We Have All Been Here Before

Recurring Patterns Across 12 U.S. Air Force Acquisition Programs

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April 29, 2010

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Introduction

Agenda

Introduction

- Independent Technical Assessments (ITAs)
- Approach

Findings

- Categorized Findings
- IT System Findings
- Continuing/Emerging Trends

Analysis

- Candidate Root Causes
- Mitigating Root Causes
- Overarching Themes
- Misaligned Incentives

SEI ITA Background

SEI conducts Independent Technical Assessments (ITAs) on large software-reliant acquisition programs

- ITAs are objective program reviews of people, programmatics, processes, technical aspects, and the environment

- ITA teams conduct interviews & review documents on program status/history

- Identify likely causes of schedule, cost, or performance issues

- Recommend improvement or recovery actions

SEI brings to the assessments

- Software, systems engineering and program management expertise

- Independent and neutral third-party assessment

- Experience in conducting over 100 ITAs and Red Teams

ITA Pattern Analysis Objectives

Identify recurring patterns, both positive and negative, that the SEI has observed across this set of ITAs:

- Strengths

- Best practices

- Weaknesses

- Issues

Provide practical information on acquisition:

- Identify underlying causes recurring problems

- Make actionable recommendations to address current, and to prevent future problems

Approach

Gather data from 12 Air Force programs reviewed between 2006 and 2009:

- 6 IT system programs
- 2 Command and Control (C^2) programs
- 2 communications system programs
- 1 avionics system program
- 1 electronic warfare system program

Perform qualitative analysis of findings

- Divide out information by system type in relevant areas (i.e., IT systems)
- Consider relevant information from other acquisition programs

Identify higher-level relationships across the findings

Identify potential root causes of cost, schedule, scope, and quality issues

Recommend corrective/preventative strategies based on these patterns

Limitations

ITA data is inherently *qualitative*
- Sample set of 12 programs is small
- Some ITAs were focused on one aspect, such as testing
- Data was not collected with intention that it be used quantitatively
- Data is biased by different ITA team expertise areas
- Programs were selected because they were already in trouble

The most frequent findings may <u>*not*</u> be the most important ones

Fundamental root causes may not be explored by ITAs
- Root causes not always needed to make practical recommendations
- ITA work is focused on helping the program—not doing research
- <u>*Example*</u>: Untrue that "Poor estimate" means "Can't do good estimates"

Best practices may not always be found by ITAs
- Focus is primarily on identifying issues to be remedied

Most Common Findings

Staffing	Inadequate PMO staff expertise	9 occurrences
	Hostility between stakeholders	8 occurrences
	Poor contractor oversight by PMO (*too reliant on contractor*)	
	Insufficient PMO staff	
	Poor user/stakeholder involvement	6 occurrences
	High PMO staff turnover	
Requirements	Ineffective risk management	
	Overly optimistic schedule	
	Poor contractor oversight by PMO (*insufficient metrics*)	5 occurrences
	Requirements scope creep	
	Inadequate requirements	
	Unpredictable delivery dates	
	"Big Bang" integration	
	Immature technology	
	Lack of functional requirements baseline	4 occurrences
	Lack of Integrated Master Schedule (IMS)	
	Poor process adherence	
	Unanticipated technical complexity	

Top 10 Overall Categories for Findings

Category	Percent	Aspects
Staffing	20%	Expertise, turnover, staff size
Requirements	10%	Adequacy, clarity, creep, baseline
Oversight	8%	Adequacy, metrics
Schedule	8%	Master schedule, predictability
Testing	7%	Fidelity, adequacy, hardware, data
Technical	6%	Complexity, maturity
Culture	6%	Inter-team relationships
Organizational	5%	Management, formality, dispersion
Stakeholder Involvement	4%	Level of involvement with program
Risk Management	3%	Effectiveness

Key IT System Findings

Ineffective User/Stakeholder Involvement

- Stakeholders not adequately involved in requirements or testing

Poorly Executed Change Management

- Little account for system impact on existing business processes
- Often resulted in (avoidable) user resistance to the new system

Lack of Program Management Rigor

- Business (vs. acquisition or IT) people were running the program
- Requests for new requirements not constrained—drove cost/schedule
- Inappropriate contractual vehicles

Technical Complexity is Rarely an Issue

- Technical complexity was not a significant issue for most IT systems

Continuing and Emerging Trends

Contracted PMO Staff
- This ongoing trend will be reversed by plans to bolster the acquisition workforce

