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# *DoD Acquisition Policy and SEI CMM Level 3*

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# *Overview*

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## **DoD ACAT 1 Acquisition Policy and SW-CMM Level 3**

### **Software Evaluation IPT**

- Objectives
- Membership
- Initiatives

### **Approved Evaluation Tools**

### **Other Results**



# *DoD ACAT I Acquisition Policy*

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## **Contractor selection**

- **Domain experience**
- **Past performance**
- **Mature software process**

## **Evaluation**

- **Using tools developed by SEI or approved for use by DUSD(S&T)**
- **Full compliance with SEI CMM Level 3, or equivalent**
- **Risk mitigation plan for deficiencies**
- **Equivalence defined by DUSD(S&T) for approved tools**
- **Must be performed on business unit proposed to do the work**
- **Reuse of evaluation results within a two-year period encouraged**



# *Software Evaluation IPT - Objectives*

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**Define equivalency requirement to provide unambiguous yardsticks**

**Establish evaluator qualifications and evaluation method requirements**

- Reduce number of evaluations
- Reduce evaluation cost
- Improve evaluation reliability



# *Software Evaluation IPT Membership*

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## **Government**

- **OSD**
- **Army**
- **Navy**
- **Air Force**
- **DCMA**
- **DSMC**
- **Aerospace**
- **IDA**
- **MITRE**
- **SEI**

## **Industry**

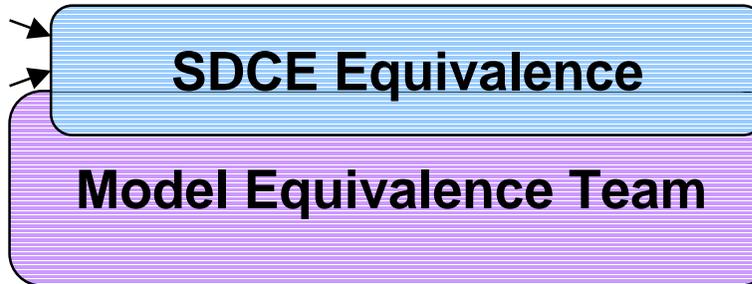
- **Boeing**
- **CSC**
- **Harris**
- **Lockheed Martin**
- **Northrop Grumman**
- **Raytheon**
- **Rockwell Collins**



# Software Evaluation IPT Initiatives

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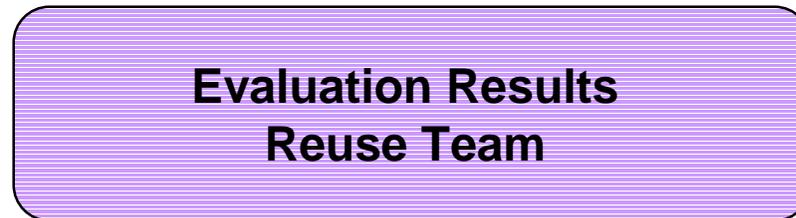
- ASC
- SMC



- Approved SDCE Core Set
- Model Equivalence Process



- Evaluation Method Requirements



- Assisted Assessment Proposal



# *Approved Evaluation Tools*

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## **Software Capability Evaluation (SCE) v3.0**

- Method and training available
- <http://www.sei.cmu.edu/>

## **Software Development Capability Evaluation (SDCE)**

- With approved core set revisions
- Maintained by USAF ASC/EN
- Method and training available



## *Other Results*

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### **Draft Evaluation Method Requirements**

- **Based on ISO 9000**
- **Input to SCAMPI appraisal method description**

### **Guidelines for Government-Assisted Internal Assessments**

- **Team requirements**
- **Reporting requirements**



# **Piloting the Level 3-Equivalent SDCE: *The Contractor Team Perspective***

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***STC 2002***  
***29 April – 2 May 2002***



# Agenda



*Process for Responding to the SDCE*

*Lessons Learned*

*Recommendations*



# Process for Responding to the SDCE



- Treated SDCE response like a proposal
- Created plans first -- answered many SDCE questions by pointing to appropriate text in the plans
- Process owners for each process
- Project leads who helped gather evidence from other projects
- Software Engineering Process Group involvement



# Lessons Learned - 1



## *Lesson 1 -- It's tough being an early adopter.*

- We bid the effort required for a 35 question “standard” SDCE
- The 130 question Extended SDCE greatly expanded our effort
  - New questions which many people had not seen before
  - Much more organizational, SE, teammate involvement
  - Detailed questions about processes not yet planned in detail, given the stage of the program

3.1.1 Q1. How are estimates for the size, effort, cost, and schedule of each software component generated? Which published estimating methods and models are used? Describe how estimates are developed for any planned incremental development or release. Describe your experience with this method relative to actual size, effort, cost, and schedule of completed projects.

**One question!** 



## Lessons Learned (continued)



- **Significant effort was spent understanding the SDCE instructions**
  - What should be in the trace matrix? How should it be organized?  
How will it be used by the government?
  - In providing sample evidence from other projects, across multiple contractors, which samples do we show?
  - What single project document shows evidence of use of a process?  
How do we show how that document fits into the other project?
- **Sometimes challenging to provide a coherent explanation and answer the questions**



# Lessons Learned (continued)



## *Lesson 2 – The size alone caused problems.*

- **For each of the 130 questions, we supplied:**
  - 2-3 page question response
  - Evidence of use on the current project
  - Evidence of use on two other projects
  - Data Cover Sheets for the evidences
- **For 33 “institutionalization” questions, we supplied answers for the prime contractor and each significant software team member**
- **For the entire set, we supplied**
  - Capability Definition Matrices
  - Data Inventory
  - Bi-Directional Cross-Reference
  - Software Development Plan (SDP), Integrated Master Plan (IMP)

**Traceability and consistency:  
a logistics nightmare**



# Data Cover Sheets



**390 of these!**

Cover Sheet for Project's Sample Data		
<b>Contractor:</b> Team A, ABC Company, XYZ Division, Rolling Hills, VT		
<b>Sample Project Name:</b> Project X		
<b>Sample Project Customer<sup>1</sup>:</b> U.S. Air Force Space and Missile Systems Center		
<b>Critical Capability(ies):</b> 4.4.2 Metrics Application		
<b>Title of Sample:</b> V4-4, Project X Software Development Metrics Reports		
<b>Explain why your experience on the sample project is relevant to the SBIRS Low project.</b> Object-oriented methods and metrics were used on the sample project. The same object-oriented methods and metrics are planned for use on the SBIRS Low project.		
ATTRIBUTES	SBIRS LOW PROJECT	SAMPLE PROJECT
<b>Application Domain</b>	Weather Satellite	Communications Satellite
<b>Product Type</b>	Ground System (Command and Control)	Ground System (Command and Control)
<b>Acquisition Phase<sup>2</sup></b>	EMD	EMD
<b>Software Development Phase(s)</b>	Design; Coding and Unit Test	Design; Coding and Unit Test, Increments 1 and 2
<b>Award Date</b>		1/94
<b>Contract Duration</b>	8 Years	5 Years
<b>Current Project Phase/ Contract Month<sup>3</sup></b>		EMD: Between System PDR and System CDR/Month 24
<b>Prime/Subcontractors<sup>4</sup></b>	2 Software Subs	Prime & 1 Software Sub
<b>Software KSLOC<sup>5</sup></b>	750	500
<b>Language(s) and Percentages</b>	Ada 95: 90% C++: 10%	Ada 83 77: 75% C++: 25 %
<b>Target Processor(s)/OS(s)</b>	RISC 6000/UNIX	VAX 6200/VMS 6.2
<b>Applicable Standards</b>	IEEE 1498	DoD-STD-2167A & 2168





