eXpress™ Newsletter

Volume 19, Number 1 Summer 2013

Vacating Responsibility in the Quest for "Diagnostics on the Cheap"

Ralph A. De Paul, Jr., founder of DSI International and pioneer in the field of diagnostic engineering, used to tell the following story of how he got involved in diagnostics. It all started in the 1950s when a couple of his friends in the military were killed—not in battle, but rather by undiagnosed equipment failures. Greatly moved by the experience, De Paul was determined to discover a way of creating more "responsible" diagnostics. Over the next decade, he developed a method of representing the causal relationships between the elements of a design—an approach that came to be known as functional dependency modeling.

As De Paul applied his methodology to a growing number of real world systems, it became quickly apparent that it was only possible to develop "responsible" diagnostics for systems that had been adequately designed to support diagnostics. By the mid-1960s, De Paul had repeatedly identified the need for a standardized approach to diagnostic system design—and he demonstrated how his "Logic Modeling" process (as he then called it) could be used both to assess the inherent diagnostic capacity of any system or device and to develop diagnostics to be fielded for that system.

His ideas caught on, slowly but steadily—as did his methods. He advocated a diagnostics-first approach to design before the U.S. Congress and the NSIA and JPL subcommittees on testing, arguing that the adoption of this approach would not only save lives, but also reduce life cycle costs and improve product availability. Finally, in the early 1980s, one of De Paul's students from the Joint Logistics Command convinced the U.S. Navy of the need for a Testability design requirement specification. As this document—which would become MIL-STD-2165—was developed, De Paul was in regular contact with the committee. As a result, not only were the diagnostic metrics in the standard an exact match of the figures of merit produced by **LOGMOD** (the 1975 computerized version of his "Logic Modeling" process), but even the definition of the term "Testability" reflected De Paul's own wording.

So, it was not without merit that De Paul was referred to as the "Father of Testability" when he received (posthumously) the John Slattery Professional Achievement Award in 1994. He was recognized not only for his contributions to diagnostic analysis, but also for his advancements in model-based diagnostics. Today, those who work in the fields of Testability and Diagnostic Development owe a debt to De Paul's pioneering work of the 1950s and 60s. Even the dependency matrix (still in use today by some companies) is based almost entirely on his early developments in logic modeling.

Inside this Issue...

Over the decades, **STAT** and ***eXpress***—DSI's third and fourth generation diagnostic engineering tools—have evolved De Paul's original modeling process into a more modular, less restrictive approach. The simple elegance of the functional dependency model has been replaced by a more pragmatic modeling technique that better represents the idiosyncratic demands of real-life testing—including asymmetric test coverage, conditional dependencies, and both hybrid & hierarchical diagnostic inference.

Of course, times have changed in other ways as well—but the need for "responsible" diagnostics has not diminished. The size and complexity of many of today's systems place a greater demand upon automated approaches to mind the gaps left by subject matter experts. Moreover, vast and indiscriminate cuts in both government and commercial spending have left many companies searching for a way to develop diagnostics "on the cheap".

Most spreadsheet-based approaches to diagnostic development are a return to the days before the emergence of "responsible" diagnostics

We've felt this pinch at DSI as well. Our customers need to develop diagnostics for systems of unprecedented size—at a fraction of the traditional cost for such an effort. The system model for a recent project had several million dependencies; the resulting diagnostic procedures (which were exported from ***eXpress*** to be hosted within the vehicle's health management system) had over 800,000 nodes. In order to be able to address the needs of systems this large—in a reasonable amount of time—DSI not only converted the ***eXpress*** software to run on 64-bit machines, but also introduced a large number of improvements—both productivity enhancements and processing optimizations—to allow the modeling and analysis to be accomplished in a fraction of the time it would have taken only a few years earlier.

Many companies have explored other ways to cut costs, including a return to the spreadsheet, with technical management banking on the belief that an aggregation of individual efforts will automatically provide the systems approach that is so desperately needed. Most spreadsheet-based approaches to diagnostic development, however, are nothing short of a return to those days before the emergence of "responsible" diagnostics, when systems designers still believed the whole to be no more than the sum of its parts. Other companies extol the use of "advanced" diagnostics that require less up-front effort, and then optimize themselves over time; unfortunately, diagnostics that learn mostly from experience are particularly poor at preventing catastrophic failure (think about it!!).

