DoD Systemic Root Cause Analysis

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SYSTEMS & SOFTWARE ENGINEERING
Office of the Deputy Under Secretary of Defense
for Acquisition and Technology

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VERSION 1.01

Systems and Software Engineering… What are we all about?

Acquisition Program Excellence through sound systems and software engineering…

- *Help shape portfolio solutions and promote early corporate planning*
- *Promote the application of sound systems and software engineering, developmental test and evaluation, and related technical disciplines across the Department's acquisition community and programs*
- *Raise awareness of the importance of effective systems and software engineering, and drive the state-of-the-practice into program planning and execution*
- *Establish policy, guidance, best practices, education, and training in collaboration with academia, industry, and government communities*
- *Provide technical insight to the leadership to support effective and efficient decision making*

Based on USD(AT&L) 2004 Imperative…

"Provide context within which I can make decisions about individual programs."

Providing Value Added Oversight & Support

• Tactical, Program and Portfolio Management

"a"

PEOs & PMs…

- PSR
- AOTR
- SEP
- TEMP
- DAES

Improved Program Execution thru…
Program Unique Recommendations

AS Results Achieved thru

- Open Communication/Debate
- Insight & Information Sharing
- Understanding of Consequences
- Data Driven, Fact-based Information Synthesis

Acquisition Leadership

Improved Acquisition Decision Making thru…

- Greater Program Transparency
- Acquisition Insight

• Strategic Management

"A"

DoD Acquisition Community

Improved Acquisition Support to Warfighter

- Systemic Issues & Risks
- Systemic Strengths & Indicators

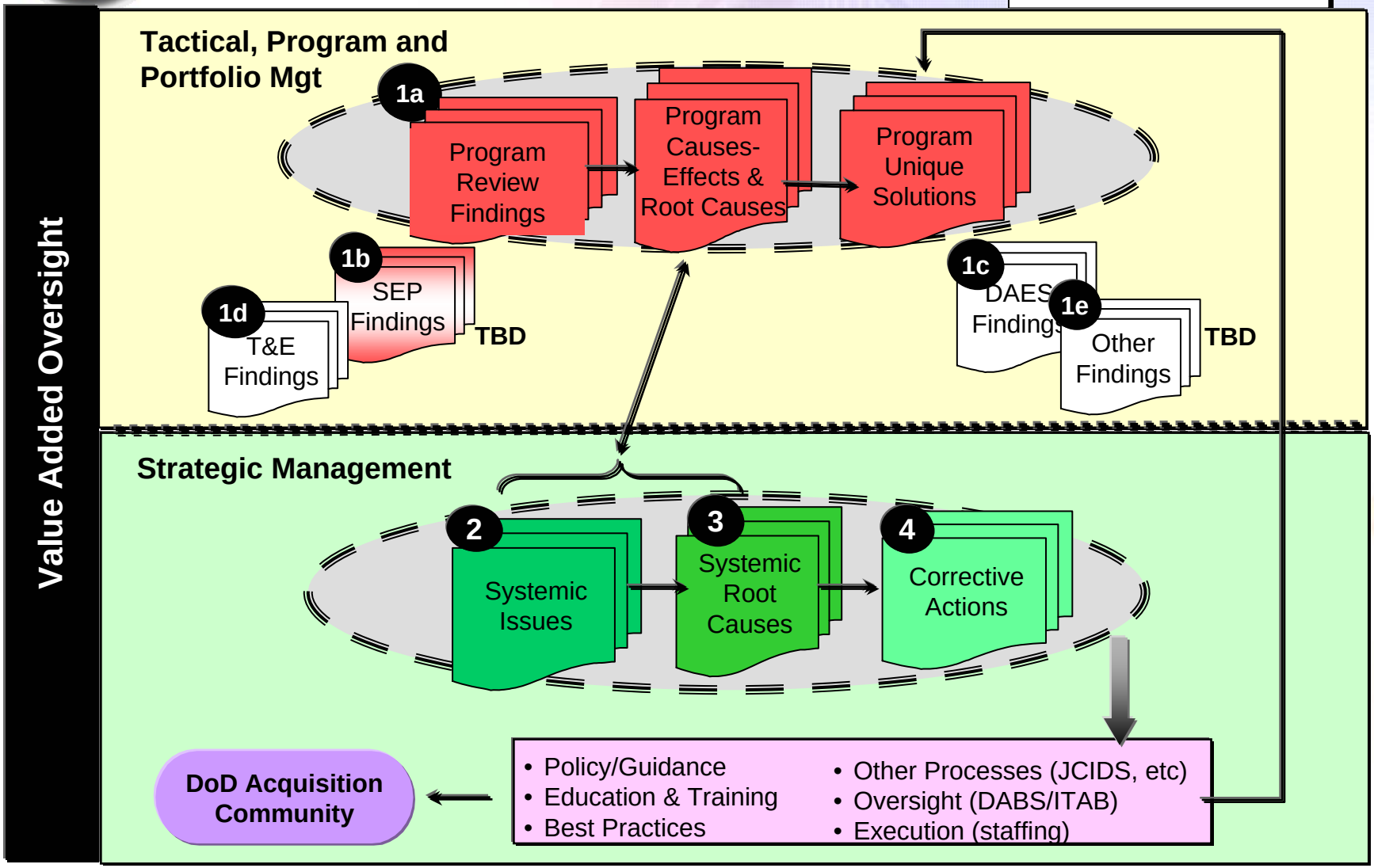
Recommendations

Improved Acquisition Support to Warfighter

- Policy/Guidance
- Education & Training
- Best Practices
- Other Processes (JCIDS, etc)
- Oversight (DABS/ITAB)
- Execution (staffing)

Systemic Analysis: Data Model Rev1

Steps 1a, 1b, 2-4 Underway…



Program Support Review (PSR)
Taxonomy of Classifications

+ Positive
O Neutral
– Negative
⌐ Issue
~ Risk

Findings

+ Positive → May be a candidate for Best Practice

O Neutral → May be a candidate for Process Improvement Recommendation

Current focus of Systemic Analysis

– Negative
- ~ Risk → Root Cause(s) | Impact(s) | Recommendation(s)
- ⌐ *Issue* → Root Cause(s) | Impact(s) | Recommendation(s)

Potential
- ~ Risk → Root Cause(s) | Impact(s) | Recommendation(s)

