

Engineering Process for Systems Testability Analysis.



Presentation of an Integrated Process

Contents

- ➤The goal
- >The problems encountered
- ➤ A Solution
- ➤ The implementation
- ➤ Synthesis Conclusion



Contents



➤The goal

>The problems encountered

► A Solution

➤ The implementation



What we want to achieve

- An Enhanced Testability & Diagnostics Modeling Process to:
 - Improved Fault Detection Confidence (FD)
 - Improved Fault Isolation to Optimum Repair Level (FI)
 - Reduced False Alarms / False Removals (FA)
 - Lower Mean Time To Isolate (MTTI)
 - Improved Safety Through Critical Fault Analysis (FMECA)
 - Improved System Availability
 - Reduced Cost of Ownership

Contents

➤The goal



>The problems encountered

► A Solution

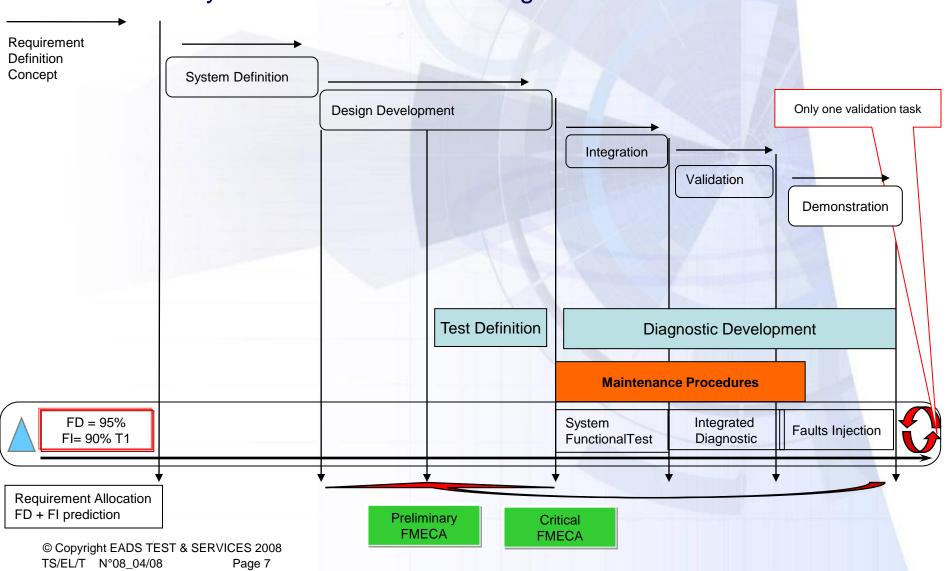
➤ The implementation

EADS TEST & SERVICES Test and Safety Process Test Definition **Availability** Safety Diagnostic Development The missing link Reliability Maintainability Safety Requirements Requirements Requirements To Reduce To reduce the To limit risk **Down Time** number of failures **Fault Detection Test** To reduce ests, BIT, BITE, Reliability Monitoring Repair Time/Cost effectiveness **Fault Isolation Test Testability** Diagnosability Safety Analysis Maintainability **Maintenance** SAFETY **Preventive** Corrective **Prognostics Fault Coverage** Severity Criticality **Isolation Rate Detection Rate**

Engineering process without eXpress



No testability milestone and the missing link.



