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14595:
Model Based Engineering for
Embedded Test Software Requirements Development

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NDIA
National Defense Industrial Association

Let's talk about…..

Embedded Test Requirements Flow

Iterative Testability Modeling & Analysis

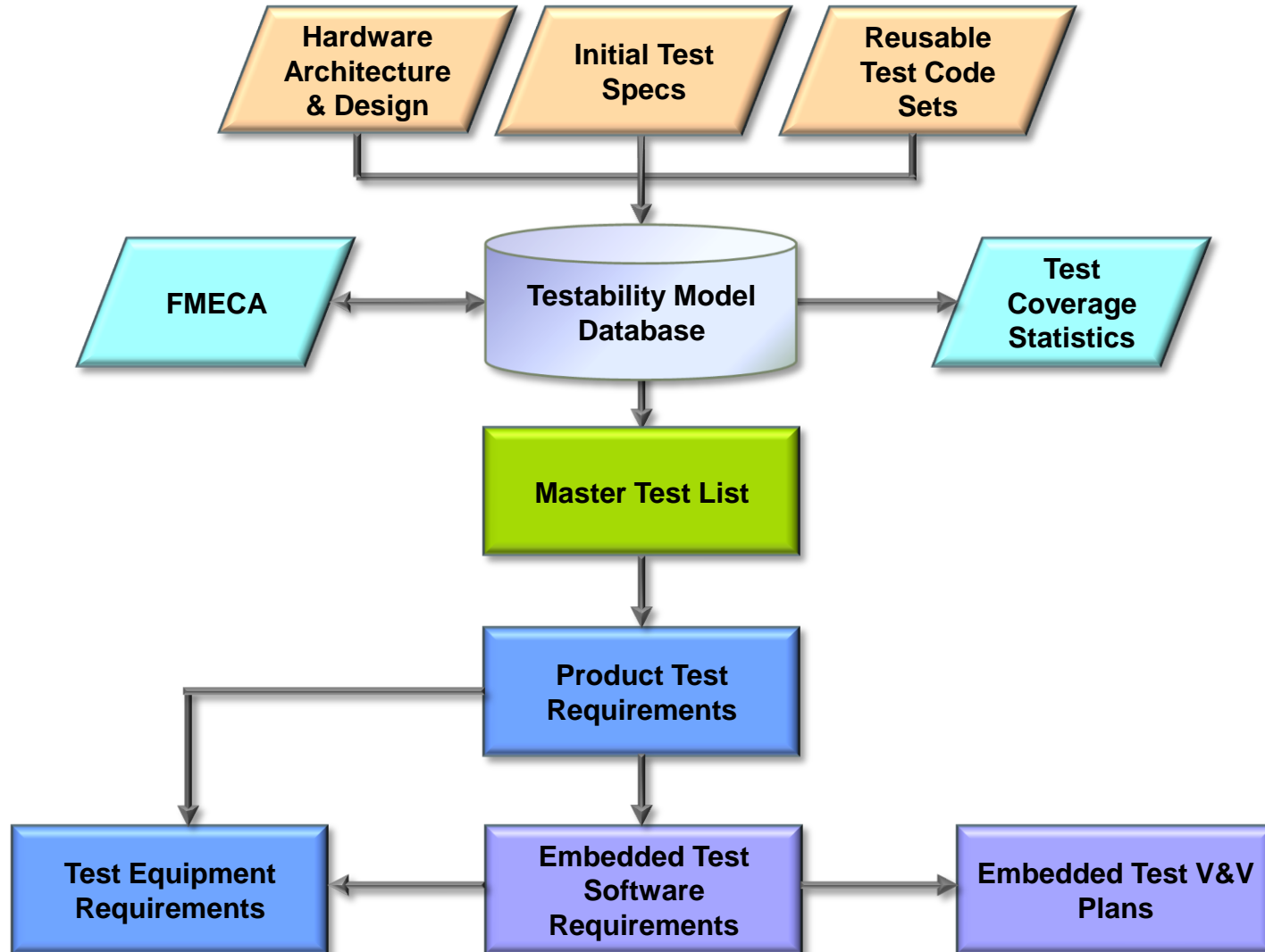Testability Analysis Outputs

Modeled Requirements Export
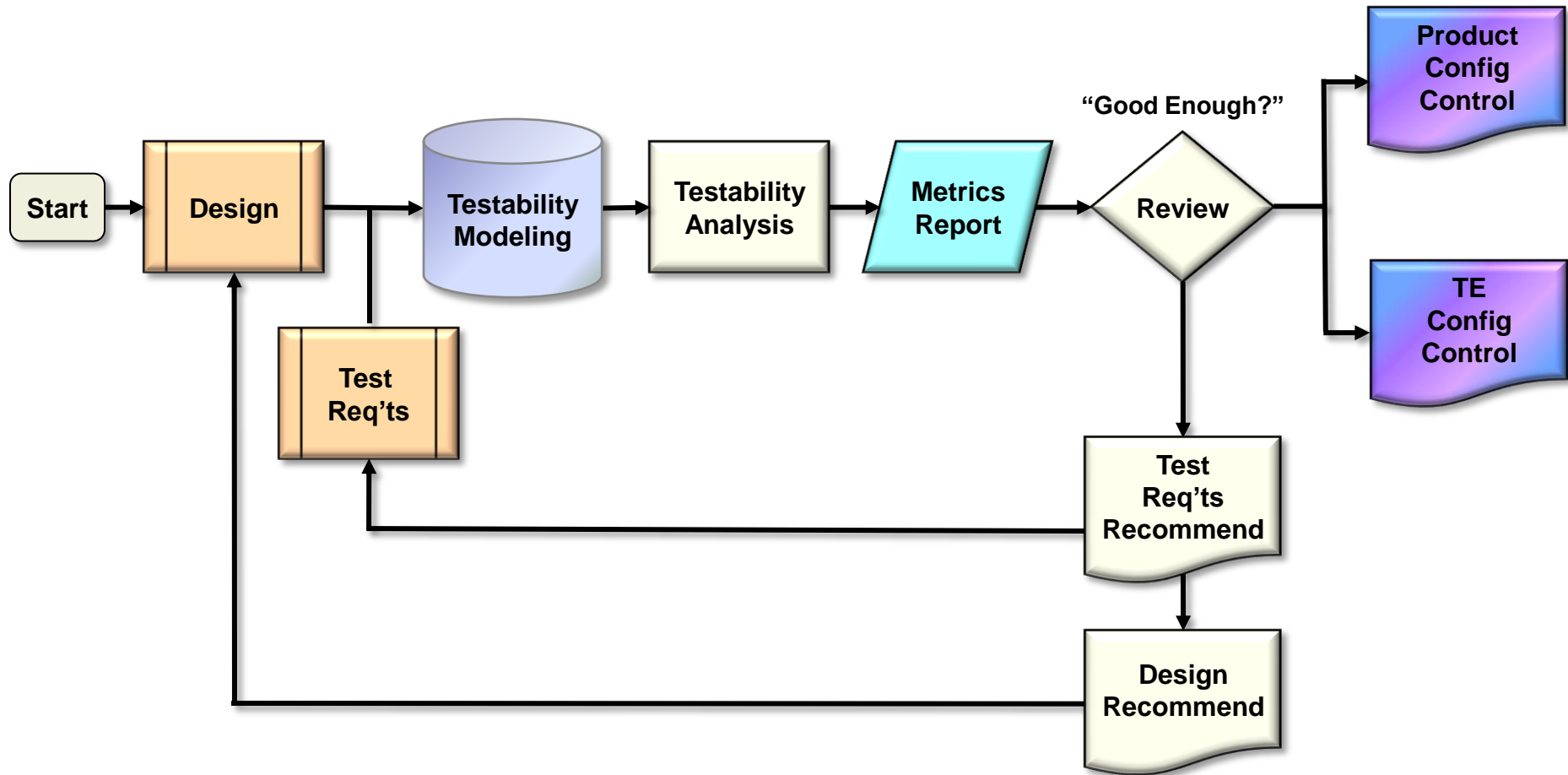
Software Requirements Derivation