~3700 Findings from Program Reviews

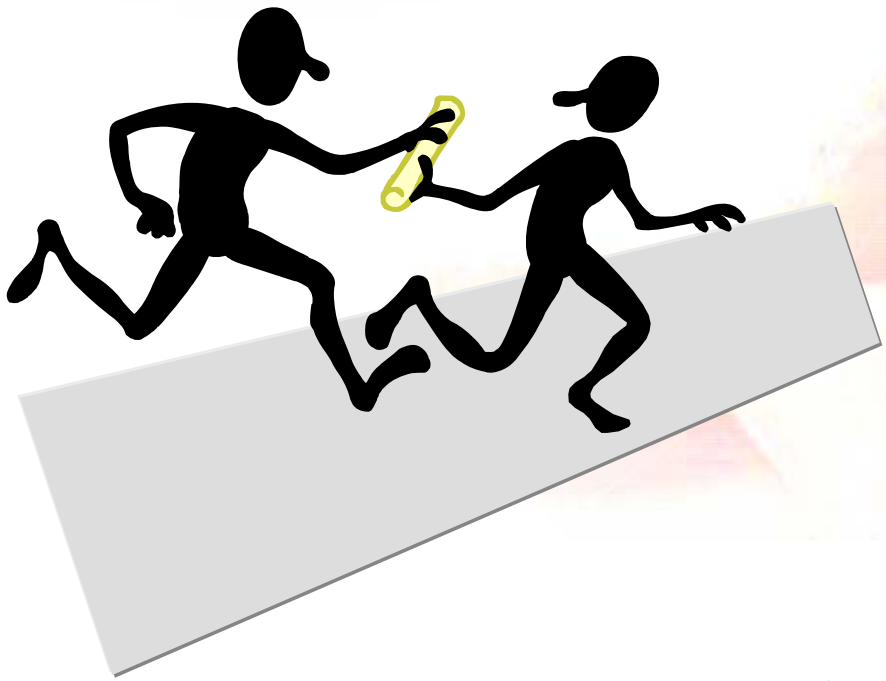
Top 10 Emerging Systemic Issues
(from 52 Program Reviews since Mar 04)

1. Management	• IPT roles, responsibilities, authority, poor communication • Inexperienced staff, lack of technical expertise
2. Requirements	• Creep/stability • Tangible, measurable, testable
3. Systems Engineering	• Lack of a rigorous approach, technical expertise • Process compliance
4. Staffing	• Inadequate Government program office staff
5. Reliability	• Ambitious growth curves, unrealistic requirements • Inadequate “test time” for statistical calculations
6. Acquisition Strategy	• Competing budget priorities, schedule-driven • Contracting issues, poor technical assumptions
7. Schedule	• Realism, compression
8. Test Planning	• Breadth, depth, resources
9. Software	• Architecture, design/development discipline • Staffing/skill levels, organizational competency (process)
10. Maintainability/Logistics	• Sustainment costs not fully considered (short-sighted) • Supportability considerations traded

Major contributors to poor program performance

Observations Since Last Year

- Programs fail because we don't…
  - Start them right
  - Manage them right



…We Don't Start Them Right

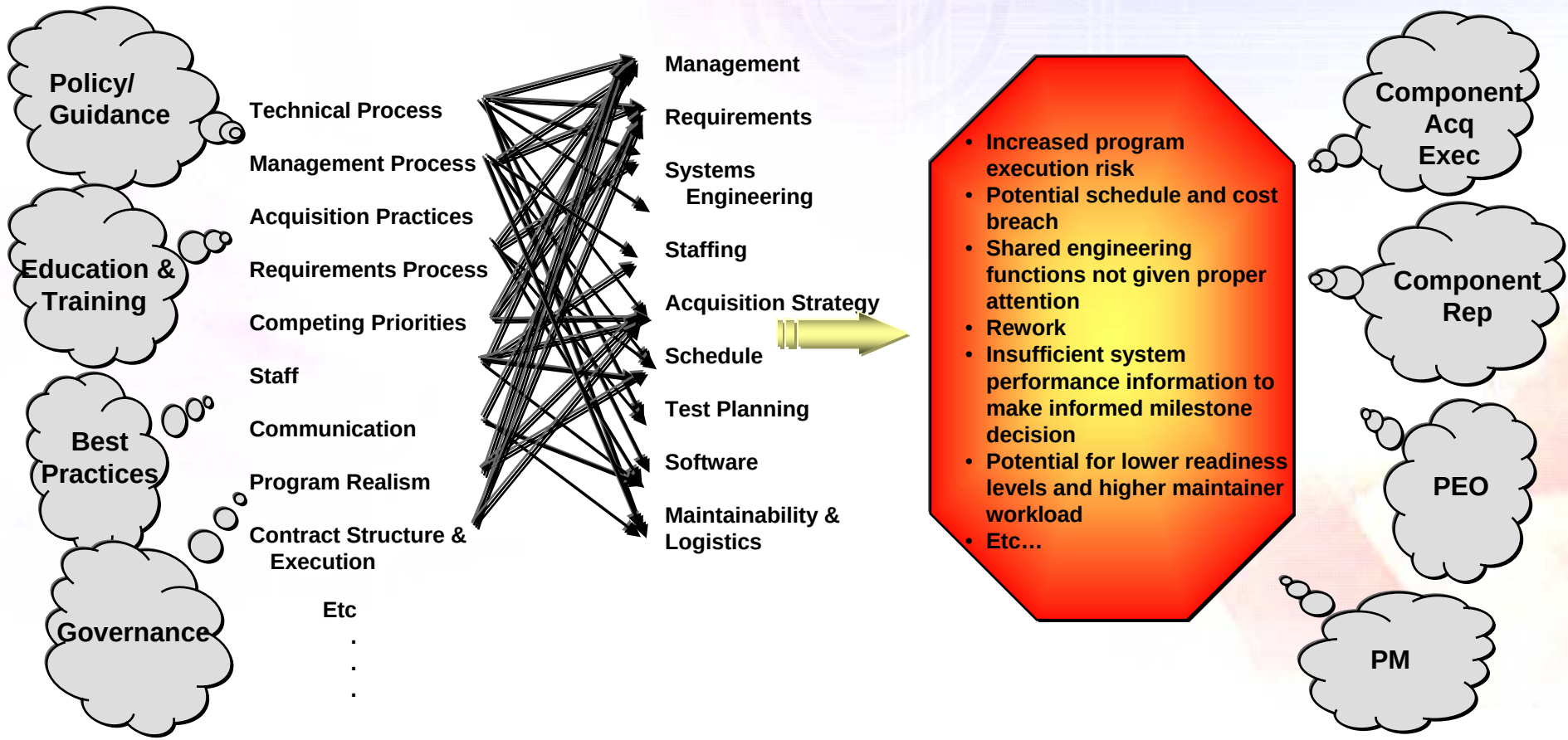
- Requirements creep/stability – not tangible, measurable, testable, defined
- Acquisition strategies based on poor technical assumptions, competing budget prioritities, and unrealistic expectations
- Budget not properly phased
- Lack of rigorous systems engineering approach
- Schedule realism – success oriented, concurrent, poor estimation and/or planning
- Inadequate test planning – breadth, depth, resources
- Optimistic/realistic reliability growth – not a priority during development
- Inadequate software architectures, design/development discipline, and organizational competencies
- Sustainment/life-cycle costs not fully considered (short-sighted)

...We Don't Manage Them Right

- Insufficient trade space – resources, schedule, performance, requirements
- Inadequate IMP, IMS, EVMS
- Insufficient risk management
- Concurrent test program
- Inadequate government PMO staff
- Inexperienced and/or limited staffing
- Poorly defined IPT roles, responsibilities and authority
- Poor communications

