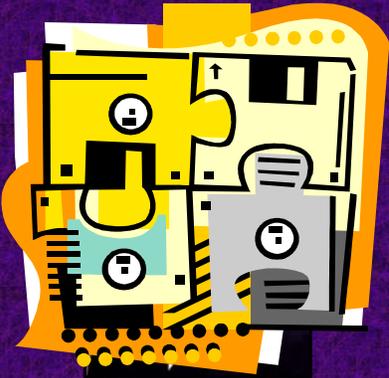


# 2003 FAA National Software Conference

## Software Reuse Policy and Guidance



### Software Reuse *FAA Policy & Guidance*



Leanna Rierson  
September, 2003



### Acronyms

• AC	Advisory Circular
• ACO	Aircraft Certification Office
• COTS	Commercial-off-the-shelf
• FAA	Federal Aviation Administration
• IMA	Integrated Modular Avionics
• IVT	Interactive Video Teletraining
• LRU	Line Replaceable Unit
• OO	Object-Oriented
• PR	Problem Report
• PSAC	Plan for Software Aspects of Certification
• RSC	Reusable Software Component
• RSCD	Reusable Software Component Developer
• RTOS	Real-time operating system
• SAS	Software Accomplishment Summary
• SCI	Software Configuration Index
• SW	Software

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## Software Reuse Policy and Guidance



### Presentation Overview

- **Software Life Cycle Reuse**
  - Overview Chapter 12 of Order 8110.49
- **Software Component Reuse**
  - Why the AC is needed
  - Common misconceptions regarding AC 20-RSC
  - Overview of AC 20-RSC
  - Experience using the AC 20-RSC concept
  - Summary of changes made due to public commenting process
  - Status
- **Other Reuse-Related Activities**



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# Order 8110.49 (Chapter 12)

Title of Order: Software Approval Guidelines  
Title of Chapter 12: Approving Reused Software Life Cycle Data  
Date of Release: June 3, 2003

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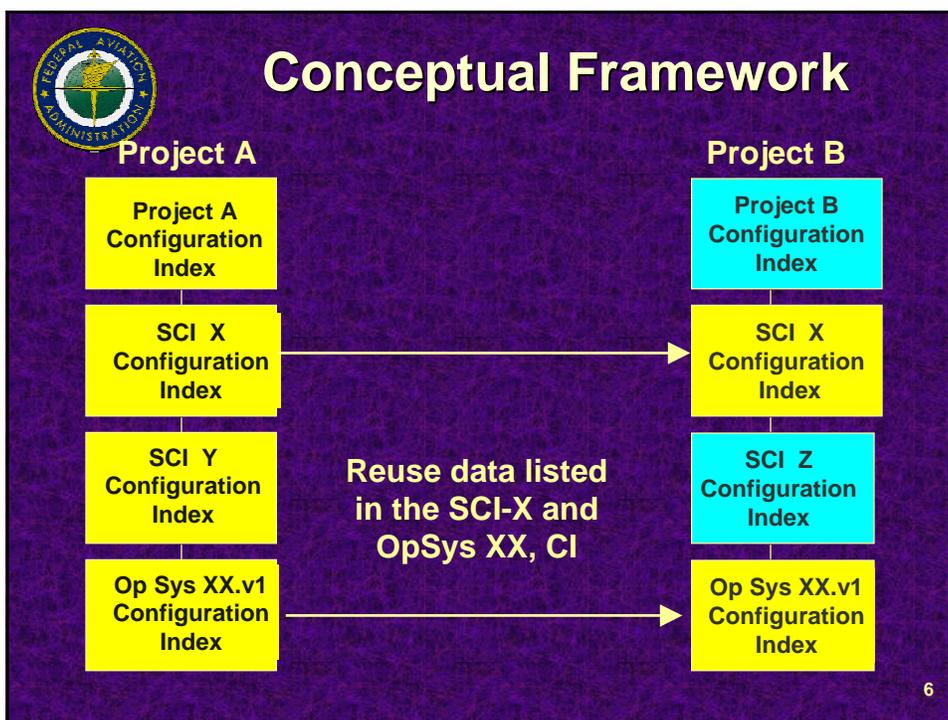
## Software Reuse Policy and Guidance



### Order 8110.49 (Ch 12) Overview

- Based on Notice 8110.97
- Addresses reuse of software life cycle data within a company
- Outline:
  - 12-1: General
  - 12-2: Software Suitable for Reuse
  - 12-3: Safety Considerations
  - 12-4: Factors Affecting Reuse
  - 12-5: Reuse Approval Guidelines
- Good packaging is needed to effectively reuse software life cycle data.

