eXpress™ Newsletter

Volume 16, Number 2 Fall 2010

Inter-Agency Technology Interchange Meeting (IATIM)

Time & Place: Tuesday, December 7, 12:30 PM – 5:00 PM
JT Schmid's Restaurant, Anaheim, CA

Purpose: To discuss how assessments of expected DPHM (Diagnostic/Prognostic Health Management) performance can support requirements for Mission Success, Availability, Sustainment and Total Ownership Cost (TOC).

Discussions:

1. Defining comprehensive Operation and Support DPHM requirements
2. Specifying comprehensive DPHM requirements in contracts
3. Balancing proposal evaluation and awards between design for Mission Success, Sustainment, and Total Ownership Cost with Performance & Acquisition Cost
4. Look at equal weighting of Acquisition Cost, Performance, Sustainment and TOC
5. Effective DPHM solutions

Note: The IATIM is focused on immediate issues facing projects today and the sharing of concerns and supporting technologies between customers and contractors. The goal is, at a minimum, to bring project requirement definitions and allocations to the forefront for recognition and possible follow-on discussions.

Planned attendees:

NAVAIR – U.S. Army – BAE Systems – Northrop Grumman – Boeing – General Atomics – Raytheon – Ridgetop Group

*(Free of charge to **eXpress** Licensees and official DoD Agencies)*

Register NOW or contact DSI for further details

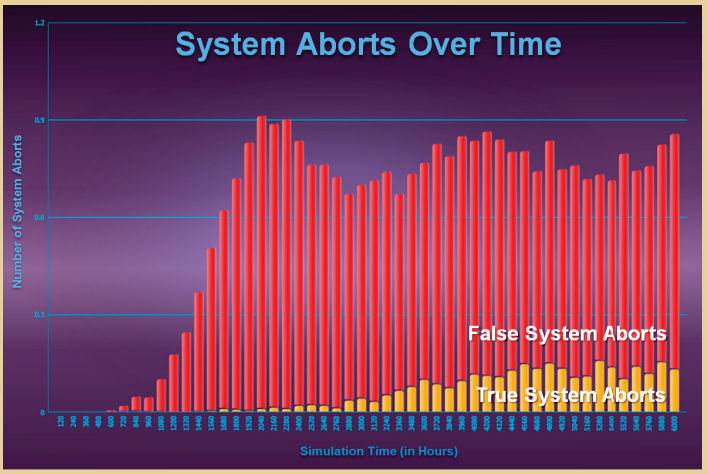
Inside this Issue...

Engineering Analyses: B+ Fielded System: D-

It is unfortunately not all that rare for a system whose Reliability, Maintainability, Testability and other RAMS-T analyses have all met contracted levels, to nevertheless exhibit disappointing performance in these areas when that system is fielded.

Although many reasons can be given for this "gap," the metrics used to characterize expected performance—many of which are ironically both overly-generalized and overly-specialized—often escape scrutiny. These metrics are over-generalized in that they each attempt to characterize a complex category of behavior that evolves over time using a single, easily legislated number (e.g., Availability). They are over-specialized in that they have been designed to be calculated within a particular discipline, ignoring considerations outside of that discipline that might exhibit diminishing returns (e.g., Testability FD/FI).

Given the complex relationships between the various behavior characterized in RAMS-T analyses, it is surprising that trade-off studies are rarely performed to fine-tune the balance between the different aspects of system behavior.