Embedded Test Algorithm Development

Embedded Test Requirements Flow

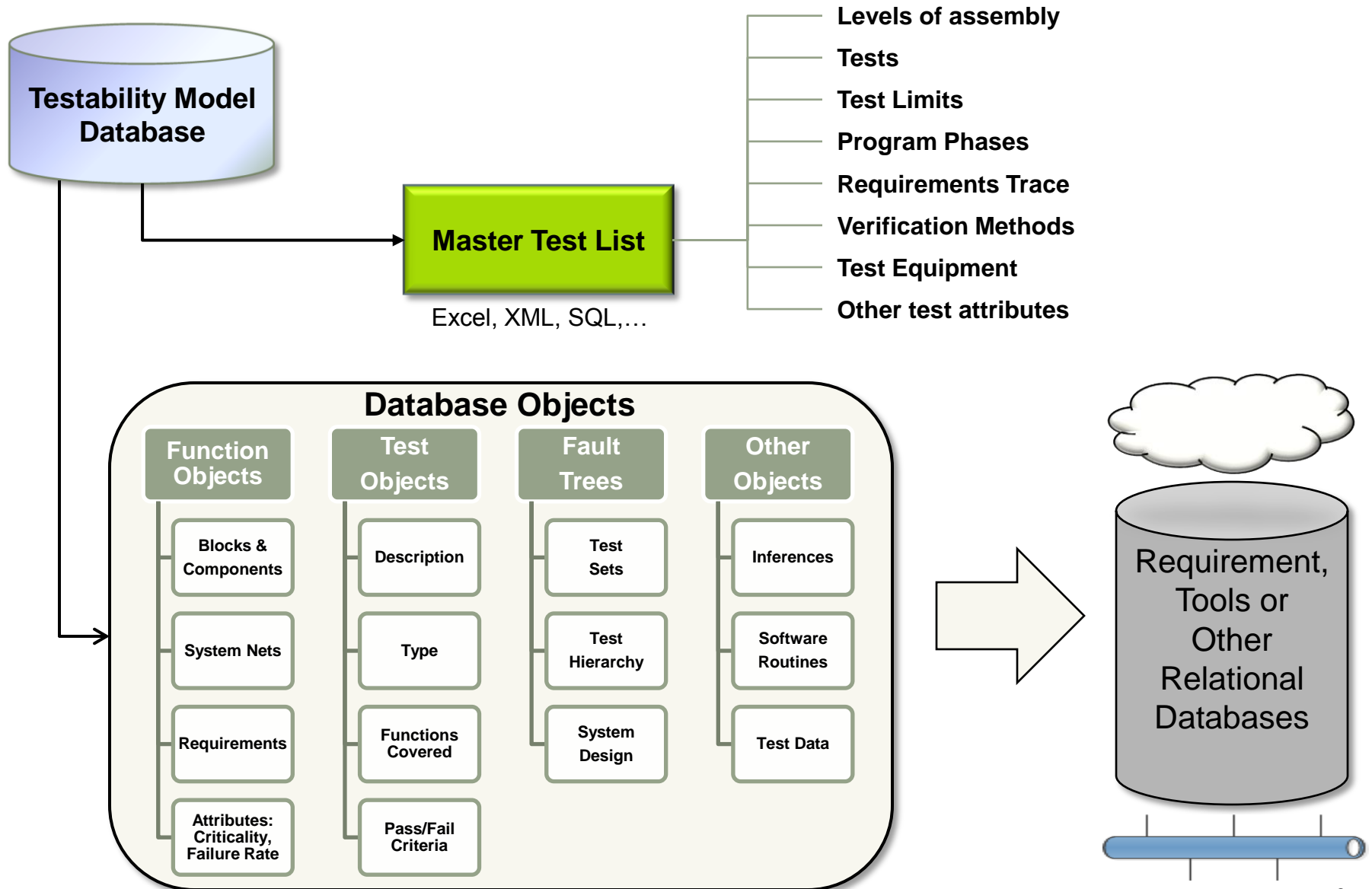# Iterative