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➤The goal

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≻A Solution

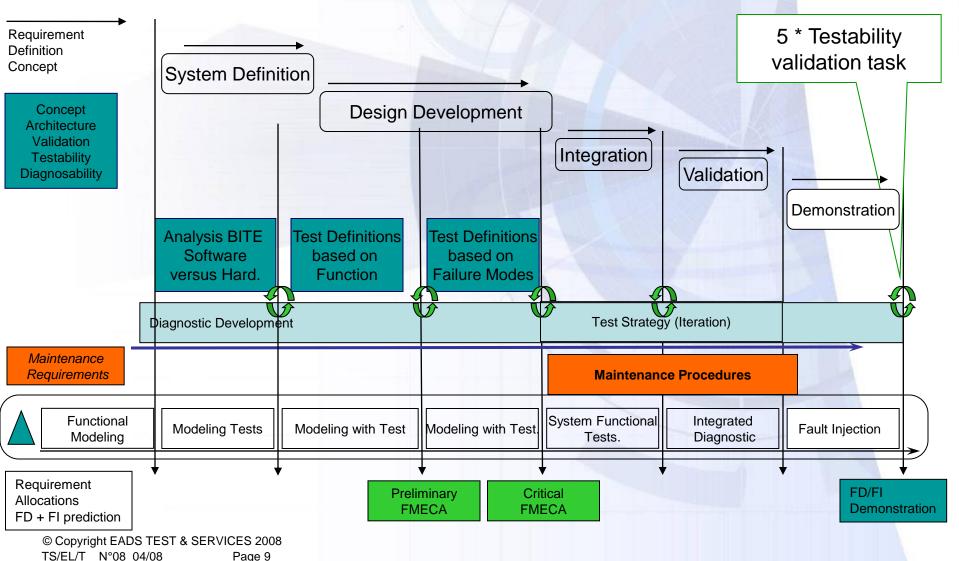
➤ The implementation



Model driven Engineering process







The Integrated process between Safety & Test



- Safety: Building the Faults Catalog through the entire process, combining Top-Down and Bottom Up approaches
 - Top Down: From the early requirements down to the equipment definition
 - Bottom Up: From initial Validation up to Servicing the System
 - All new failure Modes found are integrated from each Test level.
- ➤ Testability: Using the Faults Catalog through the entire process, combining Top-Down and Bottom Up approaches
 - Top Down: From the early requirements down to the equipment definition
 - Bottom Up: The hierarchical Tests (BIT) roll-up to the highest level definition and the Tests are Updated to the latest Fault Catalog.

EADS TEST & SERVICES The Integrated process between Safety EADS & Testability Analysis Modeling phases **Integrated Diagnostic** Diagnostic Environment **Hierarchical Tests** Safety In Service **Definition Analysis** System System Integration **FMECA** Specification Validation Diagnostic **Testability Requirement** Report Diagnostic **Validation** System Validation Integration **Functional Functional** System Validation Design Equipments Equipments **Functional Specifications** Validation **FMECA** Safety Analysis Validation Diagnostic Diagnostic Report Equipment Test Development Equipment Diagnostic Validation Definition Development Validation

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Safety

Analysis

System

Engineering

System

Design

The Integrated Process View toward a Software Framework

Testability

Diagnostic

Developers



Production
Operations
Support

Embedded
Diagnostic

Diagnostic **Test** Test Strategy Model Strategy **Development** Development Execution Level Support NTI1 O Level NTI2 I Level Diagnostic Test Test Safety Analysis **Analysis** Results Results **FMECA Analysis** Collection The goal is to reduce the risk of appearance the critical loops

Test

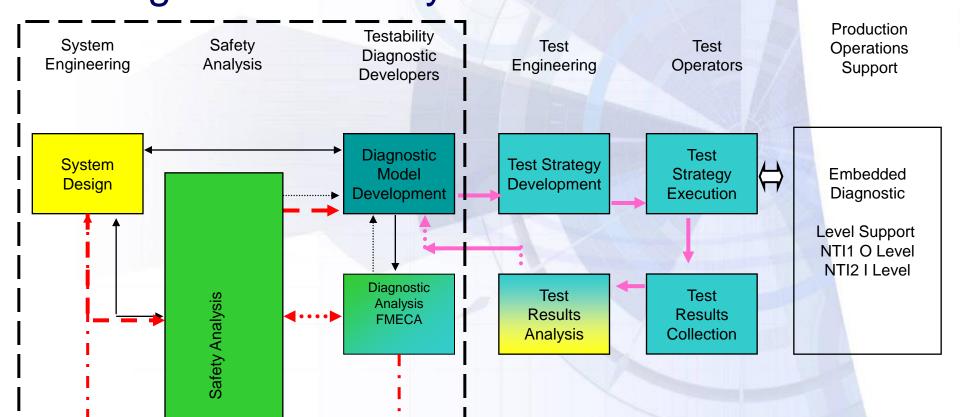
Engineering

Test

Operators

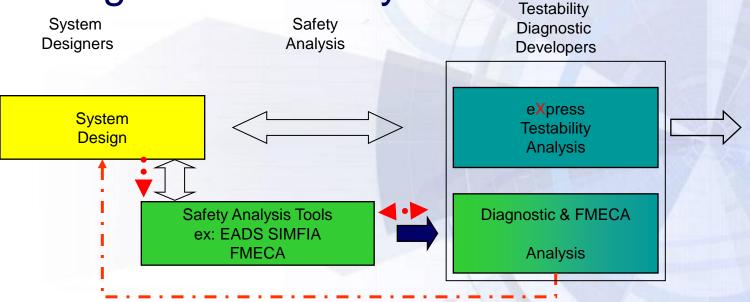
Software Framework from Design to Testability