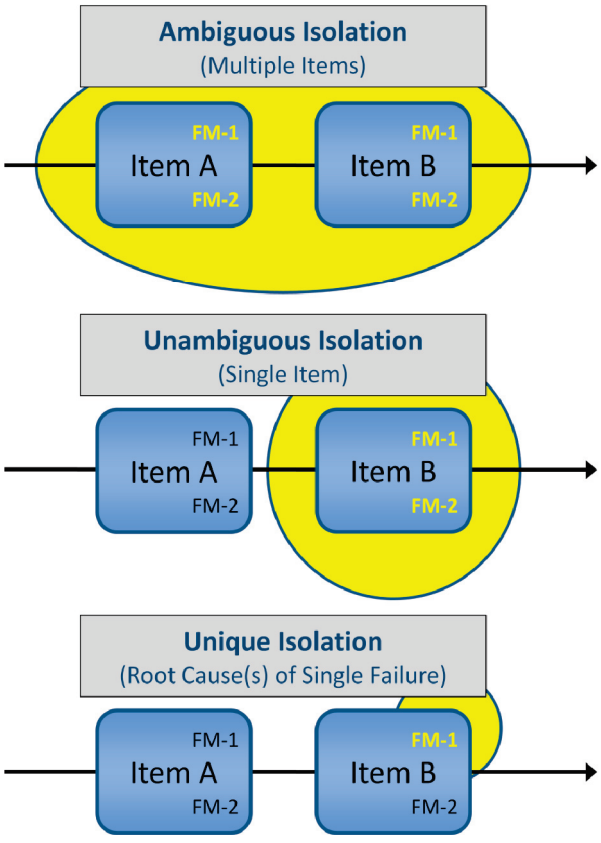
STAGE—DSI's simulation-based tool for the analysis of DPHM (Diagnostic/Prognostic Health Management) performance over time—has been designed to help analysts visualize the gaps between contracted metrics and complex system behavior. Rather than represent its calculations as single numbers, **STAGE** maps behavior over time (although, if desired, Means can still be calculated). Moreover, because it simulates not only failures, but also diagnoses and maintenance actions, **STAGE** calculations cross disciplinary boundaries (such as in the example above, where the diagnostic design is used to identify the possibility of false system aborts). Because results are displayed graphically, various aspects of DPHM performance can be easily compared, balanced and optimized.

"Unambiguous" vs. "Unique" Isolation of Faults

Although most diagnostic engineers working on large-scale government projects are intimately familiar with their contracted fault isolation requirements, very few take a step back and question the "maintenance bias" inherent to those metrics.

Traditionally, "FI numbers" indicate how effectively diagnostics can, when there is a malfunction, determine the specific unit that must be repaired, replaced, adjusted or reconfigured. Alternatively, fault resolution metrics can be used to quantify the expected number of maintenance actions needed to resolve a failure. In either case, failures that cannot be localized to a single item (or eliminated with a single maintenance action) are considered to be "ambiguous." One of the primary goals of diagnostic engineering has been to verify that failures can be "unambiguously" isolated by the diagnostics.

From a maintenance perspective, this is all fine and well. From an operational perspective, however, isolation to the failed item is not always sufficient. Sometimes not only the repair item, but also the specific malfunction of that item must be identified to determine both the severity of the failure and the proper course of action to remediate that failure. In such cases, unambiguous isolation (to the item) is not good enough; diagnostics must be able to uniquely isolate those failures that have mission consequences.



In current practice, there are no standardized metric(s) to insure that a system can uniquely isolate mission-critical failures. This is one of those requirements that has fallen through the disciplinary cracks, so to speak, landing neither within the task set of diagnostic engineers (whose evaluations of diagnostic effectiveness exhibit the maintenance bias described above) nor reliability engineers (whose efforts to diminish the effects of critical failures rarely reference the actual diagnostic design of the system).

Relative Criticality	Diagnostic Coverage				
	Failure Detected	Fault Isolation			
		Uniquely Isolated	Number of Root FMs in Fault Groups	Fault Groups	Fault Group Sizes (Number of Items)
31.2500	Yes	No	10	Fault Group # 84	2
31.2500	Yes	No	10	Fault Group # 84	2
28.6500	Yes	No	20	Fault Group # 4	7
23.4375	Yes	No	4	Fault Group # 89	2
20.8333	Yes	No	10	Fault Group # 84	2
10.4167	Yes	No	9	Fault Group # 91	1
10.4167	No	N/A	N/A	N/A	N/A
10.4167	Yes	No	10	Fault Group # 84	2
10.4167	Yes	No	10	Fault Group # 84	2
10.4167	Yes	No	4	Fault Group # 89	2
10.4167	Yes	No	10	Fault Group # 84	2
10.4167	Yes	No	4	Fault Group # 89	2
7.8125	Yes	Yes	1	Fault Group # 60	1
7.8125	Yes	Yes	1	Fault Group # 73	1
7.8125	Yes	Yes	1	Fault Group # 64	1