Testability Modeling & Analysis
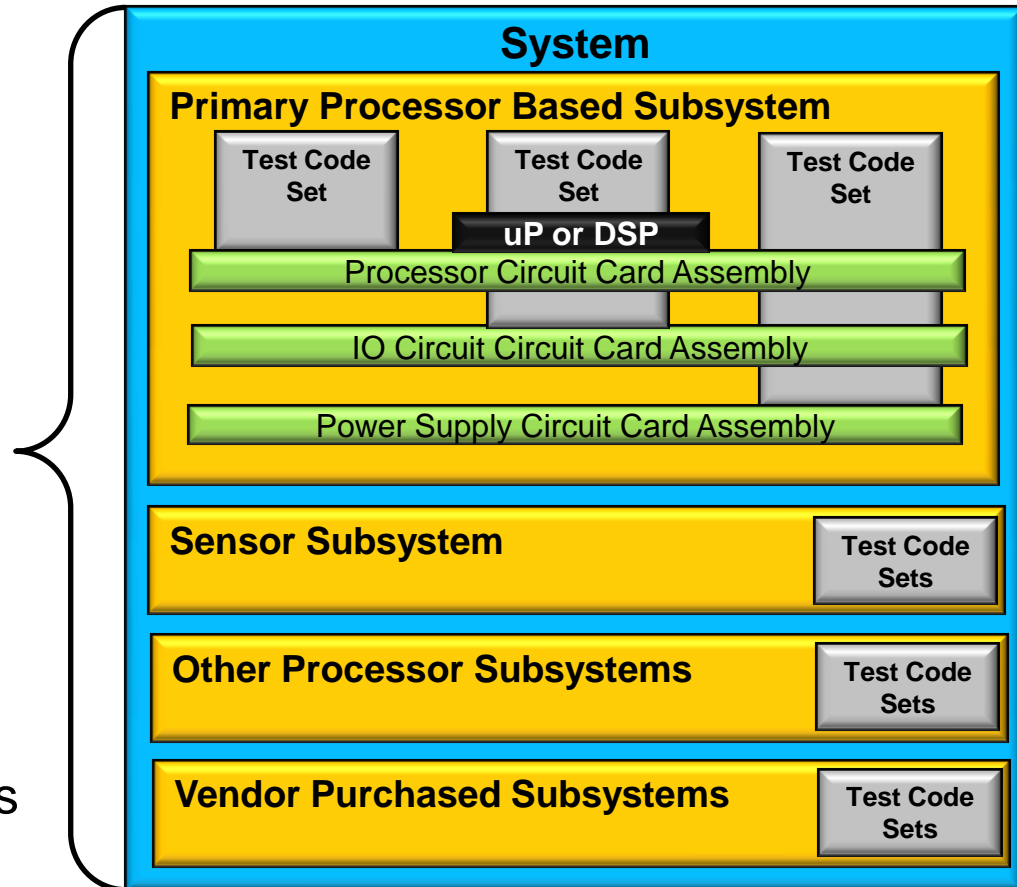
Testability Analysis Outputs