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## Software Reuse Policy and Guidance



### 12-2: Software Suitable for Reuse

- Software plans and standards
- Tool qualification data
- Software libraries
- Software requirements, design, code, verification procedures, and verification results.
- Configuration items
- *Basically: any unchanged software life cycle data*

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### 12-3: Safety Considerations

- **FAA can approve for reuse if:**
  - There is no adverse effect on original systems safety margins, and
  - There is no adverse effect on original operational capability **UNLESS** accompanied by justifiable increase in safety.

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### 12-3: Safety Considerations (cont)

- **FAA will not approve for reuse if reuse:**
  - Adversely affects safety,
  - Exceeds a pre-approved range of data or parameters, or
  - Exceeds equipment performance characteristics.

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### 12-4: Factors Affecting Reuse

- a. **Any Section 11 data can be reused if:**
  - It remains unchanged
  - It is applicable to the project
  - No safety issues exist
- b. **In-service problems might limit reuse. Open problems reports should be analyzed prior to reuse**

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### 12-4: Factors Affecting Reuse (cont)

**d. Assessment should be performed to show similarity of operational environment and safety assessment**

- Builds on a and b



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### 12-5: Reuse Approval Guidelines

- **Certification authority should ensure that:**
  - Data to be reused is unchanged.
  - The software level is equivalent to (or less than) software level of the previous approval.
  - Range & data type of inputs are equivalent to previous approval.
  - Configuration items are used on the same target environment and in same operational way.

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## Software Reuse Policy and Guidance



### 12-5: Reuse Approval Guidelines (cont)

- **Certification authority should ensure that:**
  - **Equivalent software/hardware integration and system testing conducted on same target and system as previous approval.**
  - **Applicant addressed safety considerations.**
  - **Reuse rationale is documented in "Additional Considerations" portion of the PSAC.**

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### Summary of Chapter 12 of Order 8110.49

- **Reuse of software life cycle data on multiple certification projects is feasible**
- **If a data item hasn't changed and is applicable for the current project, it is a candidate for re-use**
- **Present plan for reuse in PSAC and get early ACO agreement**

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## Software Reuse Policy and Guidance



# AC 20-RSC

Title: Reusable Software Components (RSC)  
Target Release: Sept/Oct 2003  
Briefing Based on: Draft 9 (8/11/03)

Goal: *To be able to carry certification "credit" for reusable software component from one project to the next*

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## Why Is This AC Needed?

- To support IMA concept, where reuse is critical
- To optimize use of FAA and applicant resources
- To provide guidance for third party manufacturers who may not have certification experience
- To ensure that all applicable DO-178B objectives are met for reusable components

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## Software Reuse Policy and Guidance



### Addressing Some Misconceptions About This AC



- It is not an “approval”
- It does not release the applicant from responsibility
- It will likely require additional resources from FAA and applicants on the first use of an RSC

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### Addressing Some Misconceptions About This AC (cont)

- It is not easy
- The certification authority may need to do additional review activity on an RSC if safety, operational, or function issues exist
- An RSC acceptance letter does not mean all the DO-178B objectives of the RSC are met yet

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## Software Reuse Policy and Guidance



### AC Overview

- **1-4: Purpose, Background, Related Documents, & Document Overview**
- **5: Discussion & General Guidelines**
- **6: Guidelines for the RSC Developer**
- **7: Data Supplied to RSC Integrator and/or Applicant**
- **8: Guidelines for the Integrator and Applicant**
- **9: Expectations from Certification Authorities on the First Use of the RSC**
- **10: RSC Acceptance Letter**

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### AC Overview (cont)

- **11: Expectations from Certification Authorities on Subsequent Use of an Accepted RSC**
- **12: Common Software Reuse Issues**
- **13: Changes to RSCs**
- **14: Concurrent use of an RSC**
- **Appendix 1 – Definitions**
- **Appendix 2 – Acronyms**
- **Appendix 3 – Sample Format for RSC Table**

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### Important Definitions

- **Reusable software component (RSC)** is the software code and its supporting DO-178B documentation being considered for reuse. It forms a portion of the software that will be implemented by the integrator/applicant.
- **Reusable software component developer (RSCD)** is the manufacturer of the reusable software component.

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### Important Definitions (cont)

- **Integrator** is the manufacturer responsible for integrating the reusable software component into the target computer and with other software components.
- **Applicant** is the manufacturer seeking certification or authorization of the overall system.