## Lessons Learned (continued)



### *Lesson 3 – CMM breadth of questions don't fit with SDCE depth of response.*

- **The CMM was designed as a broad overview of many processes**
  - Primary: maturity of the process in the organization (existence)
  - Secondary: planned use of the process on the project
- **The SDCE was designed as an in-depth look at the goodness of a few key processes**
  - Primary: your approach for the project (goodness)
  - Secondary: your experience with this approach on other projects
- **Using CMM questions in a SDCE meant an in-depth look at many processes that are valuable, but not critical to program success**



## Lessons Learned (continued)



### *Lesson 4 – The real value is in establishing a shared vision of risk with the government.*

- **The SDCE write-ups helped establish a common understanding of our processes**
- **The post-SDCE discussions with the government addressed the “real” issues**
  - Why we selected a certain approach
  - What other approaches we considered and rejected, and why



# Recommendations



## *Simplify the questions*

- **CMM questions should be at the Goal level, not the Practice level (reduces the number of questions by a factor of 5)**
- **Eliminate SDCE/CMM question overlaps**
- **Don't make drastic changes in the process**

## *Perform joint government/contractor process assessments*

- **Joint teams conduct periodic appraisals of defense contractors**
  - Piloted by some government organizations
  - Team members work to consensus
  - Results could be reused in subsequent source selections
- **Shared understanding of process maturity and program risk**
  - Contract monitoring focuses on risk reduction



# **Piloting the Level 3-Equivalent SDCE: *The Contractor Team Perspective***

**RON BOWLIN, Spectrum Astro**

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**MAY 2, 2002**



# The Spectrum Astro SBIRS Low Team

TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING





# Agenda

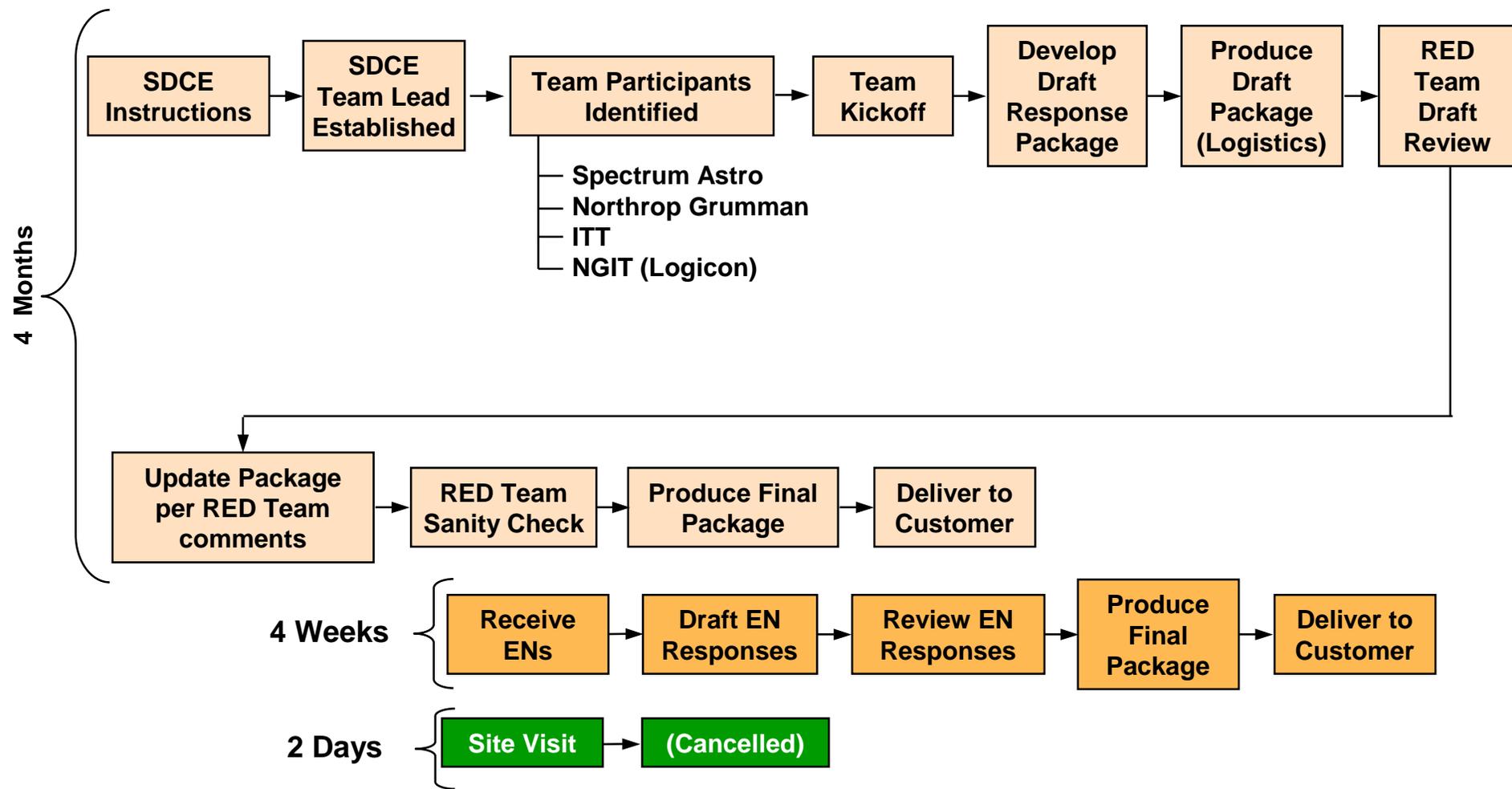
TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING

- **Process Used to Respond to the SDCE**
- **PLUS & MINUS of the SDCE**
- **SDCE Lessons Learned**
- **Spectrum Astro Team Recommendations**



