DO-331 Model Based Development and Verification Supplement to DO-178C and DO-278A

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Objectives

- **Objectives for DO-178C suite of documents, including the Supplements:**
  - Promote safe implementation of aeronautical software
  - Provide clear and consistent ties with the systems and safety processes
  - Address emerging software trends and technologies
  - Implement an approach that can change with the technology
  - Industry-accepted guidance for satisfying airworthiness requirements for avionics equipment
Purpose

• **Industry-accepted guidance for satisfying airworthiness requirements for avionics equipment**
  • To provide guidelines for software to comply with
    • Proof of no intended function
    • Proof of performance in an avionics LRU installation
  • To provide agreed criteria consistent with civil certification authorities
  • By treaty agreement, this applies to NATO nations and any other countries recognizing this set of guidelines for aviation software

• **Results Needed**
  • Agreed criteria for airworthiness certification requirements for software that doesn’t differ from one person or certification authority to another
  • Allows for recognition of an aircraft model capability by air traffic control for airspace access and interoperability
    • This last is an issue for all military aircraft
Information flow between System & SW life cycle processes

Context for use of DO-331 MBD

More detailed information flows are noted in backup charts.
DO-331 MBD Fundamentals - 1

• Its about identifying the “safe-subset” use of MBD technology to be used in safety related applications
  • Same role as the suite of DO-178C documents
  • It applies “error class analysis” to determine what needs to be considered for MBD projects to confirm best known practices and proof of safety

• Its about using suitable graphical engineering methods to design a software system
  • The ability create graphic representations of requirements, architecture and designs has existed for some time
  • Visual format promotes better understanding of the system and its interactions
  • The use of graphics has been refined with semantics of notations with more rigorous syntax and less ambiguity – leading to the use of analysis techniques on models within the modelling environment to remove errors early in the lifecycle
Clear distinctions are made between 2 types of graphical models:

- Specification Models – Defining high level requirements without implementation, software architecture, or data flow and/or control flow

- Design Models – Defining architecture and design (low level requirements)
  - If code can be written from the model, then it is considered a Design Model
  - A Design Model must have parent requirements in scope of the DO-178C development process

Note that Systems Engineering may be the author of a Specification Model and therefore subject to meeting the objectives of DO-331 for that model
Determining which artifacts will be in a model drives the determination of applicable objectives and activities

- If the model is defining requirements without indicating how it will be accomplished, then the Software Requirements Document (SRD) becomes the location for that model
- Detailed architecture, data and control flow, implementation and performance form the content of the Software Design Document (SDD)
- A MBD area of a system will continue to include:
  - Full requirement traceability and model traceability
  - Configuration control including the models and elements used
  - Verification of the models, libraries, and model elements
## Model Usage Examples

1. **Example 1**: Simplest and common use of MBD; the Design Model goes into the Software Design Document (SDD).

2. **Example 2**: The Design Model is developed from the requirements contained in the Specification Model.

3. **Example 3**: The textual description refers to LLR and possibly architecture: DO-178C guidance is applicable to these.

4. **Example 4 and 5**: Separating system and software life cycle data may be difficult: the artifacts may serve for both the systems and software groups. Use the guidance in DO-331 as the compliance criteria for the artifact(s). The MBD guidance for HLR applies to system and software Specification Models, while the MBD guidance for Low-Level Requirements (LLR) applies to software Design Models.

5. **Examples 6 and 7**: These are evolving now and added to provide guidance. These are not currently represented in DO-331, though the planning, activities, artifacts, and relationships are defined in DO-331.

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• **MBD Data Items (beyond the normal items) to be expected in a program:**
  
  • Model Planning
    • How it will be used and how and where it fits into the lifecycle; what Model Standards will be used; the verification approach; simulation - if used for credit
  
  • Model Standards and Techniques
    • The guides for both Specification and Design models, including constraints, instructions, language, symbols used, model element libraries
  
  • Model Element Libraries
    • Each element must be assured to meet the required Software Level as it is a set of executable code that generates a symbol and associated action. A full data package for each library is necessary
    • Unused elements should be removed from the library, unless the standard includes instructions prohibiting use, particularly for unassured elements
• **MBD Data Items to be expected in a program, continued:**
  • Model Coverage
    • Analysis which identifies requirements in a Design Model not verified by requirements testing;
    • This may identify unintended functionality
    • Criteria for this analysis and resolution of issues found must be defined in the planning document
  • Model Simulation
    • This activity exercises the model behavior using a simulator
    • If used for credit, the simulation cases, procedures and results are necessary
Backup Charts

Context required between Systems and Software/Hardware processes
Information flow between System & SW life cycle processes

The data flow between systems, software and hardware are critical to success and should be confirmed.
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