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### 1-4: Purpose, Background, Related Documents, & Document Overview

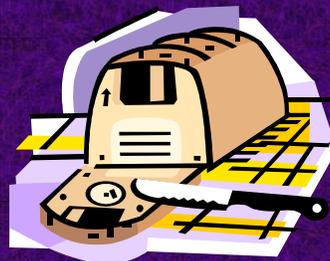
- Traditionally, software approval is at the system level.
- In the past no vehicle to carry certification credit across project boundaries existed.
- Purpose of this AC is to provide guidelines for allowing “credit for DO-178B objectives” across projects.

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### 1-4: Purpose, Background, Related Documents, & Document Overview (cont)

- RSC Examples:
  - Operating Systems
  - Libraries
  - Input/Output Data Files
  - Loading Software
- Guidelines are applicable within a company or across company boundaries.



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## Software Reuse Policy and Guidance



### Section 5 ~Discussion~

## STAKEHOLDERS

Integrator

Reusable Software Component Developer (RSCD)



Applicant

Certification Authorities

Note: Cert authorities may have more involvement than a traditional software development project for the initial component development.



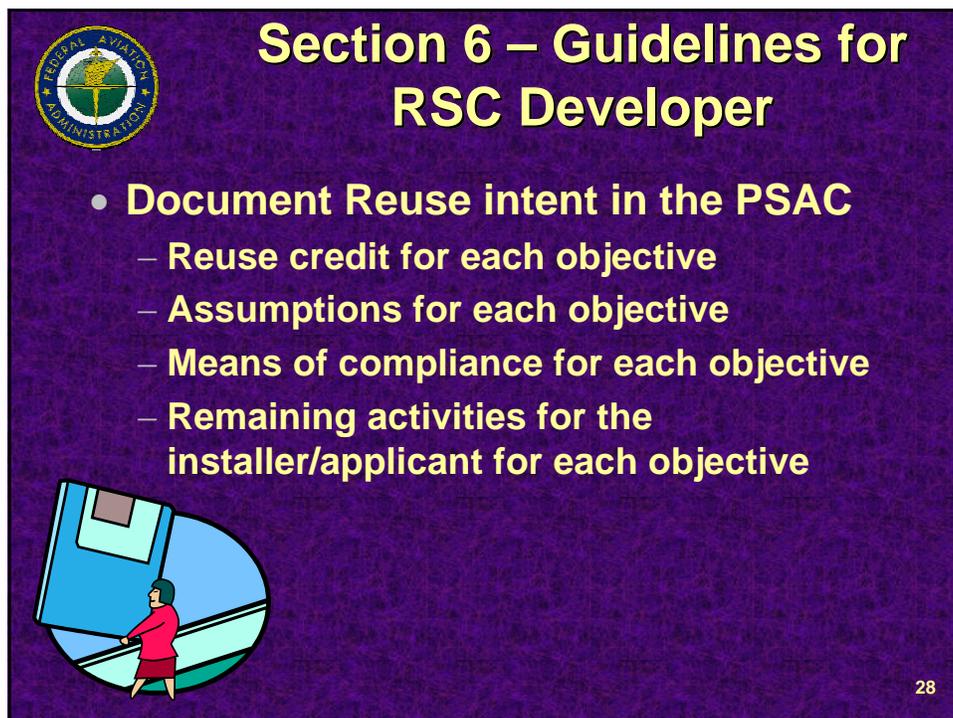
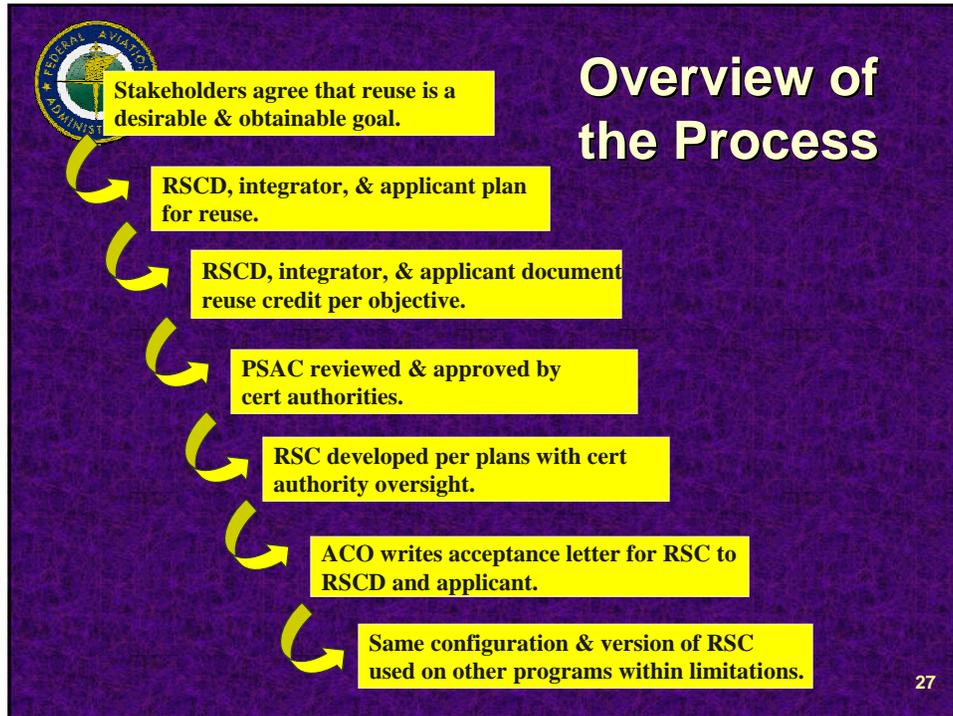
### Section 5 (cont) ~Discussion~