# Spectrum Astro SDCE Process

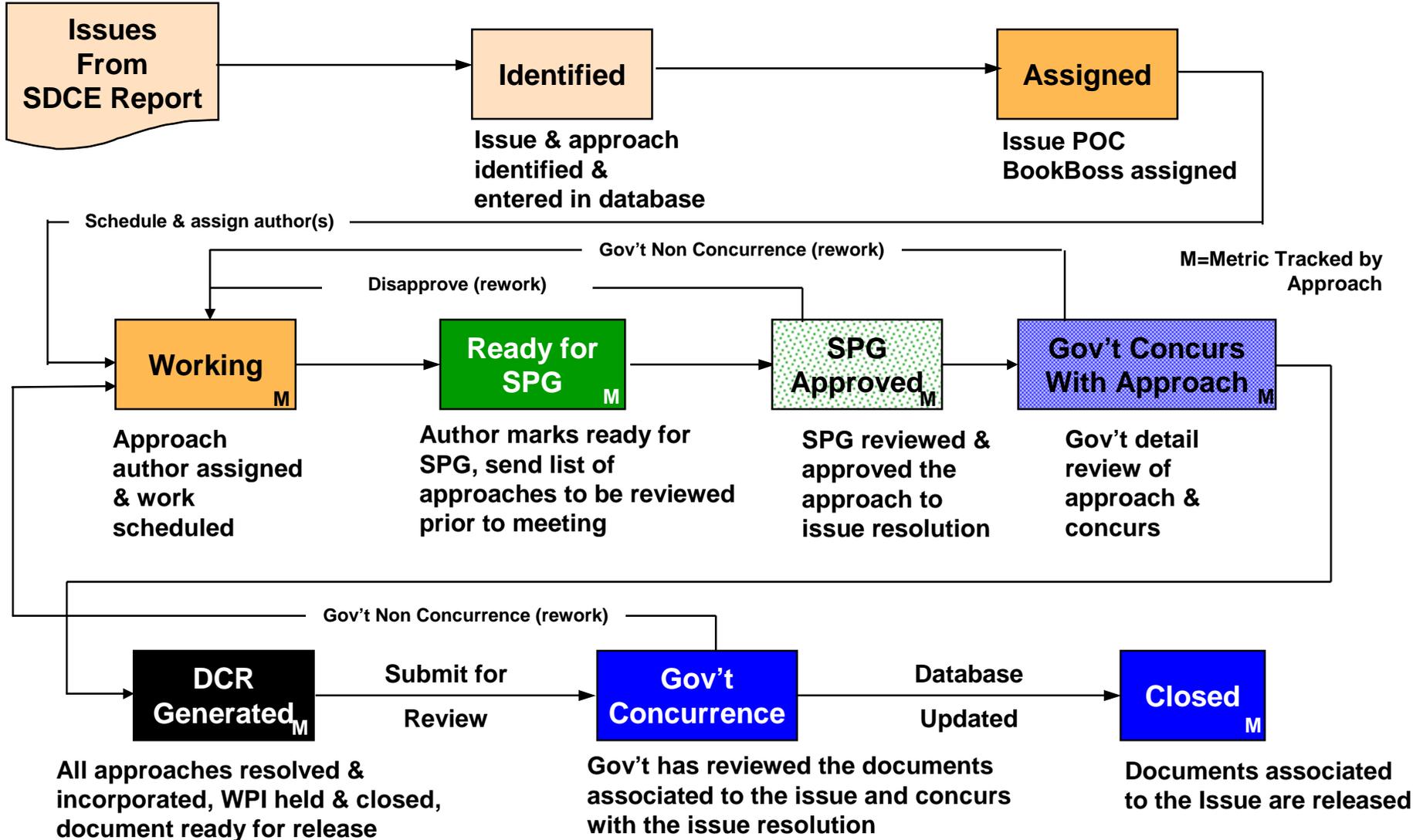
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# Issue Approach Resolution Flow

TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING





# SDCE Plus & Minus

TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING

- PLUS:** Improved SDP, Processes, Inter-Team Coordination, Identification of “Improvement” Areas
  
- MINUS:** Effort Equivalent to Major Proposal
  
- MINUS:** ~50% of Effort Directed to Mechanics of SDCE Answers (Distracted from Process Improvements)
  
- MINUS:** Details (Post PDR type Technical Information) Requested Too Early in Program



# SDCE Lessons Learned

TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING

- 1. Treat as a Stand-Alone Proposal (Ensure Management Support)**
- 2. Plan for Appropriate Resources from Multiple Disciplines to be Directly Assigned to SDCE**
- 3. Establish Software Process Group Early**
- 4. Establish Communication with SDCE Team**
- 5. Prioritize Questions, and Apply Correct Amount of Resources to High Priority Items**
- 6. Answer Questions with Processes and Specific Details**
  - Avoid Generalities**
  - Avoid Projecting the Use of “Tailoring”**



# Spectrum Astro Team Recommendations

TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING

- 1. Air Force Accept SEI CMM (or CMMI) Assessments from “Certified” Assessors**
- 2. Consider Air Force Staff Becoming SEI CMM (or CMMI) Assessors**
  - **Use the CMM (or CMMI) as the Evaluation Tool**
- 3. Keep SDCE to CAPABILITIES Evaluation and Technical Program Details Consistent with Phase of Program**
- 4. Conduct Multiple Site Visits**
  - **One Prior to First Submittal**
  - **Let Contractor Pick One Area to Review Submittal for Discussion / Questions / Clarifications**



# Acronyms

TASC · ITT INDUSTRIES · ANALEX · LOCKHEED MARTIN · LOGICON · SPACE DYNAMICS LAB · BOEING

<b>CMM</b>	Capability Maturity Model®
<b>CMMI</b>	Capability Maturity Model Integration <sup>SM</sup>
<b>D/OT&amp;E</b>	Developmental/Operational Test & Evaluation
<b>DCR</b>	Document Change Request
<b>EN</b>	Evaluation Notice
<b>I&amp;T</b>	Integration and Test
<b>LOS</b>	Line of Sight
<b>SBIRS</b>	Space Based Infrared Systems
<b>SDCE</b>	Software Development Capability Evaluation
<b>SDP</b>	Software Development Plan
<b>SEI</b>	Software Engineering Institute
<b>SPG</b>	Software Process Group
<b>SV/LV</b>	Space Vehicle/Launch Vehicle
<b>PDR</b>	Preliminary Design Review
<b>POC</b>	Point of Contact
<b>WPI</b>	Work Product Inspection

# Software Technology Conference 2002

## **Piloting the Level 3-Equivalent SDCE: *The Evaluation Team Perspective***

**Suellen Eslinger  
The Aerospace Corporation  
May 2, 2002**

# Acknowledgements

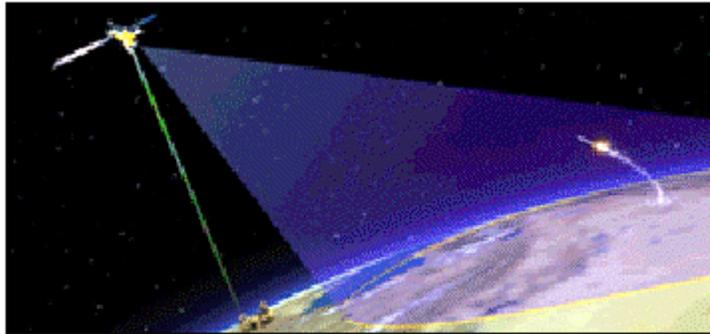
*This work would not have been possible without assistance from the following:*