Interoperability and Open Systems
- Leveraging of system capabilities through interoperability is expected to grow, building on modular design and open standards, moving toward SOA

Joint/Common Programs
- More expected to help reduce costs, despite real management challenges

Geographically Distributed Teams
- Continuing growth of dispersed teams is increasing risk of poor performance

Internet/Web Applications
- Need for Web access to key IT systems is forcing legacy modernization efforts

Enterprise Resource Planning (ERP)
- Increasing ERP use for IT systems driving business process changes

Agile Development
- Some interest in integrating agile methods with DoD 5000.02

Possible Relationships Among Findings

Program Management by "Functionals"
→leads to low PMO staff experience, which…
→leads to overreliance on contractor, which…
→leads to poor contractor oversight, which…
→leads to unpredictable delivery dates

Geographically Separated Sites
→lead to poor communication/cooperation, which…
→leads to conflict across sites

Inadequate PMO Staff Experience
→leads to poor stakeholder involvement, which…
→leads to inadequate requirements, which…
→leads to unplanned rework, which…
→leads to schedule slip

Need to 'Sell' the Program
→leads to overly optimistic schedule, which…
→leads to schedule pressure, which…
→leads to contractor sacrificing quality processes, which…
→leads to unplanned rework, which…
→leads to schedule slip

Candidate Root Causes -1

Geographically Separated Sites
- Separated sites have extra coordination overhead and poor visibility, causing delays and frustration that may turn into mutual suspicion and growing conflict

Use of Advanced/Immature Technology
- Users, government, and contractors all prefer highly advanced technology—but its inherent immaturity drives up risk and cost, and lengthens schedule

Diminished Acquisition Workforce
- Inexperienced PMO staff are less able to properly select and oversee technical contractors, and thus less able to ensure successful outcomes

Ambitious Requirements
- The desires for higher capability and "compelling" programs drive ambitious, unprecedented requirements that increase complexity and risk

Long Program Duration
- Large programs have long schedules—during which environment changes drive scope changes, causing even longer schedules and higher cost

Long Program Duration - "Longer Begets Bigger"
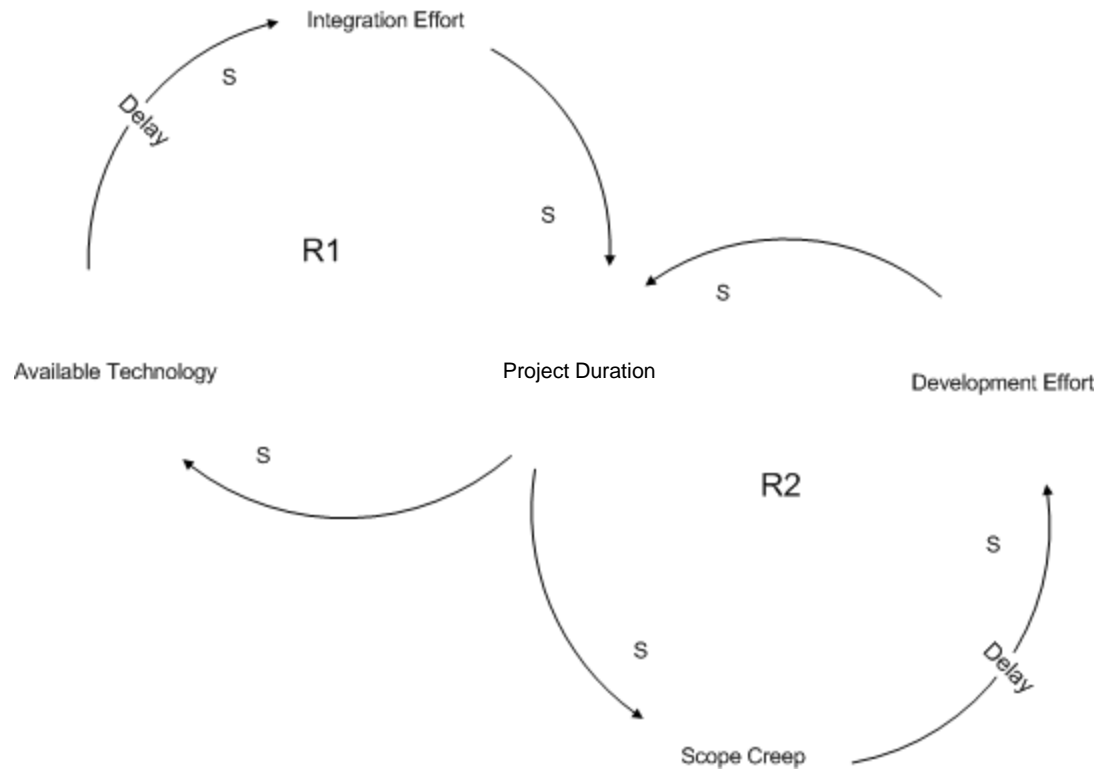
Candidate Root Causes -2