The best way to realize savings is not to dismiss the modeling process altogether, but rather to maximize the impact of your investment

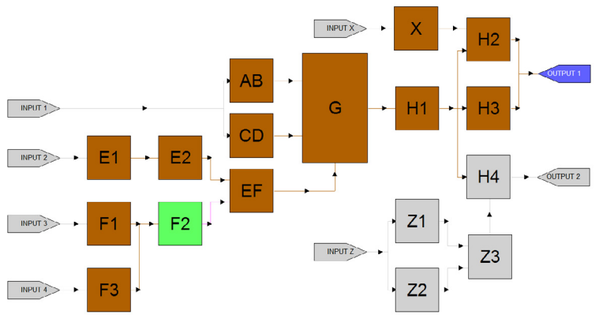
Continued on Page 2

New *eXpress* 6.2 "Interferes" Less (and More Colorfully) Than Ever

eXpress version 6.2, scheduled for release in September, includes several dozen optimizations and enhancements that have been introduced in response to user requests. All of these changes will, of course, be described in detail in the ***eXpress*** 6.2 Release Notice.

One of the most extensive areas of improvement has been in the area of test definition. In previous versions of ***eXpress***, there was no easy way to visualize the full impact of a test until after it had been used in a diagnostic study. This contributed to the sense that test definition was "difficult to master" and, as a result, modelers often resorted to using only those test types that they found most *comfortable*.

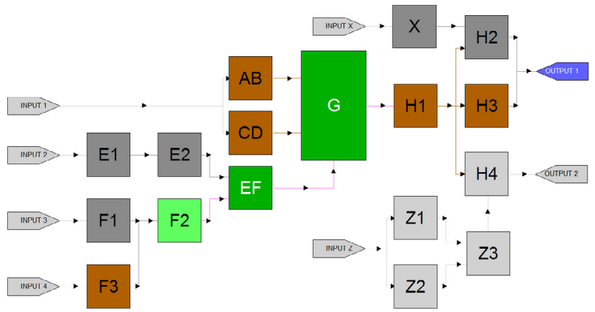
This difficulty has been overcome in ***eXpress*** 6.2 where, as you edit a test, the design drawing is now color-coded to show not only the coverage of that test, but also its interference and symmetry settings. The diagram below, for instance, shows the coverage (green) and the calculated interference (brown) for a signature test with its symmetry set to "Signature Identifies Operation":



Although the test only "covers" a small portion of this model, a large number of elements are called into suspicion when the test fails, due to the relatively remote location of the test point (colored blue). In previous versions of ***eXpress***, not only was interference not visible during test editing (you had to *imagine* the diagnostic impact of each test), but also could not be modified for individual elements. In ***eXpress*** 6.2, however, you can review the interference (which is based on your functional dependencies) and remove those failures that do not affect the test outcome. You can also convert individual functions & failure modes from interference to extended coverage.

With eXpress 6.2, interference is no longer "difficult to master"

In the example at above right, some of the calculated interference has been marked as non-interference (dark gray), meaning that those specific functions or failure modes cannot cause the test to fail. Also, since some of the interference can actually be ruled out when the test passes, these elements have been converted from interference to extended coverage (darker green).



This capability highlights a key way in which ***eXpress*** helps bridge the gap between test and diagnostics. Test data is typically provided to diagnostic engineers as discrete coverage—that is, tests are described primarily in terms of what they are intended to test. Diagnostic engineers, however, must think beyond intentions and specify precisely what the diagnostics must learn from each test. It may be necessary, when creating "fieldable" diagnostics, to understand everything that might cause a given test to fail. The interference feature in ***eXpress*** was designed to help identify (using the functional dependencies in the model) additional, non-covered malfunctions that, when they occur, might also cause a test to indicate a failure.

eXpress helps bridge the gap between test and diagnostics

With ***eXpress*** 6.2, interference is not only more visible and more easily edited, it is also more *reviewable*. You can export test coverage and interference to a spreadsheet and—in consultation with a test engineer—mark the changes to be made. You can then easily update the test definitions in ***eXpress*** by importing the modified worksheet. Moving from test to diagnostics has never been easier!