Test Engineering



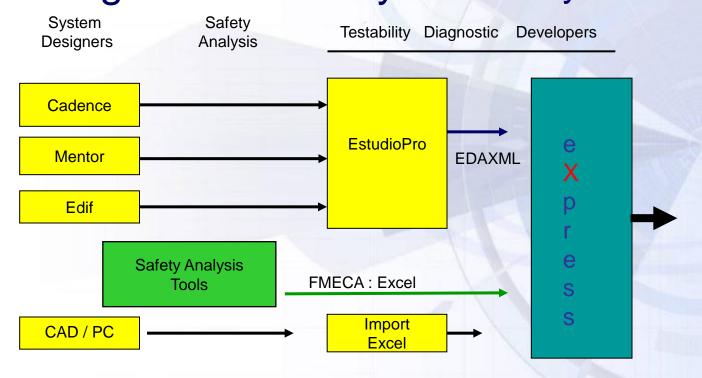
Safety Analysis Tool as SIMFIA can feed the Testability tool with:

- the safety dependency model and the reliability data's
- the Failure Modes and Hierarchical Effects
- the Severity

at the end of the Preliminary & critical FMECA

Software Framework from Design to Testability: Gateways

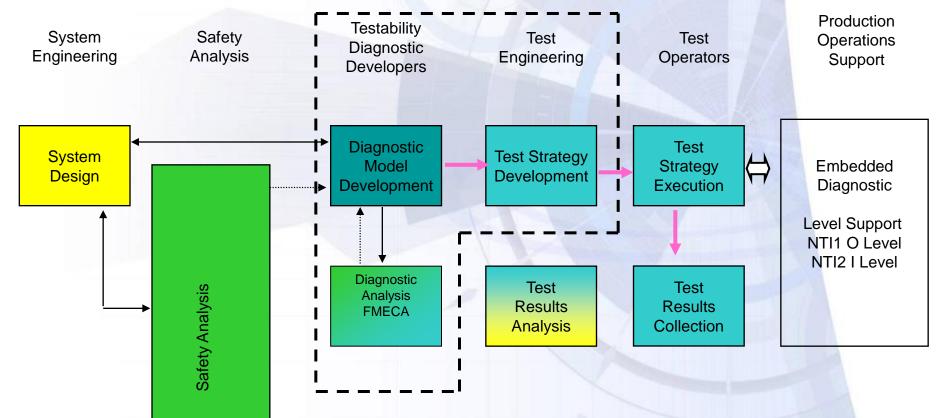




- The CAD multi-schemas are merged through Estudio Pro and imported in eXpress as one Design. Igor Luvishis [igor@elgris.com]
- The Safety Analysis Tools as Relex, Item Software, RAMS are feeding the Testability tool through Tabular FMECA

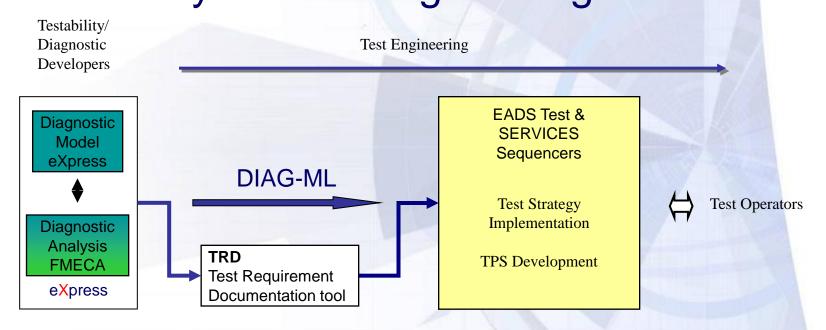
Software Framework from Testability to Test Engineering