- **Funding sources**
  - ❖ SBIRS Low Program Office (Paul Pakalapati, SMC/MT3G, and Fred Ovadia, Aerospace)
  - ❖ Mission-Oriented Investigation and Experimentation (MOIE) Research Program (Software Acquisition Task)
  - ❖ SMC Chief Engineer's Office (Mike Zambrana, SMC/AXE, and Ted Winer, Aerospace)
- **Briefing reviewers and SDCE team members**
  - ❖ Richard Adams and Karen Owens, Deputy Team Leaders, Aerospace Software Systems Acquisition Department
  - ❖ John Cantrell -- Aerospace Software System Acquisition Department
  - ❖ Fred Ovadia, Aerospace SBIRS Low Program Office
  - ❖ Paul Pakalapati, SMC/MT3G
- **Other SDCE Team Members too numerous to list**

# Outline

- **Background**
- **SBIRS Low Software Development Capability Evaluation (SDCE)**
- **Evaluation Process**
- **Lessons Learned**
- **Conclusion**

# Space-Based Infrared System (SBIRS) Missions



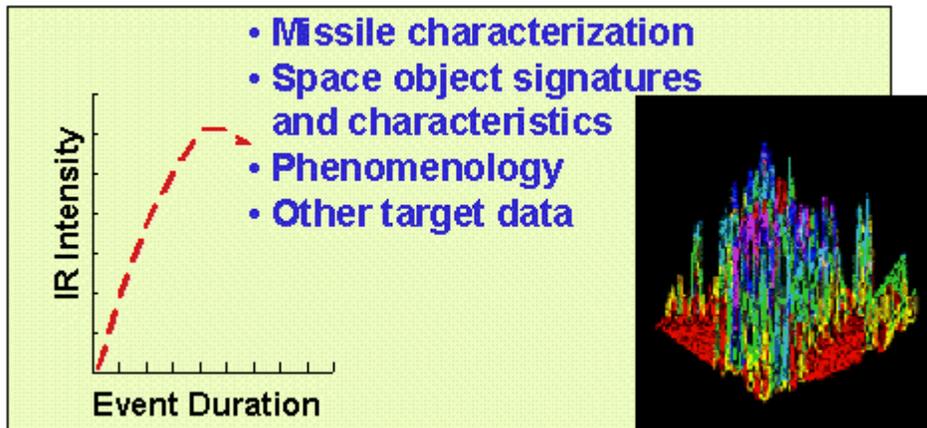
**Improved Missile Warning**



**TMD**

**NMD**

**Missile Defense**

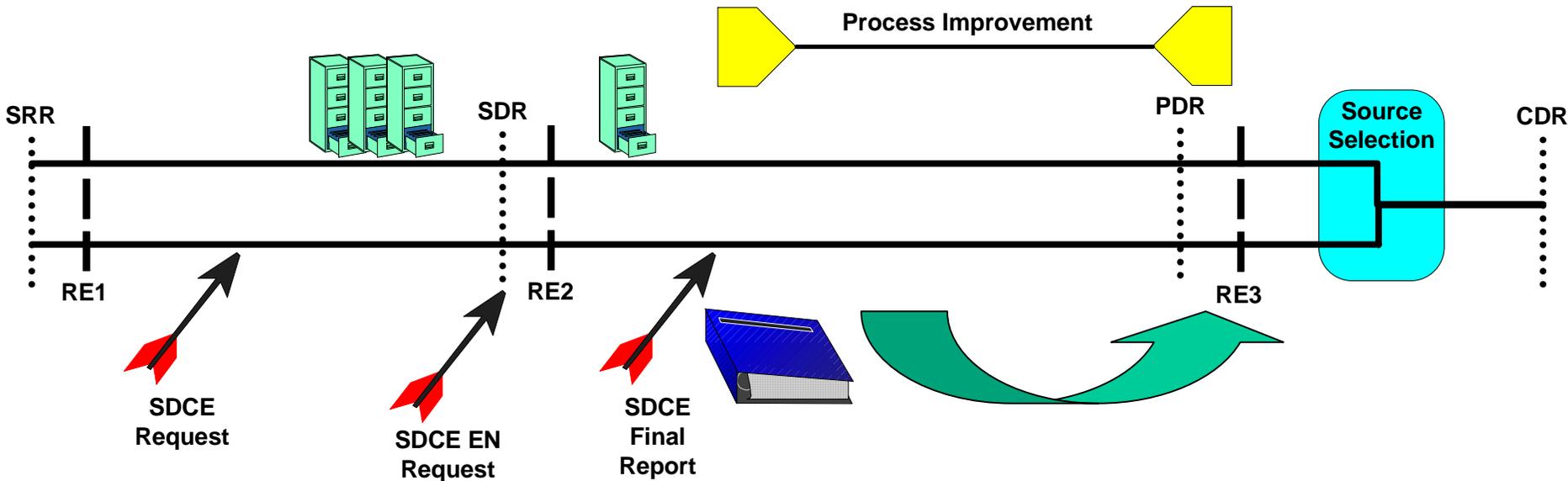


**Technical Intelligence**



**Battlespace Characterization**

# SBIRS Low Program Definition/ Risk Reduction (PD/RR) Phase



- **Periodic Rolling Evaluations (REs) after each major review**
  - ❖ Results to feed into Engineering and Manufacturing Development (EMD) source selection
- **Contractor teams tasked to respond to an SDCE during the PD/RR contract**
  - ❖ SDCE results to be included in RE3, following a software process improvement effort to address the issues found by the SDCE