- Determines system functions covered and test methods
  - External test equipment
  - Embedded self-test
  - Assembly verification

- Identifies and analyzes non-detected functions
  - Lack of access or control? Missing requirements?

- Provides recommendations to maximize embedded test, improve fault isolation and minimize cost
  - Conducts stakeholder trade studies
  - Influences hardware requirements to enable embedded test
  - Influences software requirements to control embedded test
  - Facilitates test equipment requirements
  - Helps create interface definitions

- Produces iterative coverage statistics by test type for review

- Maintains a Master Test List by subsystem and level of assembly

- Archives the program Test Strategy & Architecture documentation with decision making history

Modeled Requirements Export

Testability Model Database

Master Test List

Excel, XML, SQL,…

- Levels of assembly
- Tests
- Test Limits
- Program Phases
- Requirements Trace
- Verification Methods
- Test Equipment
- Other test attributes

Database Objects

Function Objects	Test Objects	Fault Trees	Other Objects
Blocks & Components	Description	Test Sets	Inferences
System Nets	Type	Test Hierarchy	Software Routines
Requirements	Functions Covered	System Design	Test Data
Attributes: Criticality, Failure Rate	Pass/Fail Criteria		

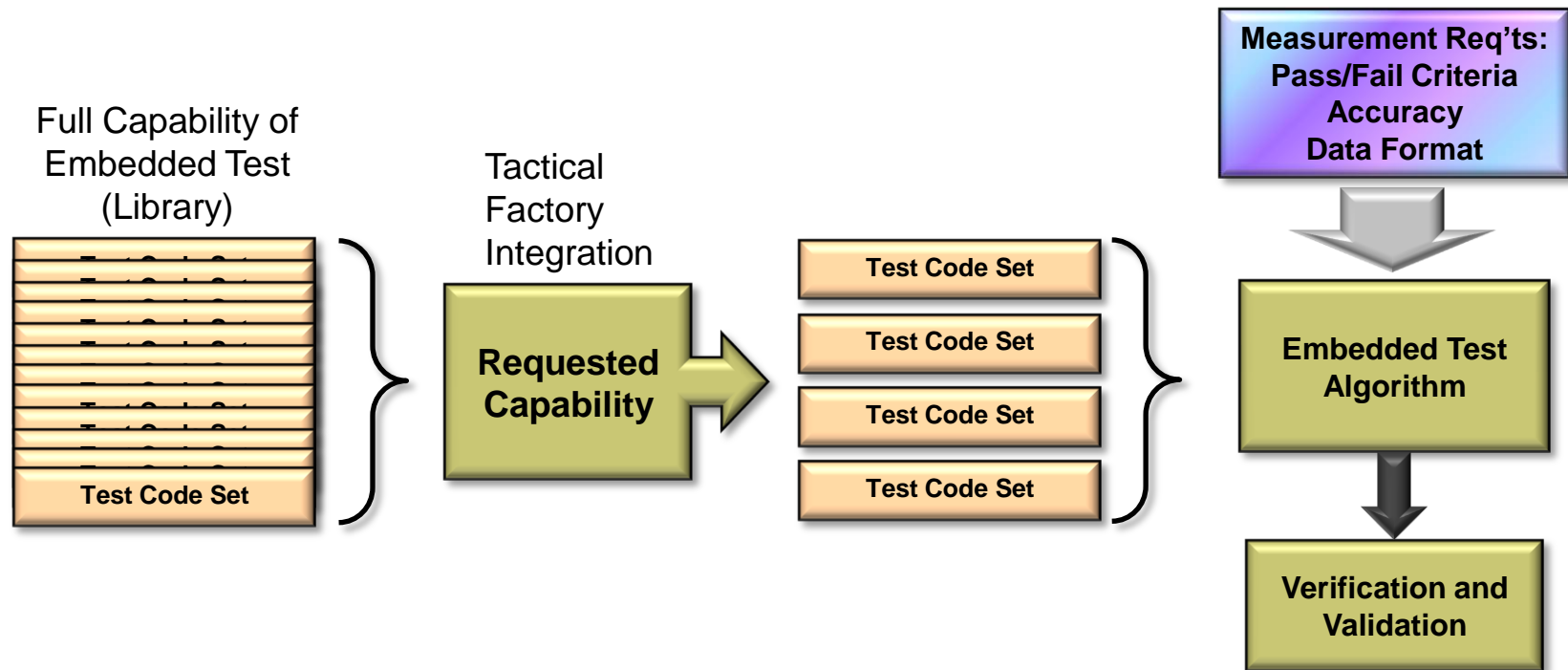Requirement, Tools or Other Relational Databases