- **Scoping the RSC guidelines:**
  - 5a – First acceptance of RSC is a “real” project
  - 5b – Stakeholders agree on reuse
  - 5c – Each project is unique and might have different “credit”
  - 5d – Applicant is responsible for final cert

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**Section 6 – Guidelines for RSC Developer**

- **Document Reuse intent in the PSAC**
  - Reuse credit for each objective
  - Assumptions for each objective
  - Means of compliance for each objective
  - Remaining activities for the installer/applicant for each objective



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### Example Approach (Appendix 1)

178B Obj #	Obj Description	Credit Sought	Assumption	Means of Compliance for the Objective	Activities Remaining For Integrator/Applicant
1-1	Software development and integral processes activities are defined.				
1-2	Transition criteria, inter-relationships and sequencing among processes are defined.				

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### Example Approach (cont)



- Document objective, credit sought, assumptions, and remaining activities in the PSAC and Accomplishment Summary.
- Address target dependencies.
- Address assumptions regarding requirements; particularly high-level requirements.
- Be specific and thorough.
- Obtain FAA input & agreement on proposals up-front.

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### Example Approach (cont) [Full Credit]

- Objective 1-1: **Software development and integral processes activities are defined.**
- Credit Sought: **Full**
- Assumptions: **Plans are completed and unchanged for router.**
- Remaining Activities: **Applicant/integrator to complete LRU level plans, reference router plans/data, & consider reuse in "Additional Considerations"**

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### Example Approach (cont) [Partial Credit]

- Objective 2-1: **High-level requirements are developed.**
- Credit Sought: **Partial**
- Assumptions: **Assuming high level requirements are document XXX, revision - and the LRU manufacturer uses those requirements.**
- Remaining Activities: **Because the high-level requirements actually exist at the LRU level, they cannot be fully implemented at the software component level. The applicant may reference and tie to the component-level high-level requirements as their own high-level requirements. If this occurred, the applicant would also need to verify the high-level functionality of these requirements in their system.**

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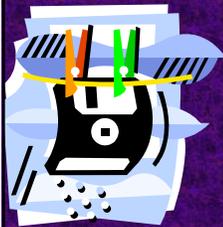
### Section 6 – Guidelines for RSC Developer (cont)

- Document safety-related issues
- Coordinate plans with all stakeholders & follow them
- Submit SAS and SCI at end of project, with the completed compliance tables
- Supply data to support the type design to the applicant (per Section 7)

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### Section 8 - Guidelines for RSC Integrator/Applicant



- Integrate RSC data into the project data
- Specify the life cycle data needed from the applicant
- Consider safety issues of the RSC
- Coordinate & follow plans
- Consider open PRs of the RSC
- Validate assumptions made by the RSC developer
- Complete the RSC objectives tables in the SAS

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### Section 9 – Expectations From Cert Authority on 1<sup>st</sup> Approval of the RSC

- Involvement with all stakeholders
- Involvement of technical experts, as needed
- Review plans of RSC developer and 1<sup>st</sup> applicant for consistency
- Perform on-site & desk reviews, as needed
- Approve project, when objectives are satisfied
- Write letter for RSC developer explaining acceptance, limitations, etc. (per Section 10)

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### Section 11 – Expectations From Cert Authority on Subsequent Use of RSCs

- Review the acceptance letter
- Contact ACO engineer who did the original acceptance, if needed
- Ensure that the applicant follows the guidelines of this AC
- Perform reviews of project plans and data
- Ensure consistency between RSC plans/data and applicant's plans/data
- Inform original ACO of subsequent use/approval of RSC