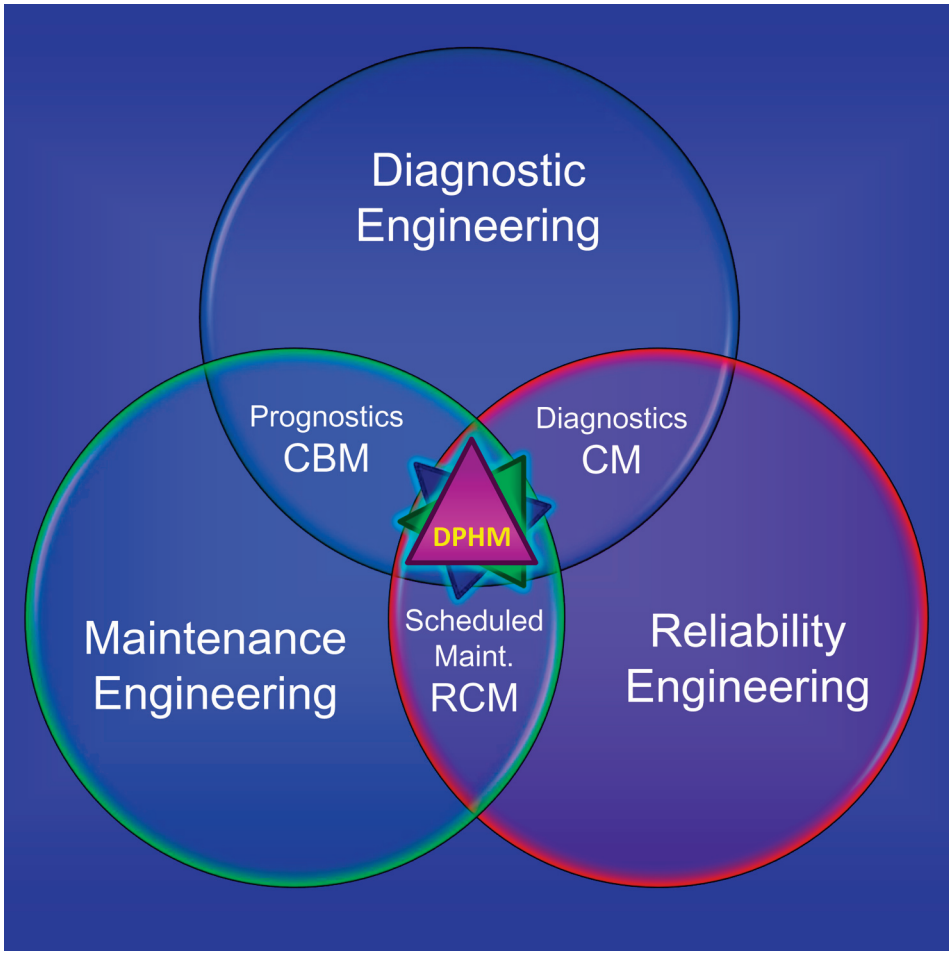
The ***eXpress*** Critical Failure Diagnosis chart includes several fields describing how well critical failures are handled by the current diagnostic design (Note: this illustration shows only the right-hand side of this useful **FMECA Plus** chart).

In the **FMECA Plus** module of ***eXpress***, data from reliability and diagnostic analysis can be combined to provide metrics that neither of the two disciplines are capable of determining on their own. The ***eXpress*** Critical Failure Diagnosis chart, for instance, lists not only how well each individual failure is detected and isolated by the diagnostics, but also whether or not it is "uniquely isolated" (included in a fault group that cannot be isolated due to any other failure). So that the most attention can be directed towards the most critical failures, this chart is sorted in criticality order.

Because **FMECA Plus** charts make use of the same failure modes, effects, rates, and severities that appear in standard FMECAs (data which can all be imported into ***eXpress***), the relative criticality of each fault is calculated from the same data as existing Reliability analyses. However, because the diagnostic information in this chart is based directly on the analysis in ***eXpress***, it is not as "speculative" as some of the diagnostic descriptions (such as Detection Method or Means) that appear in traditional FMECA charts.

The Emergence of Collaborative Engineering

Traditionally, many Concurrent Engineering efforts have been simply a matter of separate departments going about their work in parallel, providing data to each other as needed. In the current design engineering environment—where low-risk, low-cost, high-value investments are the order of the day—the shortcomings of this paradigm need to be brought into focus. What is needed is what we might call *Collaborative Engineering*, where both data and tasks can overlap departmental boundaries and common analyses can influence decision-making in multiple engineering groups. Although *repurposing* has, indeed, become a buzzword of late, DSI has been working hard to address the issue of *multi-purposing*, where the sharing of data and efforts is part of the plan from the start. DSI's analysis toolset (including ***eXpress***, **FMECA Plus** and **STAGE**) has been designed to facilitate the integration of engineering efforts, allowing the different groups to not only share in the savings that result from multi-purposed data and tasks, but also to perform analyses that are simply not possible outside of this integrated approach.



