |
| c. THIS PAGE | unclassified |
| 17. LIMITATION OF ABSTRACT | Same as Report (SAR) |
| 18. NUMBER OF PAGES | 100 |
| 19a. NAME OF RESPONSIBLE PERSON | |
Software acquisition: a well-publicized problem across the Department of Defense (DoD),
  - General Accounting Office (GAO) (2009): large-scale software acquisitions falling short of cost, schedule, and performance goals
• With sophisticated tools and capabilities shouldn’t the work be getting easier?
• Development: much more than writing code
• Complicating factors:
  – Lack of formal requirements definition
  – Misunderstandings between user and developer
  – Requirements creep
  – Technology insertions and upgrades
  – Inspections and testing
  – Volume of scrap and rework
  – Policy changes
Software-Intensive Programs: Current Policy

- MIL-STD-498: Uniform requirements for development and documentation (22 data item descriptions)
- DoDI 5000.02 and DoD 5000.04-M-1: Software Resources Data Report reporting (via Defense Cost and Resource Center)
- Software process improvement initiatives, driven by Section 804 of National Defense Authorization Act (2003), and promulgated by ASN(RDA)
- Some apply solely to Acquisition Category (ACAT) I programs; most are implemented at contract level

Complex web of policy, regulations, instructions, and best practices
Software-Intensive Programs: Research Questions

• How can the DoD adjust its acquisition processes to improve developers’ productivity?

• How can the DoD effectively reward desired behaviors?
Software-Intensive Programs: Study Overview

• Criteria for sample: ACAT I and software intensive
• Stratify programs by level of success
• Identify best practices
  – Literature review
  – Subject-matter expert inquiries
• Consider “success” metrics (cost, schedule, performance) in light of
  – Development approaches
  – Management styles
  – Organizational policy and best practices
  – DoD policy and best practices
• Findings and recommendations
Methodology: Successful Programs

- Extracted data on Navy and Marine Corps Major Defense Acquisition Programs from Defense Acquisition Management Information Retrieval service
  - Filter #1: ACAT I or special interest
  - Filter #2: No Nunn-McCurdy breaches
    - Unless Average Procurement Unit Cost breach driven by changes to quantity
  - Filter #3: Currency—active program (April 2011)
  - Filter #4: History—at least three years into development
  - Filter #5: Software intensive (> $20M in software)

Data on “successful” programs gathered from interviews and public domain sources
Successful Software-Intensive Programs

EA-18G ("Growler") Electronic Warfare Aircraft

Navy Multiband Terminal

AGM-88E Anti-Radiation Guided Missile

P-8A Multimission Maritime Aircraft

Standard Missile (SM)-6

Cooperative Engagement Capability (CEC)
P-8A Multimission Maritime Aircraft

- Replaced P-3C Orion capabilities
- Open architecture approach
- Detailed planning phase; robust Analysis of Alternatives (AoAs)
- Well-balanced package of cost, schedule, and performance (Independent Cost Estimate added funds for software development)
- Good relationship with requirements community; program could speak in unison and maintain executability
- Heightened sense of immediacy
Standard Missile 6 (SM-6)

- Next-generation SM with extended range and active missile-seeker homing capabilities; capable of responding to various threats
- Urgent need for successful program
- Thorough pre-Milestone B planning
- Strong ASN\,RDA support: full funding based on a realistic, risk-based cost estimate
- Prior experience helped manage anticipated pitfalls
- Positive relationship with industry helped ensure quality staffing
Cooperative Engagement Capability (CEC)

- Integrated battle-force combat systems and sensors; data distribution for a common composite track database; enhanced ship self-defense capability
- Classic acquisition processes through mid-1990s, when acquisition reform impacted strategy
- Strong mission focus and leadership
- Well-balanced, experienced team
- Adapted to changing labor market (Ada -- > C++)
Successful Programs: Findings

• Experience to identify and mitigate risks
• Leadership continuity (including senior engineers)
• Communication skills (candor and honesty)
• Empowerment of program managers to make good decisions
• Sound knowledge-based business plan at outset
• Clear, well-defined requirements
• Used mature technologies and/or production techniques
• Established realistic, risk-based cost and schedule
• Disciplined execution with resistance to new requirements
• Stabilization of funding and resources
• Contractual incentives and stalwart government review team
• Holistic approach to contracting (system -> platform ->)
Environmental Factors (Future Research)

- Technology levels
- Stability of requirements
- Available time and approach (incremental vs. one shot)
- Personnel and/or developer attributes
- Capabilities of analysts and programmers
- Application domain experience
- Continuity of personnel and/or learning curve
- Modern practices and tools
- Team organization and communication
Concluding Thoughts: Weapon Systems Acquisition Reform Act (WSARA) and Beyond

• WSARA aspires for more executable programs ...
  – Supplant risk with knowledge
  – Milestone A cost estimate with confidence levels
  – Competitive prototypes
  – Enhanced requirements for AoAs
  – Pre-Milestone B review of technology maturity and integration risk
  – Pre-Milestone B Preliminary Design Review
  – Renewed emphasis on systems engineering and testing
  – Configuration steering boards to stabilize requirements
  – Post-Critical Design Review assessment of progress

• GAO (2010): modest improvements; increased knowledge at key decision points

• GAO (2011): “meaningful steps” taken to reprioritize and rebalance portfolio, but still a factor on GAO High-Risk List