Instability of Program Funding
- Political concerns produce funding volatility that consumes effort in replanning, requiring programs to extend schedule or reduce scope

Military Rotations
- Short-term PM rotations place emphasis on near-term program health, creating incentives to put off longer-term investments that have no immediate benefits

Underestimation
- Both the PMO and contractor have incentives to underestimate cost to ensure that a program is funded—or else they're both out of a job

Joint Programs/Common Infrastructure
- Common infrastructure programs must reconcile competing needs into one system—but this drives up cost and schedule, and drives user programs away

Joint Programs – "Everything for Everybody"

Based on "Limits to Growth"
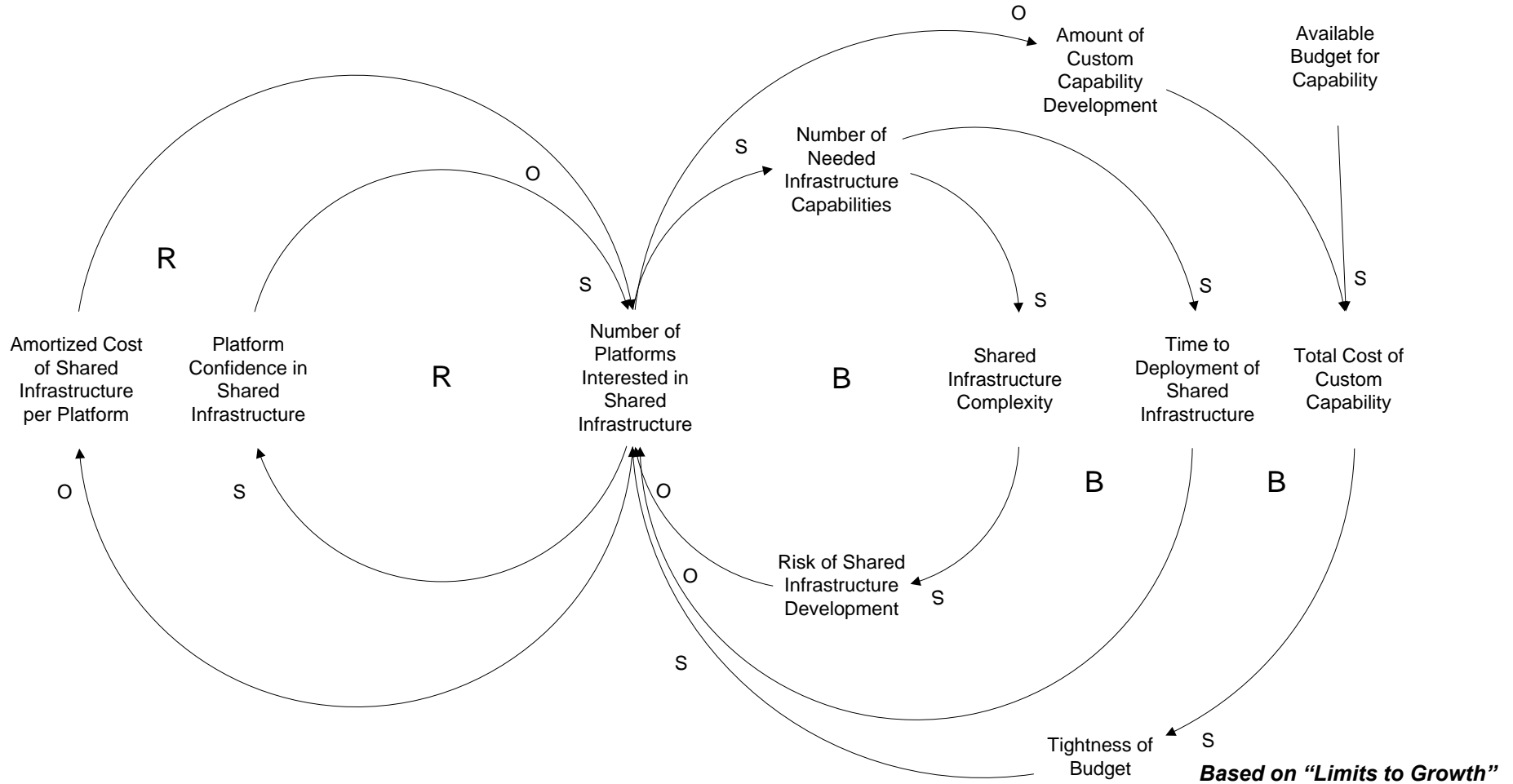
Mitigating Root Causes -1