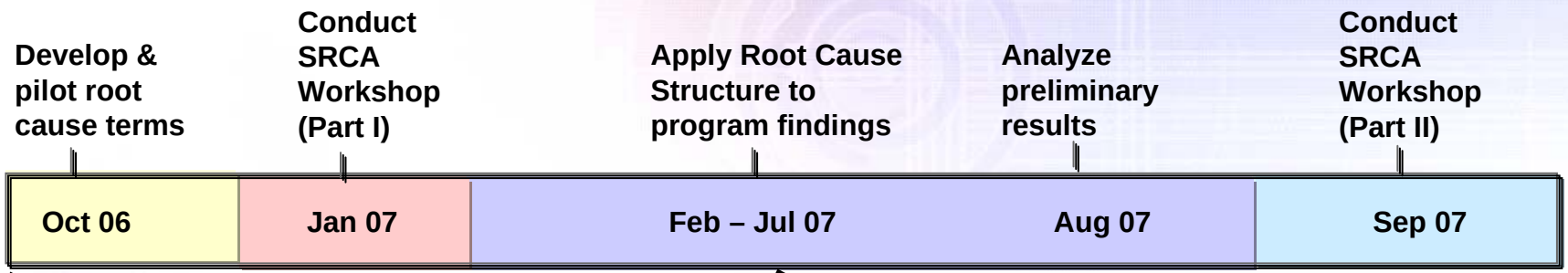
Root Cause Effects Model

Solution Set	Systemic Root Cause	Systemic Issues	→ Symptoms	Who's Affected



Recommendations Must Address Root Causes at Their Source

Systemic Analysis Milestones



- Categorized root cause textual descriptions
- Terminology developed by small team, limited
- Pilot effort proved that terms lacked proper structure and definition

- Pilot RCT on program reviews: past effort and go-forward
- Definitions enhanced, terminology revised
- Analysis of trends and applicability;

- Redefined Root Cause Type: 3 Tier
- Terminology developed by workshop participants representing DoD and Industry
- RCT structure informally tested on 4 programs from different domain areas

- Validate pilot on root cause method/structure
- Formulate systemic root cause recommendations
- Feedback on SA model and root cause methodology

Coming Up:

Oct 07: Present results to SE community (NDIA-SE Conference)
Nov07: Present results to acquisition community (PEO SYSCOM)
Dec 07: Formalize and standardize methodology
Mar 08: Incorporate other data sources (SEP, Triage, etc)

- Expand analysis to complete data set
- Establish NDIA Working Group on SRCA

Root Cause Types
Recap of Part I Results

- Root Cause Types needed to categorize and discuss root causes
- ***Root Cause Type*** structure defined
  - **Tier 1: Root Cause**
    - » Textual description; documented by PSR team
    - » Perceived program root cause
  - **Tier 2: Systemic Root Cause**
    - » From pre-defined list; assigned by PSR team
    - » Can be "A" or "a". *Conditions that are outside the PMO below the Defense/Service Acquisition Executive level. This would include lateral activities, such as Service staff functions (OPNAV, Air Staff, etc.) and the system commands.*
  - **Tier 3: Core Root Cause**
    - » From pre-defined list; assigned by PSR team
    - » At the "A" level. *Something at the DAE level (3 Star level and above) – Issues resolved through DAE coordination with Congress, DoD, Services, Industry, etc,*

Pilot Underway

Root Cause Analysis is Crux of Systemic Solutions

Root Cause Type Structure

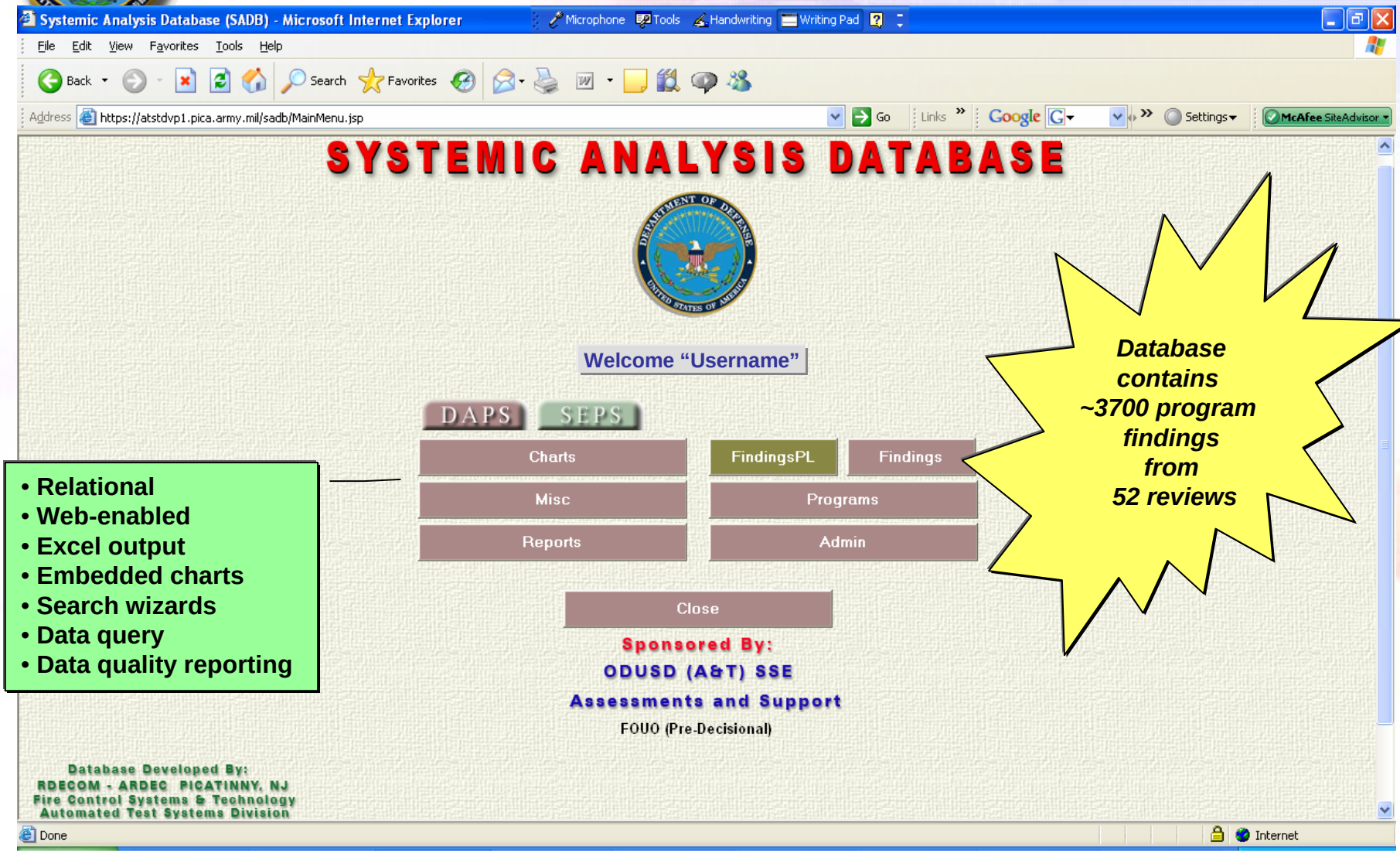
• Systemic Root Cause (Tier 2)

