

2003 FAA National Software Conference Data and Control Coupling Brainstorm

Data and Control Coupling Brainstorming Session

2003 FAA National Software Conference
September 19, 2003

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Session Overview

- Purpose of Session
- Overview of CAST White Paper
- Input on the Paper
- Common Problems in Performing Data and Control Coupling Analyses
- Potential Solutions
- Future Concerns

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Purpose of Session

- To discuss the purpose of data coupling analysis and control coupling analyses
- To discuss common problems in satisfying Objective 8 of Table A-7
- To discuss potential solutions
- To discuss anticipated future trends and needs in this technical area

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Overview of CAST White Paper

1. Introduction
2. Purpose of Data Coupling Analysis (DCA) & Control Coupling Analysis (CCA)
3. Comment Benefits and Problems with Applying DCA & CCA
4. Common Approaches to DCA & CCA
5. CAST Position

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1. Introduction

- Coverage analyses of data coupling and control coupling applies for Levels A, B, and C software.
- DO-178B defines data coupling and control coupling as follows:
 - ◆ *“Data coupling - The dependence of a software component on data not exclusively under the control of that software component.”*
 - ◆ *“Control coupling - The manner or degree by which one software component influences the execution of another software component.”*

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2. Purpose of DCA and CCA

2.1 SC-167/WG-12's Intent:

- Objective is to address correctness of the implementation relative to the design and ensure coupling coverage of integration testing
- Meiler Page-Jones book, *The Practical Guide to Structured Systems Design*, discusses the following types of coupling:
 - ◆ data coupling, stamp coupling, control coupling, common coupling, and content coupling

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2. Purpose of DCA & CCA (cont)

2.1 SC-167/WG-12's Intent (cont):

- The DO-178B definitions should be used, rather than Page-Jones.
- However, the following correlation is often considered:

DO-178B/ED-12B	Page-Jones
Data Coupling	Data Coupling
Data Coupling	Stamp Coupling
Data Coupling	Common Coupling
Control Coupling	Control Coupling
Control Coupling	Content Coupling

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2. Purpose of DCA & CCA (cont)

2.2 Purpose of Data Coupling Analysis:

- Completion check of the integration testing
- Verify design and architecture were implemented
- Identify and verify data dependencies and interfaces between components
- Evaluate interface depth
- Promotes minimal coupling interdependencies
- Promotes maximum cohesion
- Verify memory management
- Evaluate accurate use of global data and parameters
- Evaluate input/output data buffers
- Bound impact of changes and requirements effects

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2. Purpose of DCA & CCA (cont)

2.3 Purpose of Coupling Analysis:

- Completion check of the integration testing
- Verify design and architecture were correctly implemented
- Identify and verify control dependencies
- Verify correct execution call sequence
- Define & evaluate interface depth
- Assist in verifying scheduling
- Assist in worst-case execution timing analysis
- Bound impact of changes and requirements effect

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3. Common Benefits & Problems

3.1 Benefits of Good Design/Development Practices:

- Provides better awareness of functionality
- Encourages good design, high cohesion and reduced coupling
- Reduces number of test cases needed to cover functionality
- Enables a more efficient and effective change impact analysis

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3. Common Benefits & Problems (cont)

3.2 Problems Applying DCA & CCA:

- Many applicants don't perform the analyses
- DCA & CCA are often lumped together
- The objective is often misunderstood
- The analyses are often shallow and weakly supported
- Tools are not qualified
- Applicants claim that the objective is redundant of other objectives (e.g., MC/DC)

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4. Common Approaches

4.1 Data Coupling Analysis

- Evaluate number, type, range, and order of data to function calls through testing & analysis.
- Minimize and verify use of global data.
- Evaluate read/write access & memory management.
- Data coupling analysis coverage may be a by-product of good normal range and robustness requirements-based tests.

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4. Common Approaches (cont)

4.2 Control Coupling Analysis

- Produce a malicious/rogue process
- Perform call tree analysis/review
- Use qualified tool to build actual call tree during testing & compare to the design call tree
- Use testing to assist control flow analysis (using breakpoints to analyze proper operation and sequence)

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5. CAST Position

- More concern of data and control coupling analyses due to:
 - ◆ Increases in software complexity and integration
 - ◆ Increases in the size of projects
 - ◆ Combining formerly separate functions, use of partitioning , protection mechanisms
 - ◆ Increased use of object-oriented technology
 - ◆ Increased use of COTS software
 - ◆ Increased reliance on tools
 - ◆ Proposals for unconventional methods
- Data coupling analysis and control coupling analyses must be performed for Software Levels A, B, and C applications.

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What Comments Do You Have on the CAST Paper?

- Edit On-Line ...

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What Problems/Difficulties Have You Witnessed in Applying DCA & CCA?

- ...

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What Solutions/Ideas Have You Found To Address Concerns?

- ...

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What Concerns Are There in the Future Regarding DCA & CCA?

- ...

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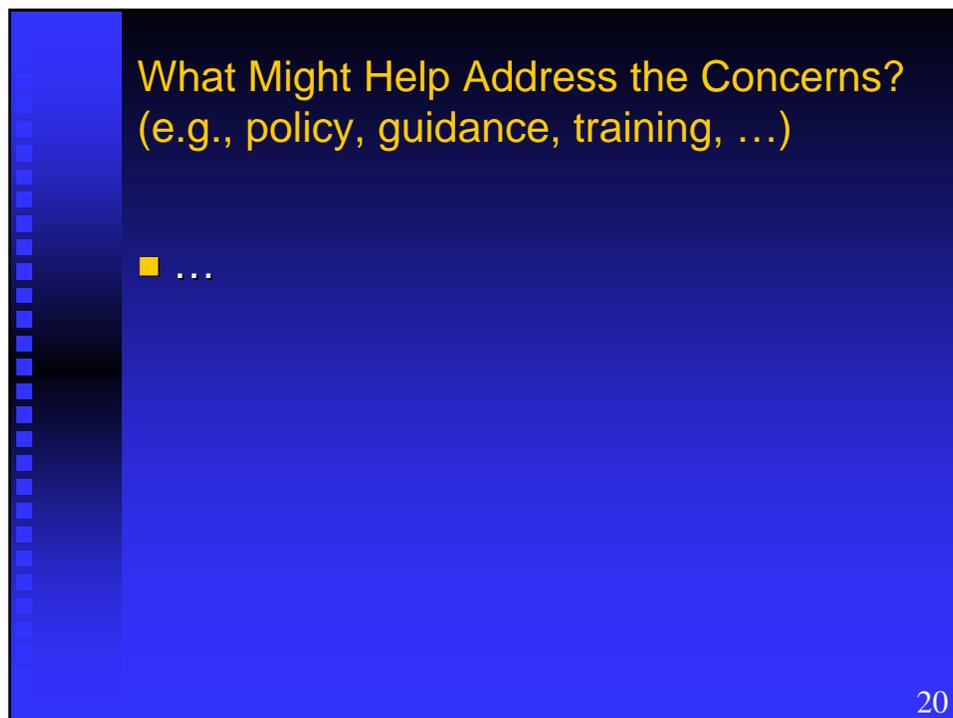


Other Thoughts/Concerns?

- ...

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What Might Help Address the Concerns?
(e.g., policy, guidance, training, ...)

- ...

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