Geographically Separated Sites

- Favor the use of co-located developers whenever possible

- Substantially invest in regular on-site presence at other sites through travel with face-to-face contact with other sites.

Use of Advanced/Immature Technology

- Increase use of Technology Readiness Assessments (TRAs) to improve visibility of the technology maturity

- Independently review PMO choices of technologies to be assessed

Diminished Acquisition Workforce

- Improve qualifications of acquisition staff emphasizing software expertise, and improve compensation and advancement opportunities to increase tenure.

Long Program Duration

- Divide large acquisition development efforts into multiple smaller, shorter duration programs.

Instability of Program Funding

- Buffer programs from funding variations to improve stability and productivity.

Mitigating Root Causes $_{-2}$

Military Rotations

- Assign PMs, DPMs, and other key positions for the program's duration and into deployment. Use civilians if military rotations are not amenable.

Underestimation

- Don't require PMO to adopt contractor's estimate for the program—or else use the difference as PM "reserve"

- Change from traditional 50% estimation confidence level to 80% level

- DoD should consider use of Vickrey "second price" auction mechanism for acquisition proposal bidding

Joint Programs

- Consider oversight above Senior Acquisition Executive (SAE) level to help ensure cooperation among multi-Service stakeholders.

Overarching Themes

It's the People, Not the Software
- Software engineering issues are rarely the main reason programs fail
- Technical issues accounted for only 6% of the ITA findings

The Need to Sell the Program
- Acquisition promotes 'selling' programs with 'unfounded optimism and parochialism'

The Evolution of "Science Projects"
- Prototypes that grow in scope during development often fail the transition to become production-quality systems

Common/Joint Programs Replace "Islands of Automation"
- The temptation of an ideal custom solution vs. a shared "one-size-fits-all" system is often too great for stakeholders to resist

Misaligned Incentives
- People are too often incented to do what's best for themselves, at the expense of their organization or larger community

Misaligned Incentives

The acquisition system incentivizes…

- PMOs to 'sell' programs, even when making poor progress
- PMOs to downplay risks, even if they may jeopardize the program
- PMOs to do "big bang" integration to shorten schedule, despite the risk
- PMOs to choose the low bidder, even if it may cause poor performance/quality
- Contractors to underbid programs, and then overrun cost/schedule
- Contractors and PMOs to use immature technology, driving up cost/schedule
- Contractors to move expert staff off awarded programs, onto proposed programs
- Services and contractors to prefer siloed systems over Joint programs
- Military personnel to leave programs soon after they become valuable staff
- Cost-Plus contracts that inadvertently encourage longer programs
- DoD to fund too many programs, thus underfunding all of them
- Users to demand exotic features, because they bear no cost for doing so

…and these behaviors indirectly drive many key reasons for failure

For Additional Information

Upcoming SEI Technical Note: "*An Analysis of Recurring Issues Found Across 12 U.S. Air Force Software-Reliant Acquisition Programs*"

Website: http://www.sei.cmu.edu/acquisition/research/archetypes.cfm

"*Acquisition Archetypes*" analyze recurring patterns in actual programs, and recommend interventions and preventative actions:

- Firefighting
- Brooks' Law
- "Happy Path" Testing
- Longer Begets Bigger
- The Bow Wave Effect
- Shooting the Messenger
- Feeding the Sacred Cow
- Everything for Everybody
- Underbidding the Contract
- Robbing Peter to Pay Paul
- Staff Burnout and Turnover
- PMO vs. Contractor Hostility

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