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### Section 12 – Common Issues & Considerations

- Requirements definition
- Re-verification
- Interface
- Partitioning/Protection
- Data and Control Coupling
- Use of Qualified Tools
- Deactivated Code

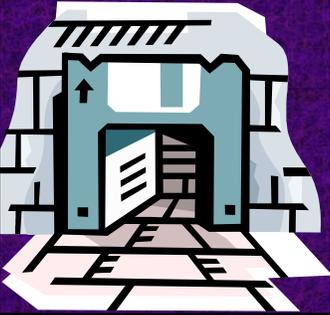


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### Section 13 – Changes to RSCs

- When RSC is changed, cannot be reused without another reuse application.
- Change impact analysis should be performed on changes to RSCs
  - Info from Order 8110.49 on change impact analysis is repeated, because we could not reference the Order in the AC



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### Section 14 – Concurrent Use of An RSC

- **RSC Developer Should Create a “Reuse Plan” including:**
  - List of known applicants
  - Policy for addressing additional applicants in the future
  - Schedule for upcoming projects
  - Reuse approach
  - Software life cycle data being developed
  - Summary of unchanged data to be used by applicants and any user-specific data

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### Section 14 – Concurrent Use of An RSC (cont)

- **“Reuse Plan” includes (cont)**
  - Suggestions for optimizing FAA and applicant resources. For example:
    - ♦ Suggested ACO to lead the effort (based on applicant locations and schedules)
    - ♦ Suggested approach for performing software reviews
  - List of affected applicants & ACOs
  - Plan for informing and keeping users up-to-date as the RSC develops

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### Section 14 – Concurrent Use of An RSC (cont)

- “Reuse Plan” should be coordinated with affected ACOs, applicants, and integrators.



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### Experiences Using the RSC Concept To Date

- Several Real-Time Operating Systems (RTOS)
- A Communication Stack
- A Piece of the NexComm System (the vocoder)
- A C++ Library



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## Software Reuse Policy and Guidance



### Changes to The AC Due To Public Commenting

- Several editorial changes.
- Added a point to emphasize that acceptance of an RSC for one project does not guarantee acceptance on a subsequent projection. Installation, safety, operational, functional, and performance considerations must be considered on each project. Additionally, the compliance to all applicable RTCA/DO-178B objectives and regulations must be addressed by every applicant on their particular project.

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### Changes to The AC Due To Public Commenting (cont)

- Added a note address AC applicability to tools.
- Added a point to emphasize that on international programs there may be additional issues to address.
- Modified the safety assessment info to be provided by the RSC developer. Now focuses on interface and vulnerability analysis. To be used by integrator/applicant in their safety assessment.

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## Software Reuse Policy and Guidance



### Changes to The AC Due To Public Commenting (cont)

- Emphasized that RSC applicant will need to provide verification cases, procedures, and results.
- Emphasized the applicants responsibility when using an RSC. Even with an acceptance letter, the applicant is responsible for demonstrating compliance to all applicable objectives.

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### Changes to The AC Due To Public Commenting (cont)

- Changed “coupling and cohesion” section to “data and control coupling analysis”.
- Added a point in the concurrent reuse section to address an approach for future users that may not be known when the “Reuse Plan” is submitted (i.e., a process for reuse).
- Added a sentence to state that for concurrent projects, the first ACO to have a project using the RSC will typically be the focal point.

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## Software Reuse Policy and Guidance



### Changes to The AC Due To Public Commenting (cont)



- Added paragraph on “traceability” in the common reuse issues (section 12)
- Added paragraph on “robustness” in common reuse issues (section 12)

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### Status of AC 20-RSC

- **In Final Stages of AC Completion**
  - Public Comments Have Been Received and Addressed
  - We Are Finishing the Final Editing Stages
  - Should Be Completed in 2-3 Months
- **Interactive Video Teletraining is Scheduled**
  - Oct 29-30, 2003
  - Video Will Be Available Approx 1 month after the IVT

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## Software Reuse Policy and Guidance



### Other Reuse-Related Activities

- ◆ COTS Research
- ◆ OO Research and Handbook
- ◆ Software Service History Handbook
- ◆ Integrated Modular Avionics
- ◆ Tools Research and Reuse

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### Summary



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## Software Reuse Policy and Guidance



### Summary

- Order 8110.49 addresses reuse of software life cycle data within a company
- AC 20-RSC addresses reuse of software components across company boundaries (when the components are unchanged)
- The RSC concept is being used in several projects
- IMA concept will build upon the RSC concept by doing “module qualification”
- AC 20-RSC has been updated, based on public comments and should be completed within 2-3 months.

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