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Software Requirements Derivation

- Master Test List is sorted for embedded tests and data is assigned to test requirements documents for each configuration item

- Software Systems Engineer or Architect interprets embedded test descriptions from Master Test List for required software capabilities

- Derived software requirements are added to specification databases and linked for traceability

- Early engineering embedded test code is traced to modeled functions and embedded tests for reuse

- Additional code sets are developed per software specifications

System

Primary Processor Based Subsystem

Test Code Set | Test Code Set | Test Code Set

uP or DSP

Processor Circuit Card Assembly

IO Circuit Circuit Card Assembly

Power Supply Circuit Card Assembly

Sensor Subsystem — Test Code Sets

Other Processor Subsystems — Test Code Sets

Vendor Purchased Subsystems — Test Code Sets

Embedded Test Algorithm Development

Full Capability of Embedded Test (Library)

Tactical Factory Integration

Requested Capability

Test Code Set

Test Code Set
Test Code Set
Test Code Set
Test Code Set

Measurement Req'ts:
Pass/Fail Criteria
Accuracy
Data Format

Embedded Test Algorithm

Verification and Validation

- The full capability of embedded test is contained in the test code sets (Library of objects)
- The requested capability may come from the factory, integration or a tactical requirement
- The code sets are treated as objects and their embedded test applications tagged
- Once the code sets are identified for a given test, the Embedded Test Algorithm will determine the run order
- The Algorithm itself can be modeled as well, e.g. a test tree
- The Algorithm can be an element in the library

Final Comments

- Testability models are not performance models

- Modeling test code to system functions will identify gaps in the code set
  – Measurement accuracy
  – Data format
  – Pass/Fail Criteria

- The test coverage model is used to evaluate and assess changes during iterative, evolving solution development

- The test model provides clarity and early visibility into the embedded test requirements

Embedded Test Modeling accelerates the SW development Life Cycle

Biography

James Brewer

Mr. Brewer is a Test Architect at Raytheon Missile Systems, currently working in Advanced RF Guidance Systems, Model Based Engineering and Virtual Design Environments. James has been with Raytheon since 2007, having spent his 20+ professional years in design, test and project management. His experience spans the product life cycle and the industries of digital electronics, avionics, semiconductors, factory automation and embedded software. He has a Bachelor of Science degree in Electrical Engineering, a Master of Arts degree in Eastern Classics and other post-graduate work in linguistics, philosophy, software and the sciences.

Tim Morrill

Mr. Morrill is an Engineering Fellow and Chief Engineer for the Electronic Subsystems Directorate at Raytheon Missile Systems. Tim has been with Raytheon for 13 years, originally hired into the electronic controls department. He was a Section Manager for 7 years while he worked multiple programs. Prior to Raytheon, Tim worked for Delco Electronics in Kokomo, IN for 5 years. He was the Electrical Design Lead for the 4-wheel steering program that was integrated on the Denali line of SUVs. He worked for Hughes Aircraft Company in Las Vegas, NV for 10 years designing one of a kind Radar systems. Prior to private industry, Tim is a veteran of the USAF.

Leif Robinson

Mr. Robinson has worked for Raytheon 18 years in test equipment design and manufacturing. Leif is co-chair for the Testability Communities of Practice (CoP), is the RMS point of contact for testability software development and received the RMS Excellence in Technology (EiT) award for his work creating new testability methods and processes. He earned his Bachelor of Science degree in Electrical Engineering at the University of Arizona, and has a passion for good BBQ.

Contact Information

James Brewer

Mr. Brewer is a Test Architect and Systems Test Engineering Section Head at Raytheon Missile Systems. James oversees the test development on several programs across the company through his engineering staff and is a direct contributor to Advanced RF Guidance Systems, Model Based Engineering and Virtual Collaborative Design Environments.

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