Training Schedule

Course Number	Pre-requisite	Course Description	Dates	Location	POC
200	120	Advanced Diagnostic Development & Assessment	6 December 2010	Orange, CA	Denise Aguinaga, DSI
230	205	***eXpress*** Advanced "Tips and Tricks"	6 December 2010	Orange, CA	Denise Aguinaga, DSI
205	200	Advanced Test Development & Importing	8 December 2010	Orange, CA	Denise Aguinaga, DSI
240	205	FMECA Development and Assessment using FMECA Plus	13 December 2010	Orange, CA	Denise Aguinaga, DSI
250	205	STAGE Time-Based Assessments & Principals	14 December 2010	Orange, CA	Denise Aguinaga, DSI
100		System Diagnostics Concepts and Applications	10 January 2011	Orange, CA	Denise Aguinaga, DSI
110	100	Basic Modeling & Introduction to Testing	10 January 2011	Orange, CA	Denise Aguinaga, DSI
120	110	Introduction to Testing & Analysis	13 January 2011	Orange, CA	Denise Aguinaga, DSI

eXpress 5.11 — a Holiday Surprise for Active Users

In early December, DSI will begin shipping ***eXpress*** 5.11, a new general release of the software that has "a little something for everybody." The upgrade from version 5.10.x to 5.11 is free for all users with active maintenance agreements.

Central to the new version is the ability to evaluate the system impact of Prognostics, both by itself and in conjunction with Diagnostics. Test sequences can be optimized based on the confidence that prognostics will have prevented certain failures. Alternatively, diagnostics can be evaluated for only those failures not covered by prognostics. Collectively, these enhancements open up a wide range of evaluations and case studies that can be used to fine-tune system health management!!

Support for prognostics is, of course, only one of many features new to ***eXpress*** 5.11. Here are a few (to whet your appetite):

- New **Fault Group Ranking Report** lists Fault Groups sorted by their Impact upon Ambiguity, Criticality, Repair Time or Repair Cost
- **Advanced Design State Options** greatly reduce the time and effort needed to generate design states for large systems
- New **Extended Coverage** feature allows signature/inspection test coverage to be extended to include adjacent items, based on assigned attribute values
- **Diagnostic status** (color-coded items) can now be displayed for **lower levels models** in the design hierarchy
- In addition to English, several popular ***eXpress*** reports can now be generated in Chinese, French or Japanese!!

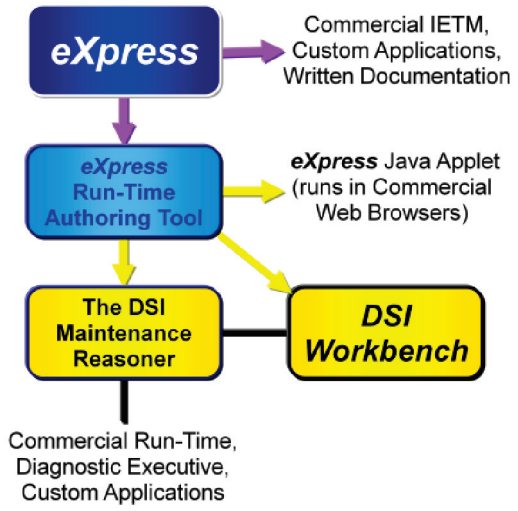
Check with your department Buyer to make sure that your ***eXpress*** maintenance is up to date—you'll want nothing to prevent you from immediately taking advantage of this important new release.

New Tool Available from DSI: DSI Workbench

The DSI Workbench—the latest tool in DSI's Integrated System Diagnostic Design (ISDD) suite—is now available on a per-seat basis. This high-end diagnostic and maintenance tool can be used independently or interactively with test equipment, allowing the same diagnostic procedures developed for system design assessments in ***eXpress*** to be utilized with the fielded system.

Designed specifically to assist technicians in production and maintenance environments, the DSI Workbench provides a level of customization and flexibility that is unprecedented in a turn-key run-time solution. The interface is highly customizable, allowing multiple design views (including photos, schematics, isometric drawings, as well as graphics exported from ***eXpress***) to be displayed on multiple monitors in detachable/docking windows.

Several modes allow the tool to work as a run-time monitor, a diagnostic session-master, an interactive diagnostic toolbox, or a fully-automated diagnostic reasoner (in early 2011, the reasoner module will be separately available for integration with project-specific or third-party solutions on various platforms).



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