1. Ineffective communication
2. Competing priorities
3. CONOPs change
4. Definition of enterprise
5. Engagement of supply base in SE process
6. Expectations not defined
7. Inadequate baseline management
8. Inadequate contract structure and execution
9. Inadequate cost metrics e.g. EVMS
10. Lack of accountability
11. Lack of capital investment
12. Lack of enterprise wide perspective
13. Lack of appropriate staff
14. Lack of trade space/constraints
15. Lack of trust and willingness to share information
16. Obfuscating bad news
17. Ineffective organization
18. Poorly defined roles/responsibilities
19. Process - Management
20. Process - Production
21. Process - Requirements
22. Process - Technical
23. Program realism
24. Responsibility w/o authority
25. Poor Acquisition Practices

• Core Root Cause (Tier 3)

1. Acq Reform: Loss of govt. capital investment
2. Acq Reform: Loss of MS A requirement
3. Acq Reform: Transferred Authority
4. Enabling infrastructure
5. Budget POM process (PBBE)
6. Culture
7. Rotations / continuity
8. Inadequate JCIDS process
9. Pool of clearable skilled people
10. External influences
11. Poor business practices

SADB Features



- Relational
- Web-enabled
- Excel output
- Embedded charts
- Search wizards
- Data query
- Data quality reporting

Database contains ~3700 program findings from 52 reviews

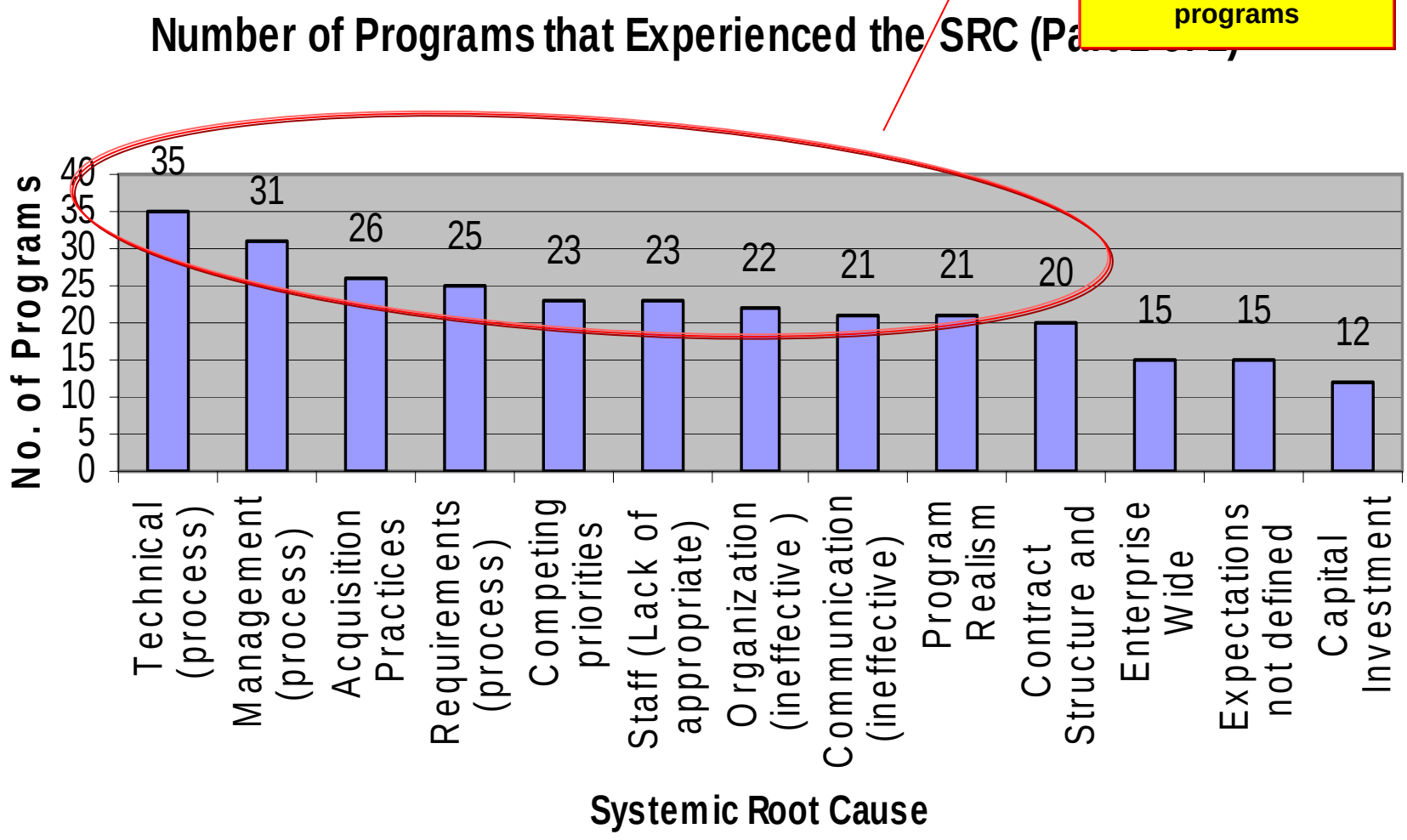
Systemic Root Cause Analysis
Preliminary Results

- Analysis performed on 44 program reviews
- SRCA applied to *negative* findings: ~ 48% of total set, ~1500 findings
- Trends shown by:
  - (1) Systemic Root Cause (SRC)
  - (2) DAPS areas related to leading SRC
  - (3) Core Root Cause (CRC)
  - (4) SRCs as related to:
    - » CRC = Poor Business Practice
    - » CRC = Culture