Vacating Responsibility - *Continued from Page 1*

The best way to realize *real* savings is not to dismiss out-of-hand the holistic rigor of the modeling process, but rather to maximize the impact of your investment. You can do this by using the same intellectual property to leverage multiple tasks in the design process. Customers of DSI have used the ***eXpress*** software to assess system testability, determine areas where a design can be improved, provide the diagnostic projections needed by other analysis efforts, identify areas where prognostics would be most beneficial, develop test sequences for production & maintenance, generate the diagnostic framework for embedded health management, provide the data for troubleshooting procedures, and a host of other tasks. Moreover, once a system has been modeled, that model becomes intellectual capital that can be re-invested—in whole or in part—not only in later versions of that same system, but also as a starting point for future systems.

As long as companies attempt to slash costs, but not address the waste incurred by parallel (as opposed to concurrent) engineering, there is a severe risk that diagnostic engineering will regress to the very stage that so incited Ralph De Paul's concerns in the 1950's.

eXpress™ Newsletter Summer 2013

DSI Workbench 3.0 Learns (and Teaches) from History

DSI Customers are simply going historical over the new History & Feedback module for DSI Workbench 3.0!!

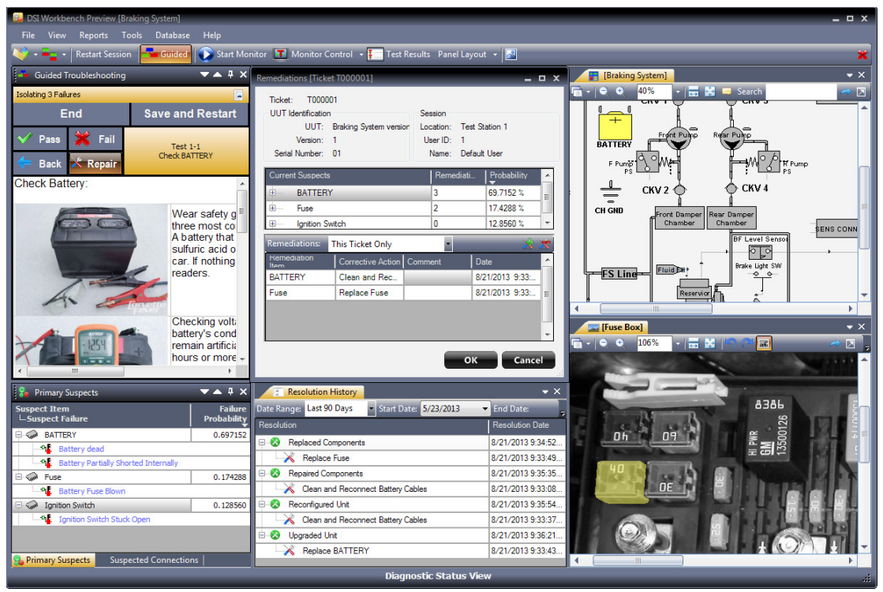
This module provides a fully-integrated back-end database that can be used to associate diagnostic sessions with specific work orders or tickets, to analyze production or maintenance efficiency, and to track historical issues and their resolutions. The database stores not only the repair history for the units tested, but also any other factors that impact production or maintenance—including issues with the design, manufacturing, test equipment, facilities, documentation or training. Some of the benefits of using this module along with DSI Workbench include:

This sample report shows ticket resolution by month, with the number of resolved tickets categorized by user-specified resolution categories (in this example, the categories are: Process-related, Component Failure, Design Issue, Test Station Failure & Misdiagnosis).

The Database Itself – With this module installed, DSI Workbench will automatically store a wealth of data in its integrated back-end database—information about specific work orders, diagnostic sessions, test results, diagnosed failures, corrective actions, ticket resolutions, and other related activities. As it is collected over time, this data can be useful for a variety of applications, including trend analysis, design or process improvement, efficiency assessment, and logistics planning. Knowledge is Power!!

Automated Reporting – The History & Feedback module has a report generator that allows you to quickly generate useful graphs showing information such as Ticket Resolutions, Ticket Times, Open Tickets or Rework Cycles. The data can be broken down by UUT, repair item, User ID or specified date intervals. Because the data is categorized by resolution category, you can track manufacturing defects or process-related issues over time. Or you can compare, for several UUTs (or technicians), the average ticket times that result from component failures. Of course, these are just a couple of the built-in reports—you can also easily create your own reports based on information in the database!