# SBIRS Low SDCE Purposes

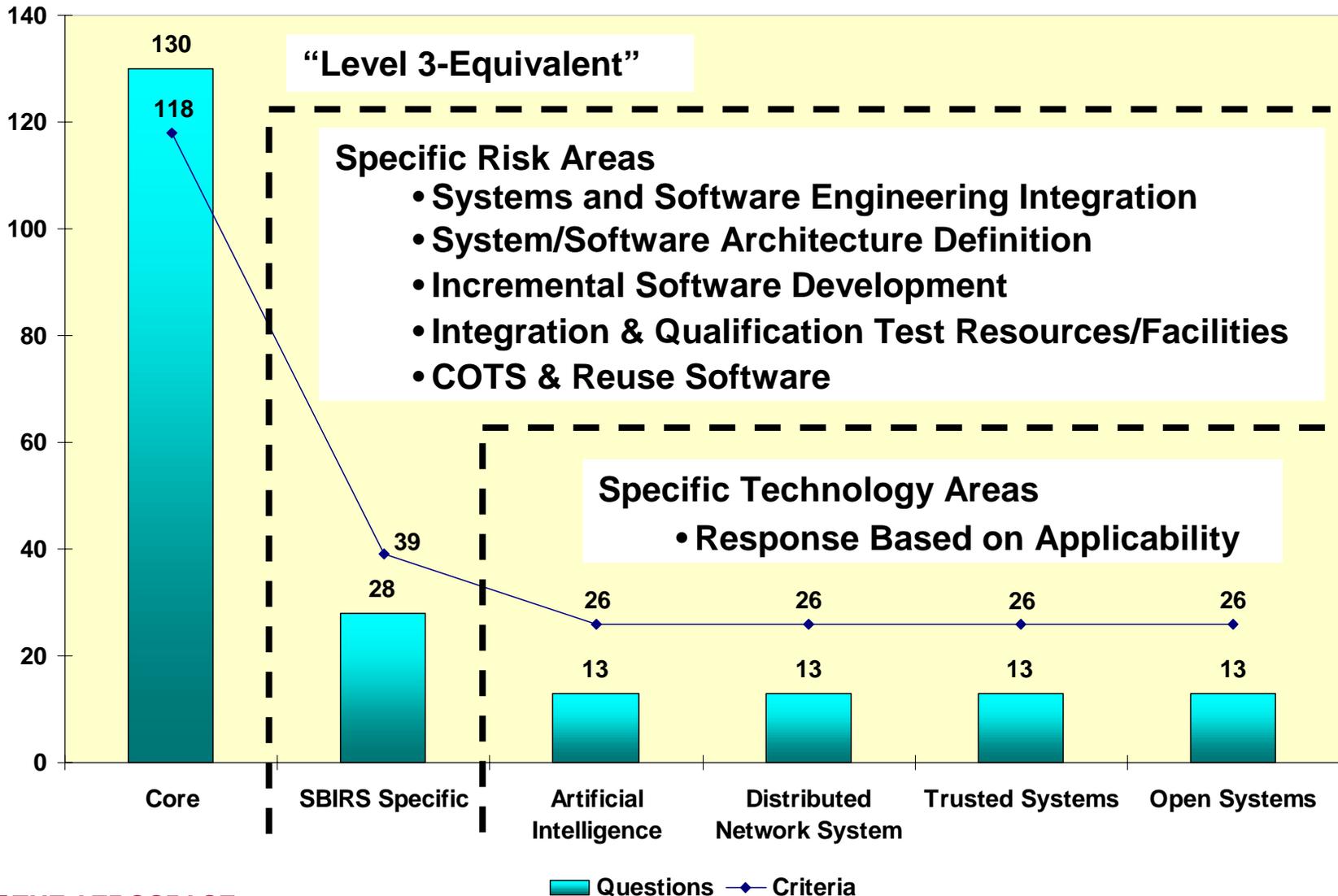
***Goal: The best software processes in place before the start of EMD***

**Stimulate early process improvement effort**

**Stimulate early process assessment**

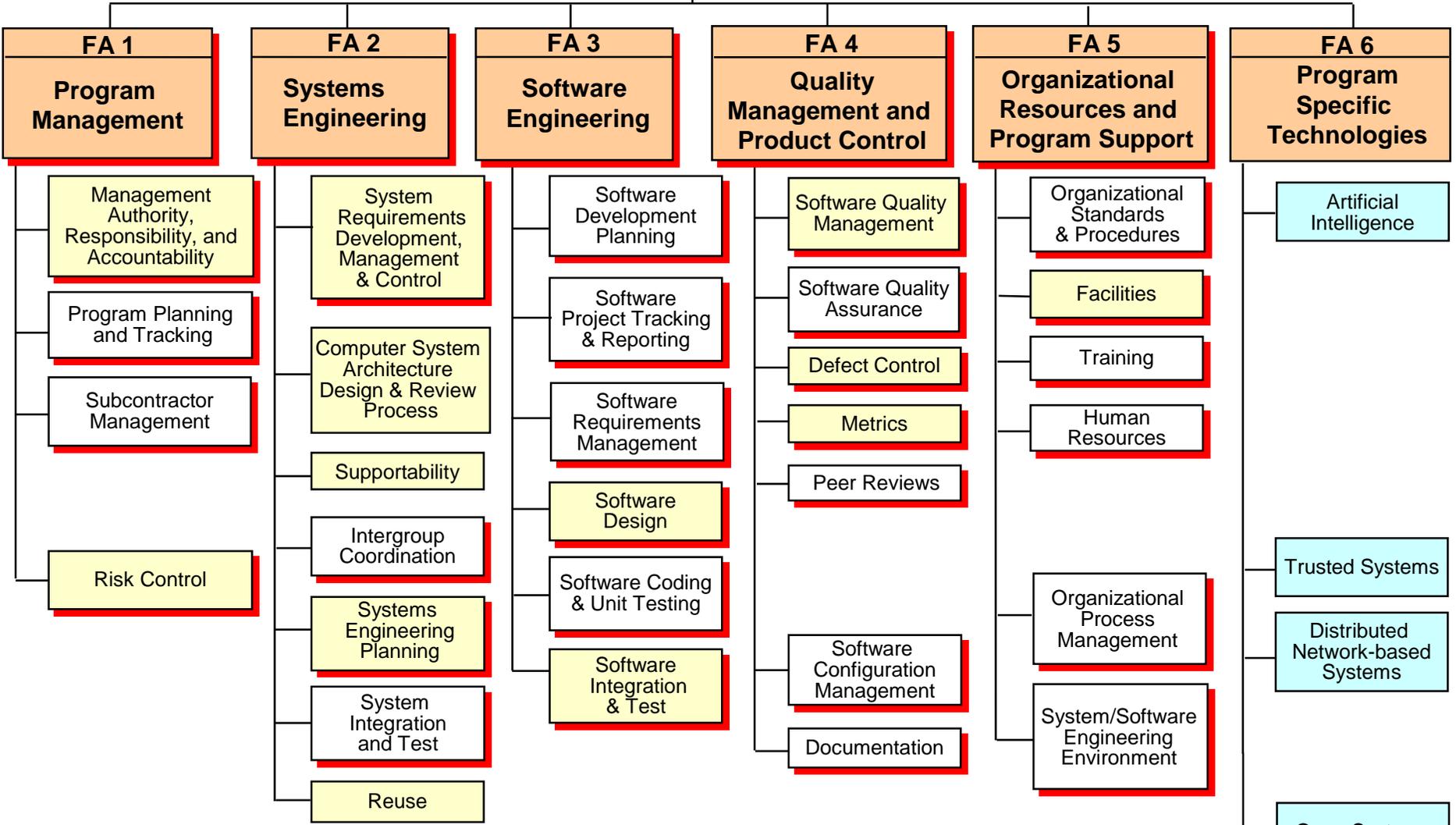
**Stimulate early software process definition**