See Next 5 Slides for Results…

Categorization by Systemic Root Cause

•Occurred on 50% or more of the programs

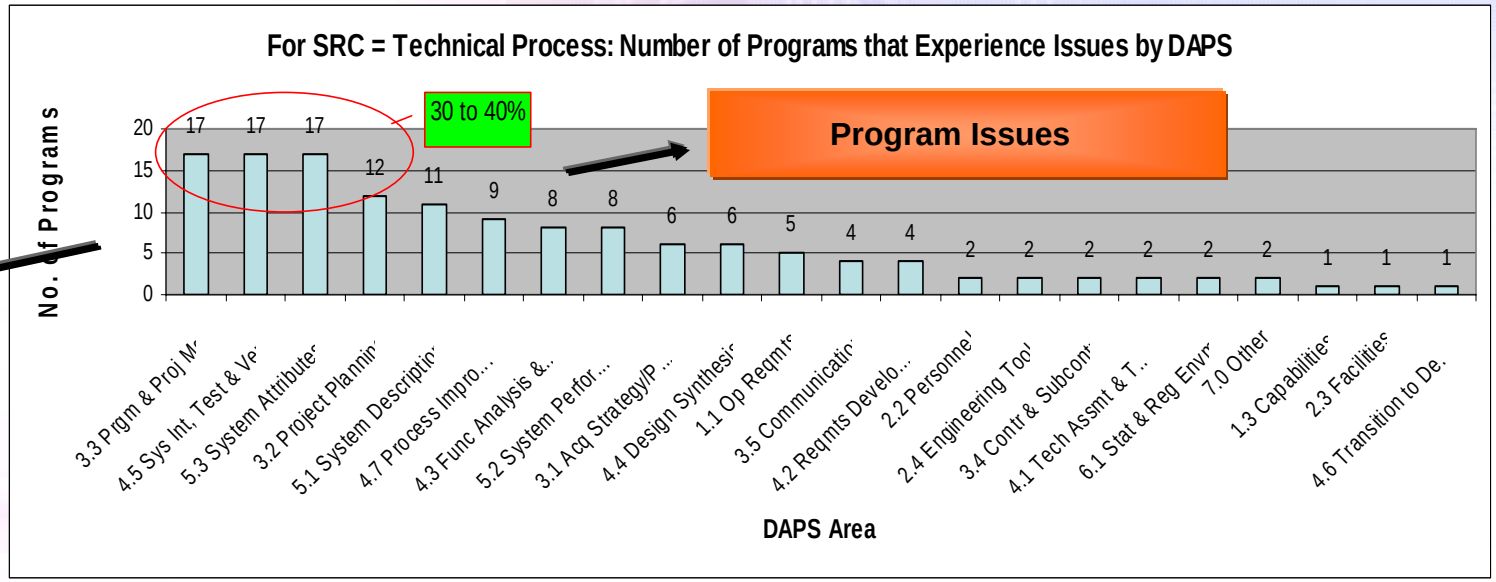


Note: Chart shows 13 of 26 SRCs

Systemic Root Cause: Technical Process

Systemic Root Cause

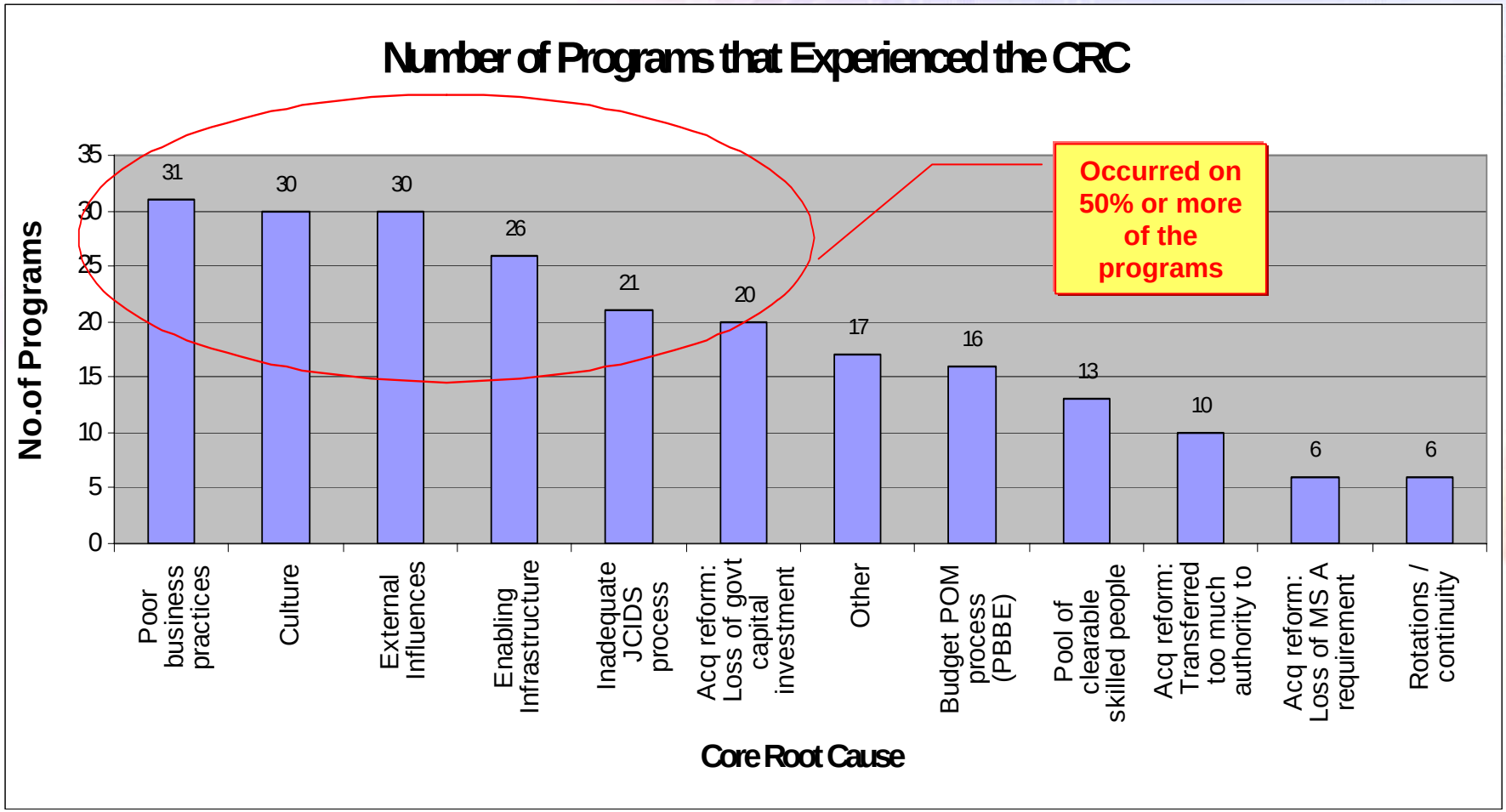
Technical Process



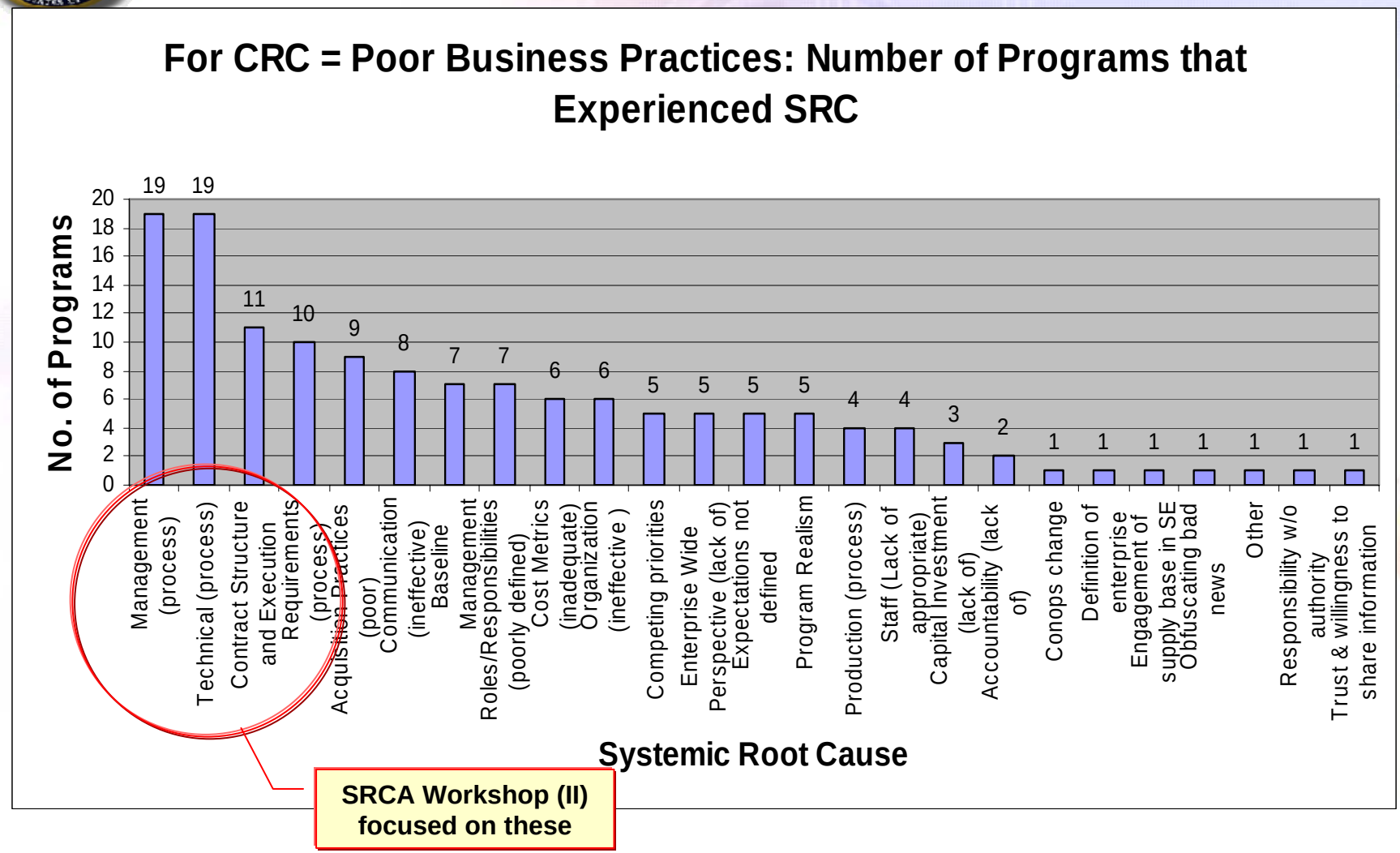
Root Cause Themes

- **Aggressive, success-oriented, highly concurrent test schedule**
- **Reliability not progressing as planned or has failed to achieve requirements**
- **Software reuse was significantly less than planned or expected**
- **Testing and verification approach are inadequate**
- **Program has inadequate systems engineering process**

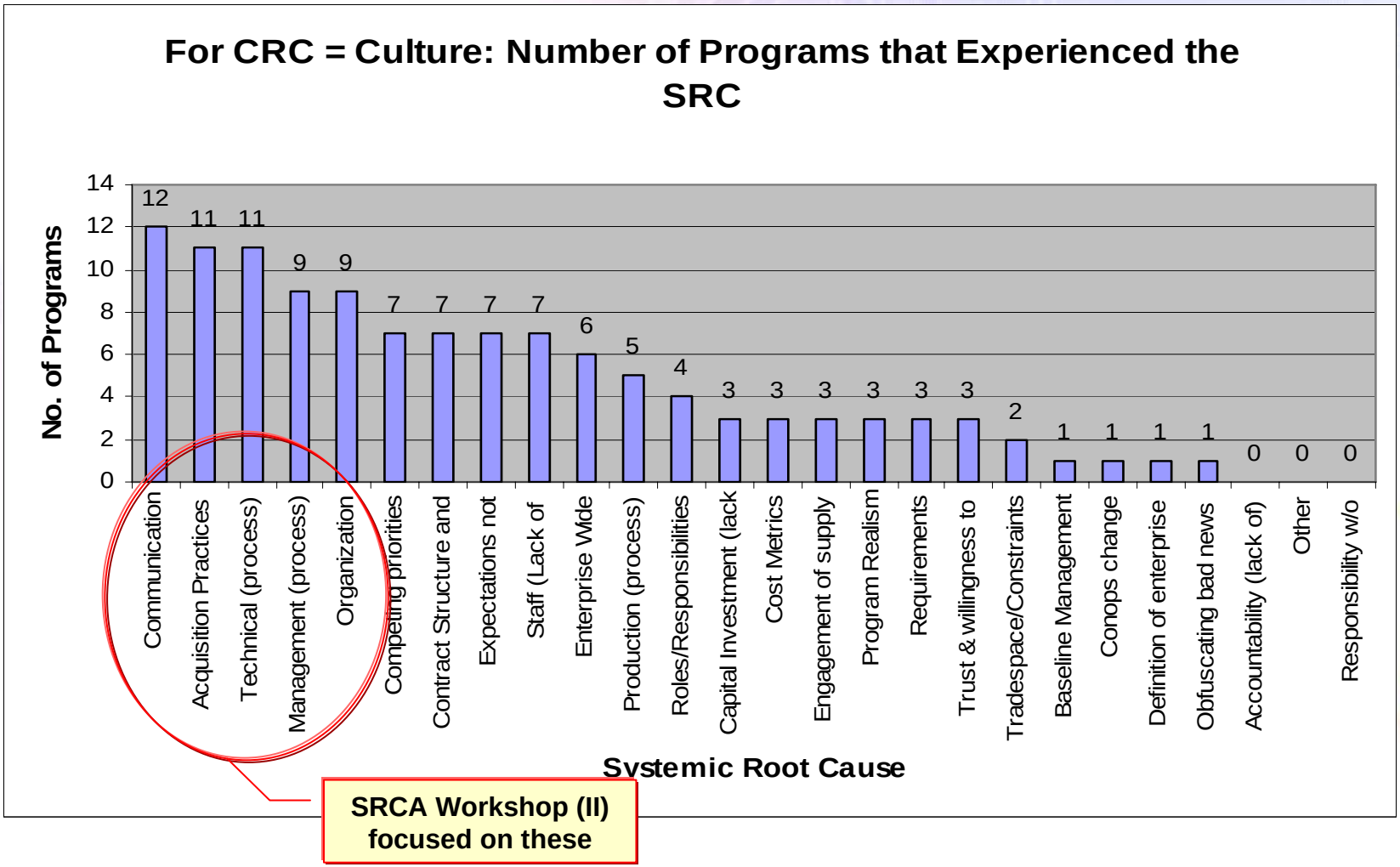
Categorization by Core Root Cause



Relationship between CRC and SRC



Relationship between CRC and SRC



SRCA Workshop Participants
(Part II) 25-26 Sep 07

- Approximately 33 participants representing government and industry
- Non-OSD participants included…
  - Government
    - » Col Horejsi, US Air Force (PEO)
    - » Mr. George Mooney, USAF CSE
    - » Ms. Kathy Lundeen, DCMA
    - » Mr. John Snoderly, DAU
  - Industry
    - » Mr. Bob Rassa, NDIA/Raytheon
    - » Mr. Brian Wells, Raytheon
    - » Mr. Rick Neupert & Mr. Jamie Burgess, Boeing
    - » Mr. Stephen Henry, Northrop Grumman
    - » Mr. Per Kroll, IBM
    - » Mr. Paul Robitaille, Lockheed Martin
    - » Dr. Dinesh Verma, Stevens Institute of Technology
    - » Mr. Dan Ingold, University of Southern California