Software Framework from Testability to Test Engineering



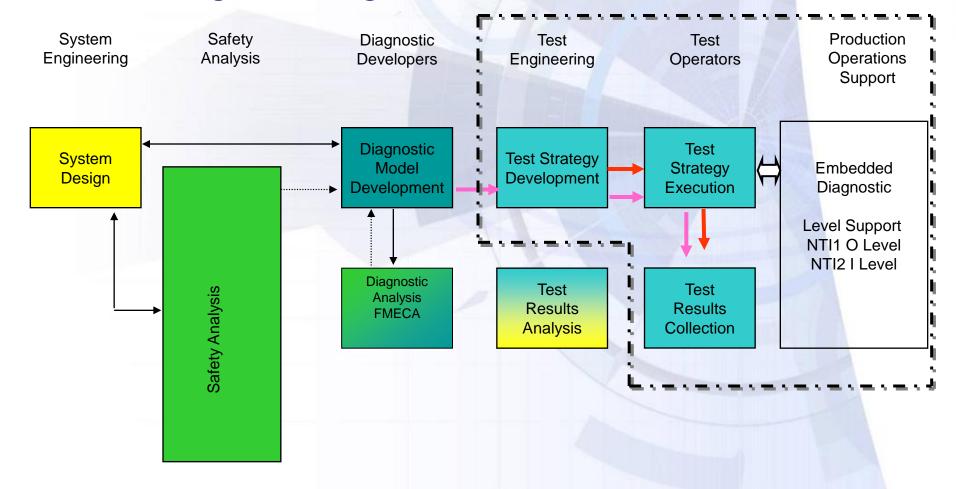


A Testability tool as eXpress is forwarding to the Test Sequencer efficient Test Strategies, for the target System, exporting:

- the UUT Description (hierarchical)
- the Diagnostic Flow Diagram (Detection and Isolation)
- the Test Attributes which can be enhanced with a tool like TRD
- the global Diagnostic Information (Faults Group data).

Software Framework from Test Engineering to Test





Software Framework from Test Engineering to Test



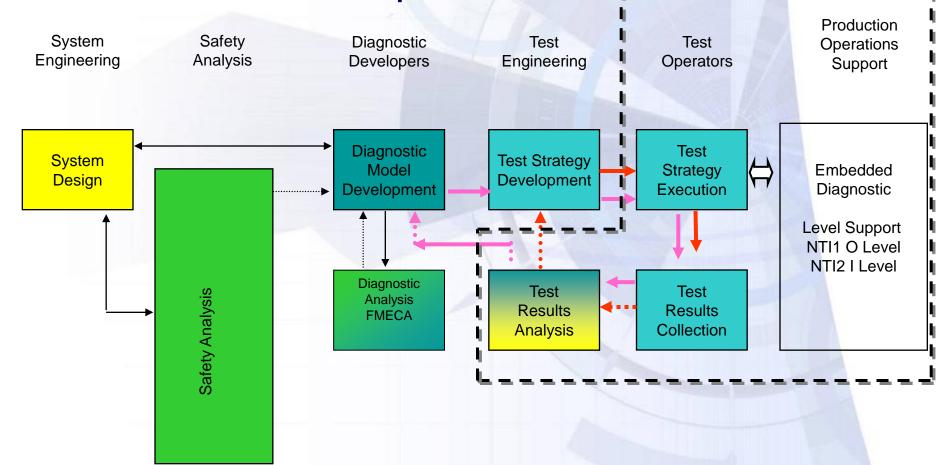
Test Engineering UUT **Test Operators EADS TEST & SERVICES** Sequencers Test **Test Strategy** Production Strategy **Implementation** Operations Execution Information Pipeline Information Pipeline Support Test Results Collection

A Framework integrating an ATML compatible Information Pipeline

- which goal is to reduce development time and maintenance costs by facilitating information exchange
- based on XML Schemas description for information about
 - ➤ Test Station, Instrument, Test adaptor, Tests, Test results, UUT
 - ➤ Diagnostic, Maintenance Information Collection and Analysis