Resolution History – During a diagnostic session in DSI Workbench, a new panel displays a list of relevant past solutions that have been stored in the database. Because this list is tied to test results, it will only contain resolutions that are related to the current diagnostic session (as you perform more tests, the list will shrink). More than a list of corrective actions, this list contains heuristics based on all resolutions that technicians have discovered during previous diagnostic sessions, including (but certainly not limited to) manufacturing defects, improper documentation, issues with a particular test station and process-oriented problems.



At left is a screen capture showing how data from the History & Feedback module is integrated into a diagnostic session in DSI Workbench.

The panel in the center of the screen shows the remediation history for the current ticket, listing not only the current suspects, but also all repairs, replacements or adjustments that have already been performed.

At the lower left are two panels (arranged side-by-side in this example) that guide the technician toward the most likely source of the problem. One lists the Primary Suspects for remediation (using diagnostics developed for this unit). The other lists the Resolution History for the problem—past solutions that match up with the current test results.

DSI Welcomes Jack Amsell and David Joseph

DSI International is very pleased to announce that Jack Amsell and David Joseph have joined the DSI team.

Jack comes to DSI with a rich 30 years of experience in project management and engineering (including 12 years working with DSI's ***eXpress*** Diagnostic Engineering Software). Jack's distinguished career has included positions with HP, Boeing and Raytheon. Jack will be a welcome addition to DSI's team of expert Diagnostic Scientists.

David has over 25 years of experience in sales, marketing and business development. In his most recent position, David was the VP of Sales, Marketing and Business Development for Orbital Systems. As DSI's VP of Sales and Business Development, David will introduce DSI's philosophy and tools into new commercial markets.

Welcome aboard Jack and David!

New Training for a New Era

DSI has a new training strategy in place. First of all, both the Basic (Series 100) and Advanced (Series 200) courses have been updated to include new capabilities of the ***eXpress*** software (including features introduced in version 6.2!)

Another major change is that the training is no longer focused exclusively on ***eXpress***. DSI now demonstrates how the same basic analysis data can be leveraged to improve the efficiency of multiple related tasks using other applications in DSI's suite of tools for Integrated Systems Diagnostic Design. Fully in tune with current trends in Integrated Diagnostic development, DSI also teaches how diagnostic models can be efficiently constructed by capturing data from legacy systems.

Continuing to thrive in the current business environment, DSI has consistently inspired industry leaders to adopt a more integrated, holistic paradigm for Systems Engineering, Diagnostic Engineering, Sustainment, and Integrated Logistics Support (ILS). DSI's tools bring these diverse areas together in innovative ways, enabling our customers to capitalize on these leaner, more effective engineering approaches.

REALTIMEWAVE

Now Representing DSI in South Korea!

Training Course Catalog

Course Number	Pre-requisite	Course Description	Dates	Location	POC
T-100		System Diagnostics Concepts and Applications	Sept. 9, 2013	Orange, CA	Denise Aguinaga, DSI
T-110	T-100	Basic Modeling & Introduction to Testing	Sept. 9 &11, 2013	Orange, CA	Denise Aguinaga, DSI
T-120	T-110	Introduction to Testing & Analysis	Sept. 12 & 13, 2013	Orange, CA	Denise Aguinaga, DSI
T-199		Custom Applications - Customer Supplied Agenda	Call for Dates	Orange, CA	Denise Aguinaga, DSI
T-200	T-120	Advanced Diagnostic Development and Assessment	October 14 -16, 2013	Orange, CA	Denise Aguinaga, DSI
T-205	T-200	Advanced Test Development and Importing	October 16 - 18, 2013	Orange, CA	Denise Aguinaga, DSI
T-230	T-205	***eXpress*** Advanced "Tips & Tricks"	Call for Dates	Orange, CA	Denise Aguinaga, DSI
T-240	T-205	FMECA Development and Assessment using FMECA Plus	Call for Dates	Orange, CA	Denise Aguinaga, DSI
T-250	T-200	STAGE Time-Based Assessments & Principals	Call for Dates	Orange, CA	Denise Aguinaga, DSI
T-260	T-100	RTAT and Workbench Theory and Application	Call for Dates	Orange, CA	Denise Aguinaga, DSI

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