# SBIRS Low SDCE Questions



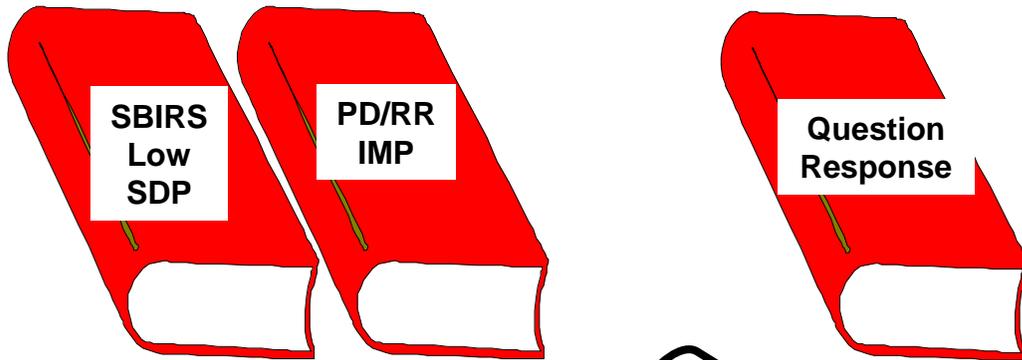
# Tailored SBIRS Low SDCE Model – Top Level

## SDCE Model

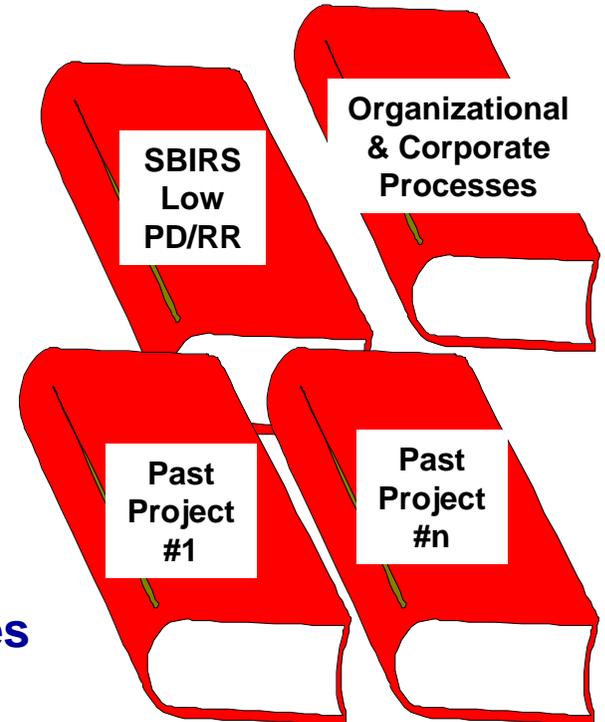


# SDCE Instructions to Contractors

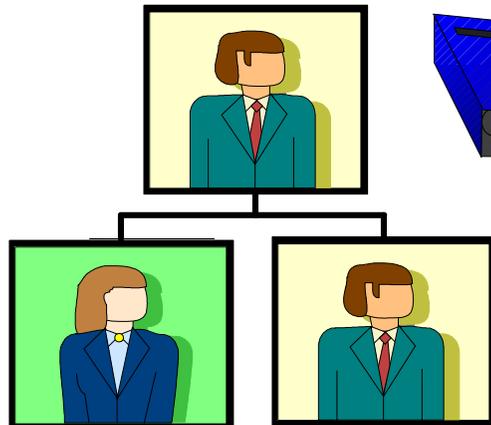
## Page Limited Response



## Substantiating Evidence (No Page Limits)



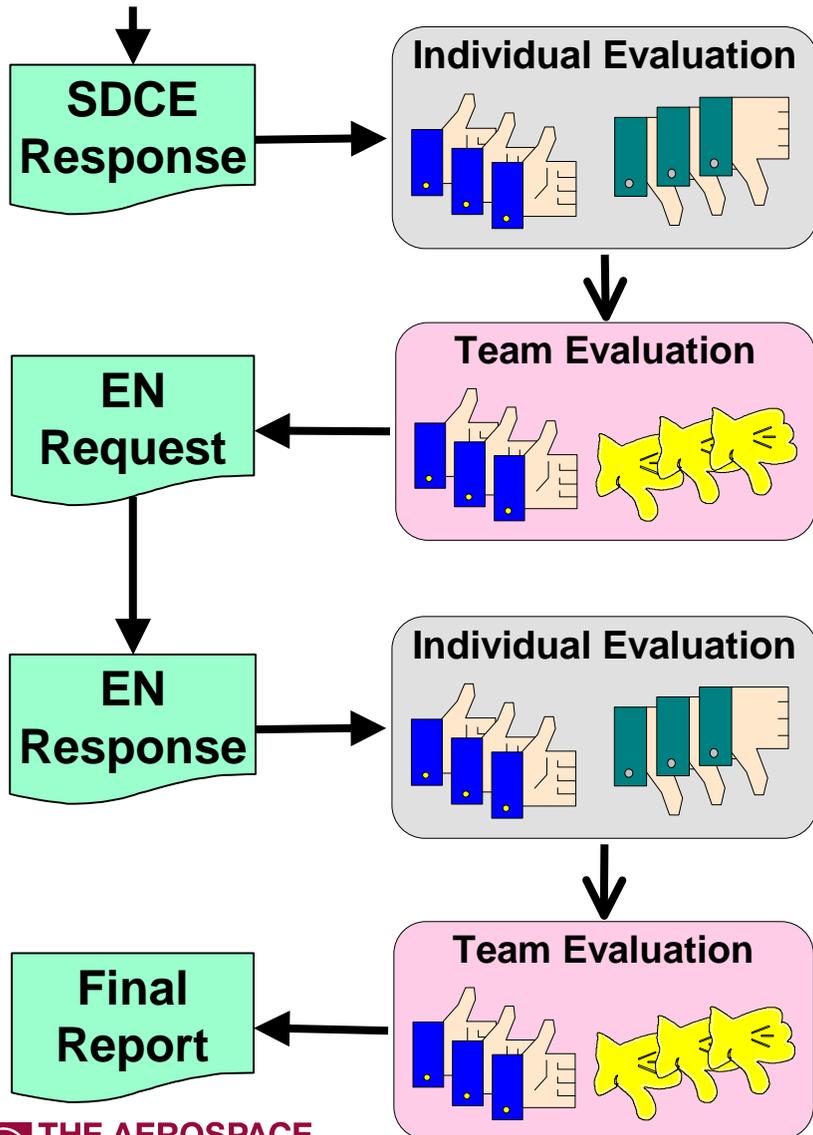
## Products & Processes



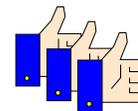
## PD/RR & EMD Processes

## Significant Software Development Team Members

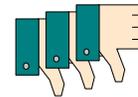
# SDCE Evaluation Process and Terminology



- **Inadequacy:** failure to meet an SDCE criterion
- **Weakness:** flaw that increases the risk of an unsuccessful software development effort
- **Strength:** exceeding an SDCE criterion