Raytheon

BOEING

STEVENS Institute of Technology

NORTHROP GRUMMAN

IBM

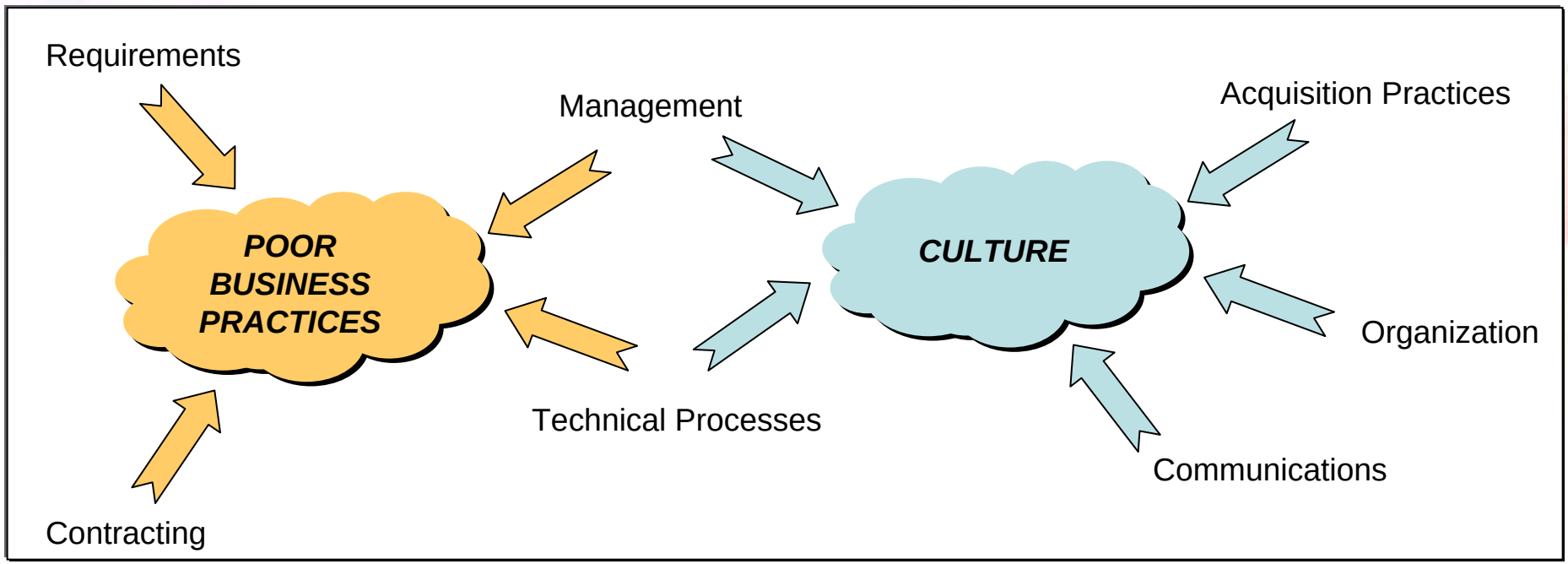
USC CSSE

LOCKHEED MARTIN

DAU Defense Acquisition University

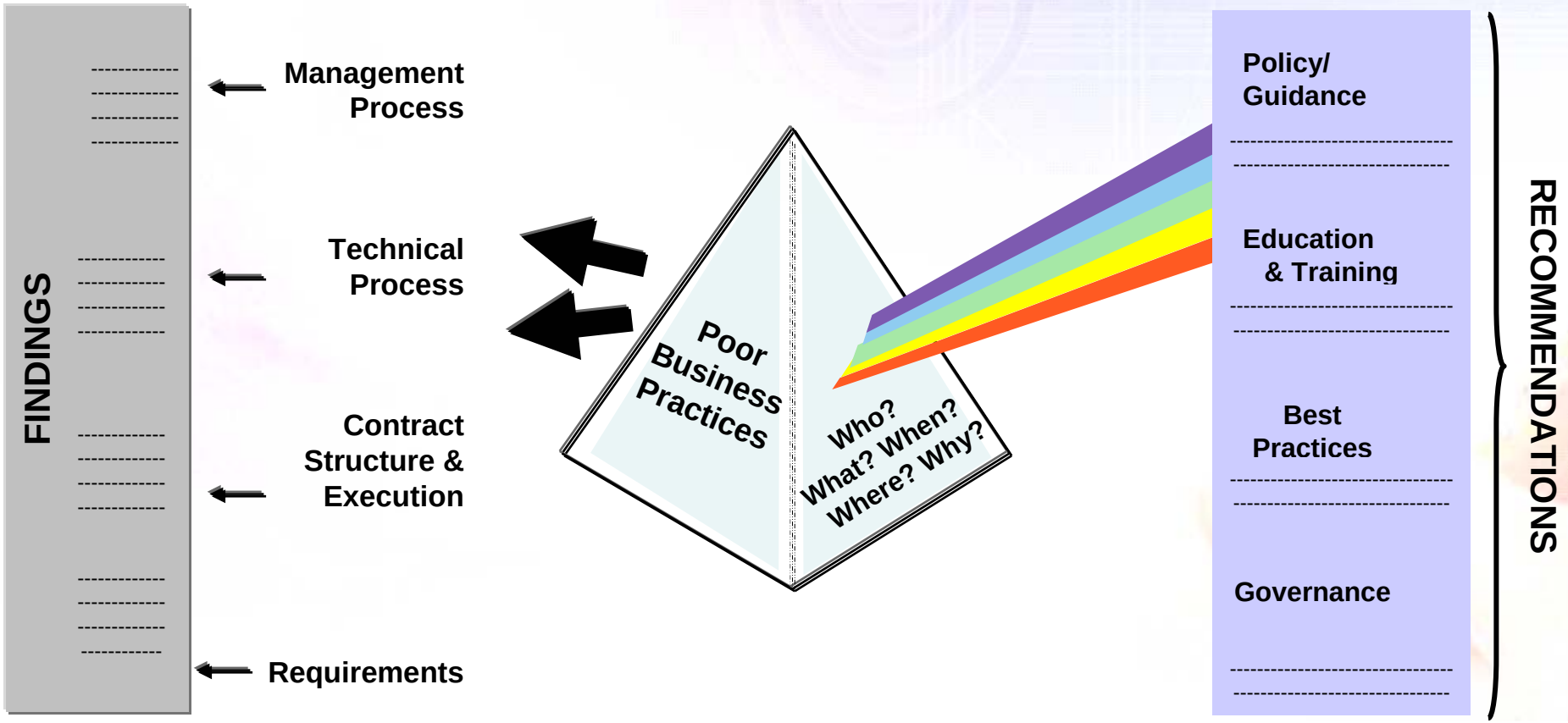
SRCA Workshop (Part II) Objective

- Primary SRCA Workshop II objective:
  - *Formulate systemic root cause recommendations*
- Participants focused on manageable subset of analysis results
  - 2 CRC areas and their top 4-5 SRCs