Software Framework from Test to In Service phase





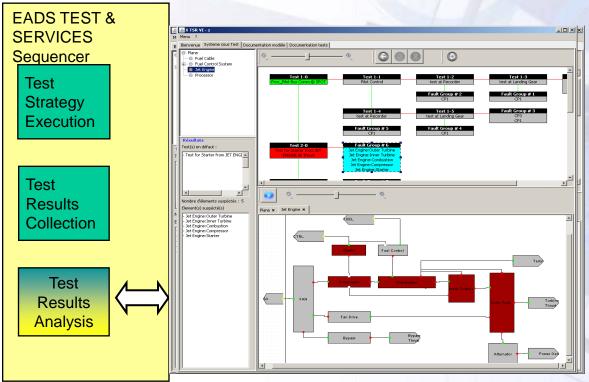
Software Framework from

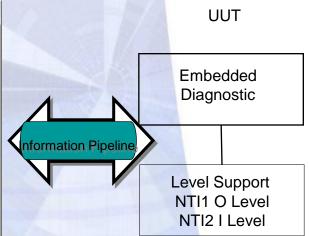
Test to In Service phase

Test Operators



Production Operations Support





A Visualization Interface

Hierarchical Level Indicator

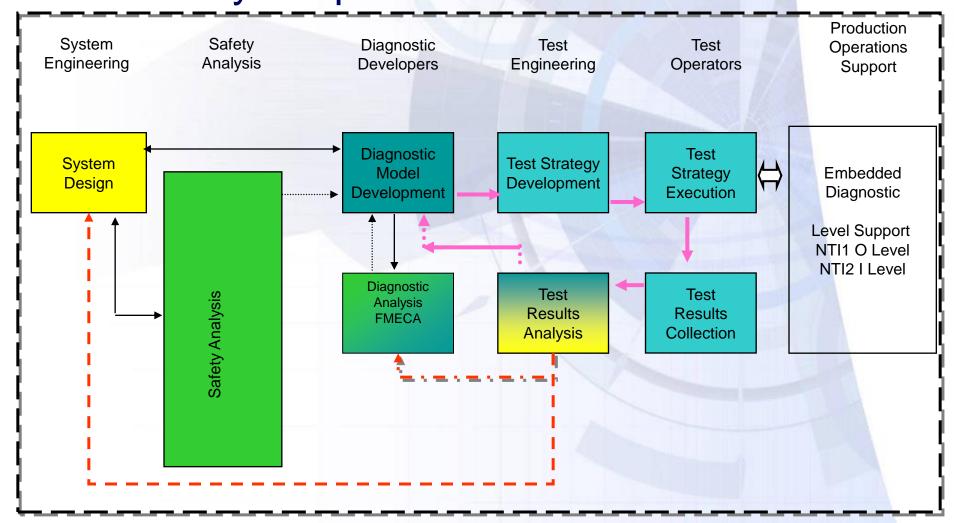
Diagnostic Flow Diagram

Hierarchical Graphical Models Schema

Panel displaying Test / Isolation Results

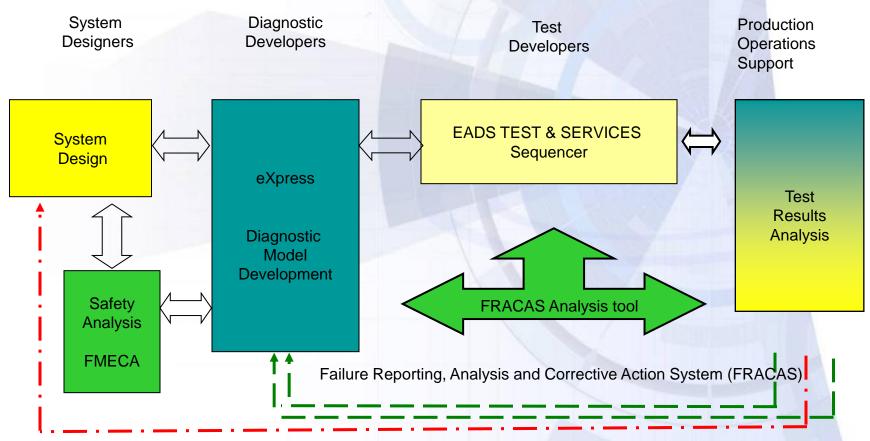
Software Framework Testability Requirements Validation





Software Framework Testability Requirements Validation





Learning from the critical loop

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➤ Synthesis - Conclusion



EADS DEFENCE & SECURITY

Synthesis

➤ Testability tools allows Development of diagnostic models using CAD/CAEE data Diagnostic Model Development and Diagnostic Analysis with FMECA inputs through the V cycle Evaluation of diagnostic performance Generation of Diagnostic Test Strategies to be exported ➤ EADS T&S sequencers allow Test Executive and Run-time execution using multiple test environments Import Diagnostic Test Strategies and ATML XML format definition Schemas ➤ Validation Visualization of the Design and Diagnostic Test Strategies Results, RoEx information's Model Information's, Diagnostic Test Strategies from an extended DIAG-ML

Conclusion



- > The integrated process allows
 - Schematics, FMECA, Tests and Diagnostics
 - Reduction of the total cost of ownership of the system
 - Improved traceability and Quality of Test Coverage (Detection/Isolation) and Test Results Analysis
- ➤ An integrated process is possible in a software Framework including:
 - eXpress
 - EADS Test & Services tools