Strengths

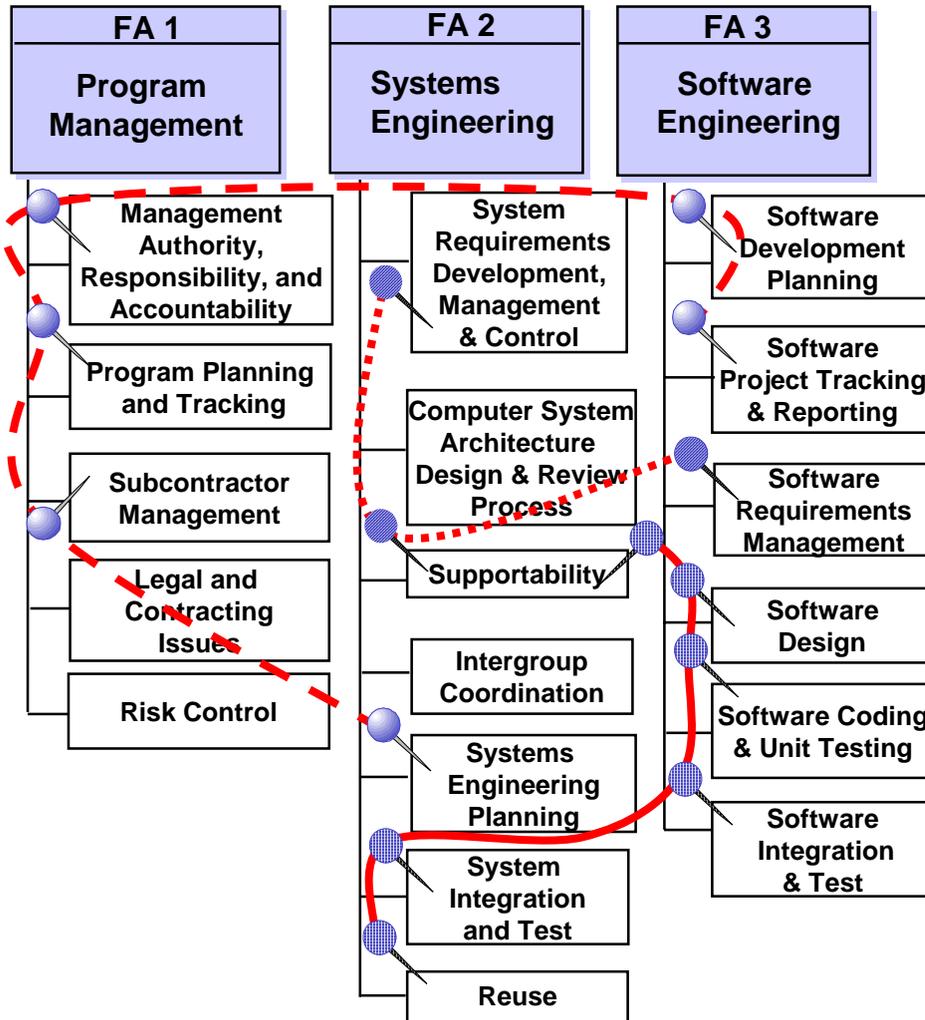


Inadequacies or Weaknesses



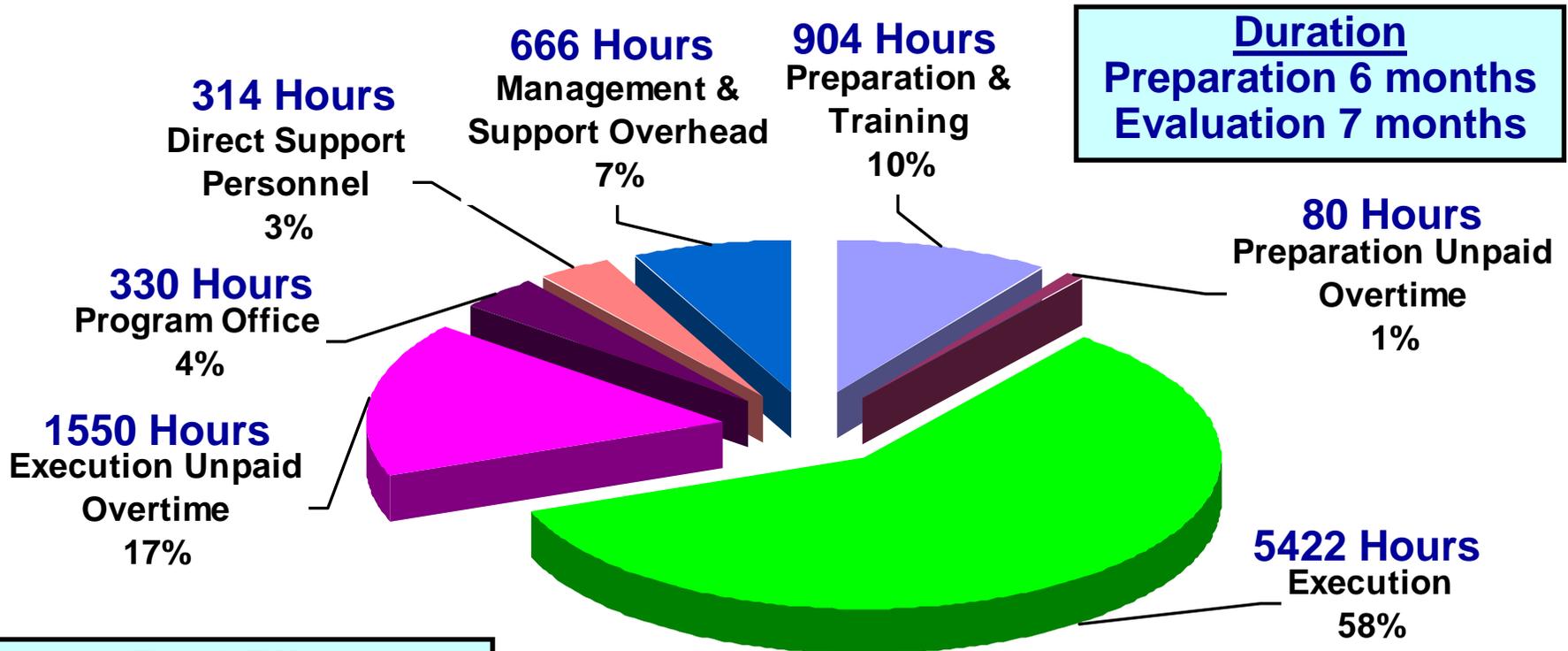
Issues or Deficiencies

# Symptom-Issue Relationship

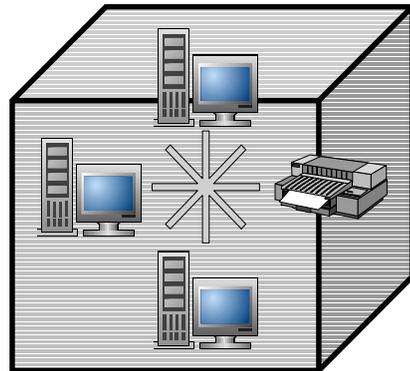


- Individual inadequacies and weaknesses (risks) are generally symptoms of larger, underlying problems, called “issues”.
- The symptoms are synthesized across SDCE functional areas to derive the issues documented in the final reports.
- “Deficiencies” are collections of related issues that together increase the risk of an unsuccessful software effort to an unacceptable level.