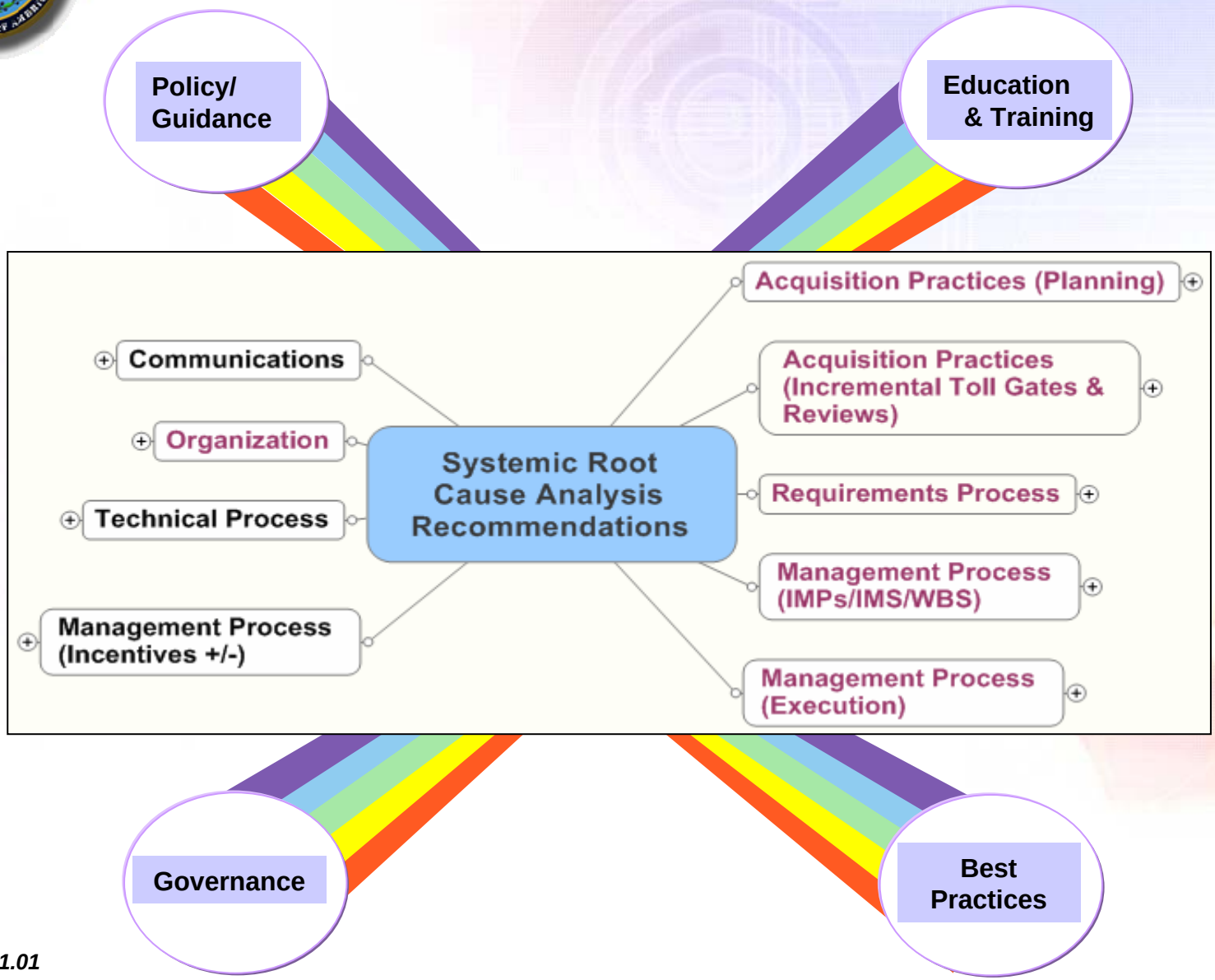
Root Cause Model
(e.g., Poor Business Practices)

Source	Systemic Root Cause (Top 4)	Core Root Cause	Solution Set



Recommendations Must Address Root Causes at Their Source

Initial Thoughts on Systemic Improvement…



SRCA Workshop Part II - Results

- Over 50 recommendations
  - Varied level of detail
  - Directed at variety of sources
    - » Acquirer & Developer
    - » PM, PEO, Comp. Rep., Acq. Exec
    - » Senior Management to Systems Engineer

Industry panel will discuss top 5 next!

Next Steps

- Develop Action Plan
  - Prioritize the emerging recommendations
  - Assign stakeholders
  - Establish timelines
- Complete analysis on remaining CRC areas
- Formalize NDIA Working Group to continue recommendation development on CRC analysis

Questions / Discussion

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Systemic Root Cause Analysis

Industry Panel Discussion

Panel Moderator: Mr. Bob Rassa

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VERSION .9

Industry Panel Members

- Mr. Stephen Henry
  - Northrop Grumman: Principal Engineer
- Mr. Brian Wells
  - Raytheon: Chief Systems Engineer
- Mr. Per Kroll
  - IBM: Manager - Methods IBM Rational
- Mr. Paul Robitaille
  - Lockheed Martin: Director of Systems Engineering Lockheed Martin Corporate Headquarters; President, INCOSE
- Mr. James Burgess
  - Boeing: Systems Engineering Senior Manager, Leader of the Boeing Systems Engineering Best Practices Initiative Boeing Integrated Defense Systems

Results – SRCA Workshop Part II

5 “Heavy Hitter” recommendations include:

1. Increase or improve competition – down select at SRR/PDR/CDR
2. Provide mechanisms for better performance & Implement consequences for non-performance
   - » Increase use of toll gate reviews with off-ramps and specific guidance/requirements
3. Ensure better definition and verification of requirements. E.g. use meta-language, SE-based modeling, etc.
4. Require more close coupling of the IMPs/IMS/WBS
5. Increase acquisition workforce and expertise
   - » Use “green teams” to augment needed acquisition expertise

When is Extended Competition Cost Effective?

Program Complexity & SW Growth	ATP	SRR	PDR	CDR
Medium High Complexity Holchin Level 7*	188%	144%	122%	111%
Down Select Cost Savings Medium High		34%	31%	-3%
Medium Low Complexity Holchin Level 3*	144%	122%	111%	106%
Down Select Cost Savings Medium Low		12%	-2%	-42%

* SW Growth Based on Holchin Growth Curve Average Growth

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