# SDCE Resources and Duration (AF & Aerospace)



**Total Effort**  
7636 hours  
+ 1630 hours overtime  
9266 hours



**Other Resources**  
Dedicated Conference Room  
(8 Months)  
Dedicated Network  
(8 Computers, 1 Hub, 1 Printer)

# Significant Lessons Learned



## Lesson # 1

### **Too much time and effort to perform a Level 3-equivalent SDCE**

- ❖ Not cost effective
- ❖ Could not be accomplished during source selection time period



## Lesson # 2

### **“Core” set of questions and criteria needs significant improvement**

- ❖ Too much overlap and redundancy between questions/criteria
- ❖ Inconsistent questions and criteria
- ❖ Poorly worded questions and criteria
- ❖ “Institutionalization” questions focused on organizational processes of the individual team members rather than the program team

# Significant Lessons Learned



## Lesson # 3

### **Questions, criteria and instructions need to focus on presenting process integration across the software team members**

- ❖ Requested processes were those used by each software team member
- ❖ Presenting the integration of those processes across the team was not explicitly requested



## Lesson # 4

### **Roll-up of individual inadequacies and weaknesses vertically to functional areas does not work**

- ❖ Individual inadequacies and weaknesses are symptoms of larger, underlying issues
- ❖ Symptoms must be synthesized across functional areas to derive the significant issues

# Significant Lessons Learned



## Lesson # 5

### Use and effectiveness of substantiating evidence needs significant improvement

- ❖ Substantiating evidence was not required from each software team member for each question
- ❖ All substantiating evidence submitted for a particular program was not from the same baseline
- ❖ Substantiating evidence was not required for the “institutionalization” questions
- ❖ Instructions need to be clearer about evidence of process use
  - ☞ Artifacts of process use need to clearly show the process used
  - ☞ A process description does not demonstrate process use
- ❖ Substantiating evidence organization, identification and referencing needs to be defined explicitly
- ❖ Substantiating evidence from the current program was the most useful

# Significant Lessons Learned

A cyan ribbon banner with a white rectangular box in the center containing the text "Lesson # 6".

## Lesson # 6

### Team training needs improvement

- ❖ Team exercises and additional examples
- ❖ Hands-on training for use of the computer system
- ❖ Refresher training before each step in the process

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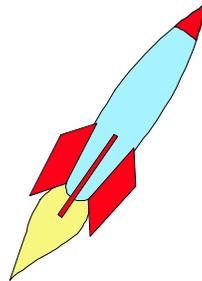
## Lesson # 7

### Face-to-face discussions with the contractor teams would have been beneficial for clarification of

- ❖ SDCE instructions and groundrules
- ❖ SDCE issues

# SBIRS Low SDCE Goal was On-Target

*Goal: The best software processes in place before the start of EMD*



**Stimulate early process improvement effort**

**Stimulate early process assessment**

**Stimulate early software process definition**



# Conclusions

- The currently defined Level 3-equivalent SDCE takes too much time and effort for the information gathered
  - ❖ A significantly smaller SDCE could have achieved program goals
- Use of the currently defined Level 3-equivalent SDCE is not recommended for satisfying the ACAT I software capability evaluation policy
- An approach for satisfying the policy is needed that:
  - ❖ Is cost effective
  - ❖ Fits within the time and manpower constraints of source selection
  - ❖ Identifies the program-specific software-related strengths, inadequacies, and weaknesses (risks) for each bidding team

# Backup and Reference Charts

- **Issue Categories**
- **SDCE References**
- **Speaker Contact Information**
- **Acronym List**

# Issue Categories - 1

## 1. Process categories

- ❖ Software team members and responsibilities
- ❖ Software item definition and management
- ❖ IPT structure and definition
- ❖ Process definition, especially across IPTs and team members
- ❖ Life cycle model
- ❖ Quantitative project management (e.g., cost, schedule, effort, metrics)
- ❖ People/group interface management
- ❖ Training
- ❖ Peer reviews
- ❖ Multi-site software development
- ❖ Quality assurance
- ❖ Configuration management
- ❖ Risk management
- ❖ Subcontractor management

# Issue Categories - 2

## 2. Product engineering categories

- ❖ Requirements analysis and management
- ❖ Computer system architecture and design
- ❖ Testing approach and management (integration and verification)
- ❖ Interfaces
- ❖ Specialty engineering, especially RMA and supportability
- ❖ Traceability
- ❖ Operations and maintenance approach
- ❖ COTS and reuse software
- ❖ Open systems
- ❖ Distributed network-based systems
- ❖ Trusted systems
- ❖ Artificial intelligence

## 3. SDCE response

## 4. Government issues

# SDCE References

- **SDCE pamphlets**

- ❖ “Acquisition Software Development Capability Evaluation,” Vols. 1 and 2, Air Force Materiel Command Pamphlet (AFMCPAM) 63-103, 15 June 1994

- ❖ Available at

- <http://www.afmc.wpafb.af.mil/pdl/afmc/63afmc.htm>

- **Core questions and criteria**

- ❖ Available from the DoD Software Collaborators Group website

- ❖ <http://dodsis.rome.ittssc.com/resources.html>

# Speaker Contact Information

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# Acronyms - 1

<b>ACAT</b>	<b>Acquisition Category</b>
<b>AF</b>	<b>Air Force</b>
<b>AFMCPAM</b>	<b>Air Force Materiel Command Pamphlet</b>
<b>CDR</b>	<b>Critical Design Review</b>
<b>COTS</b>	<b>Commercial Off-the-Shelf</b>
<b>EMD</b>	<b>Engineering and Manufacturing Development</b>
<b>EN</b>	<b>Evaluation Notice</b>
<b>FA</b>	<b>Functional Area</b>
<b>IMP</b>	<b>Integrated Master Plan</b>
<b>IPT</b>	<b>Integrated Product Team</b>
<b>MOIE</b>	<b>Mission-Oriented Investigation and Experimentation</b>
<b>NMD</b>	<b>National Missile Defense</b>
<b>PD/RR</b>	<b>Program Definition/Risk Reduction</b>
<b>PDR</b>	<b>Preliminary Design Review</b>

# Acronyms - 2

<b>RE</b>	<b>Rolling Evaluation</b>
<b>RMA</b>	<b>Reliability, Maintainability, Availability</b>
<b>SBIRS</b>	<b>Space-Based Infrared System</b>
<b>SDCE</b>	<b>Software Development Capability Evaluation</b>
<b>SDP</b>	<b>Software Development Plan</b>
<b>SDR</b>	<b>System Design Review</b>
<b>SPO</b>	<b>System Program Office</b>
<b>SRR</b>	<b>System Requirements Review</b>
<b>STC</b>	<b>Software Technology Conference</b>
<b>TMD</b>	<b>Theater Missile Defense</b>