DSI international, inc.
eXpress™ Newsletter
Volume 30 Number 1 Winter 2024

The Government Knows What You're Doing

As many of you know, DSI's technology has its roots in Ralph De Paul's efforts to foster more responsible diagnostics after friends of his in the military were killed in the 1950s—not by enemy (or friendly) fire, but rather when their equipment malfunctioned. He soon discovered that existing systems were generally incapable of supporting effective diagnostics; that this ability must not only be *designed into* a system, but also optimized through iterative cycles of assessment and improvement. To facilitate this, he devised a way of quantifying a design's capacity to be diagnosed—known today as Testability Analysis—as well as a means of determining how designs can be improved to better support diagnostics. In the early 1980s, the U.S. Navy published a standard (MIL-STD-2165) partly inspired by De Paul's work and began including Testability requirements in all its procurement contracts.

Although De Paul considered diagnostic development and diagnostic assessment to be two sides of the same coin—collectively comprising what we might today call Diagnostic Engineering—industry, for the most part, took a different view. Testability efforts, when added to a project (typically to satisfy explicit contract requirements), were initially allocated to the logistics disciplines. RAM (Reliability, Availability & Maintainability) became RAM-T. Alternatively, Testability would be incorporated into the Systems Engineering workflow. Either way, the engineers who were assigned to assess a design's diagnostic capability were rarely the same as those developing the actual run-time diagnostics. Attempts to link design-time assessments to a system's actual behavior during sustainment were few and far between.

Fast-forward 40 years and we find that the customer (and by *customer*, I mean the U.S. Government) is becoming more and more hip to this disconnect and the various risks that it incurs. Suppliers are being required to demonstrate that their fielded diagnostics are capable of detecting and isolating failures in a manner consistent with design-time Testability assessments.

What does this mean for users of ***eXpress***? Well, there are two ways of correlating predicted and actual diagnostic performance. Following the *deductive* method, engineers must match the fielded diagnostic procedures (along with isolated faults) to the diagnostic capabilities assumed when the Testability statistics are generated. This can be labor-intensive (and sometimes impossible) when the assessment of a system's diagnostic capability and the creation of actual diagnostic procedures are independent efforts. Moreover, in addition to all this, the supplier must still demonstrate that the fielded diagnostics work as intended.

With the *inductive* approach, a negotiated number of faults are inserted into a representative system. Failures isolated by the fielded diagnostics are then compared with those assumed by the Testability Analysis. In ***eXpress***, this comparison is easily performed using the tool's Desktop Fault Insertion™ feature, which allows faults to be inserted virtually into the diagnostic model. For companies who generate both Testability Analysis and run-time diagnostics using the same ***eXpress*** model (in particular when the two tasks have been integrated digitally), the main effort of diagnostic validation is reduced to showing that implementation matches intent.

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Latest Software Versions

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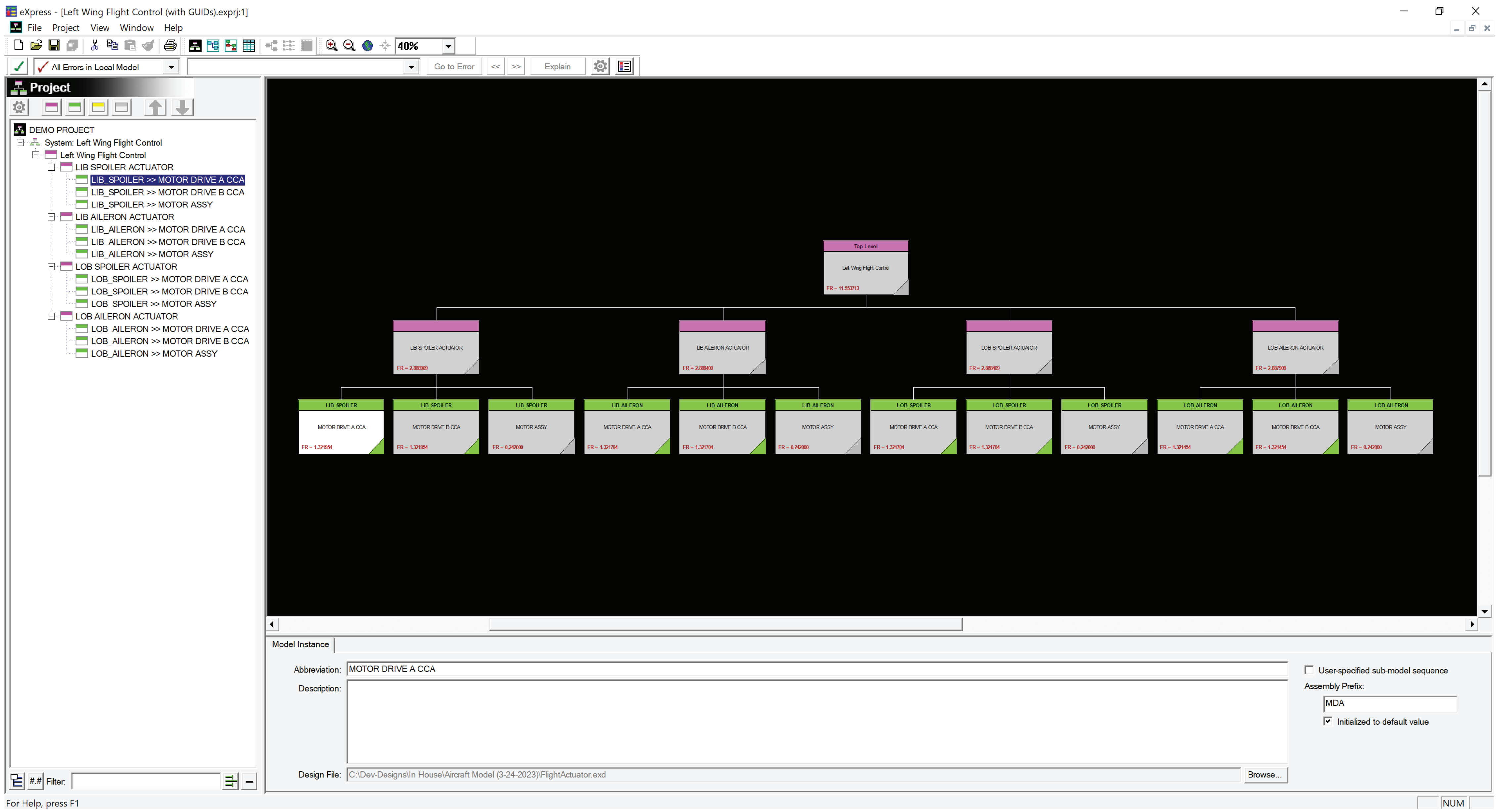
• STAGE	Act II, Scene 3	10/16

Feature Sneak Peek: Projects in *eXpress* 8.0

In the upcoming version 8.0 release of ***eXpress***, a new Projects capability will redefine how analysts work with systems. An ***eXpress*** *Project* is a new document type that stores data that is not included within the individual models that comprise a system. The first thing you will notice when you look at a project is that the entire system architecture is displayed—both in the Explorer tree on the left and as a System Hierarchy Diagram in the design drawing window. This provides analysts with a useful framework for both demonstrating and navigating system hierarchy in ***eXpress***.

When you highlight a model in the project, all instances of that model within the system can be easily identified by a color-coded triangle at the bottom of each block. In the example below, the model for a single circuit card has been selected; the green triangles show that there are a total of eight instances of this circuit card in the system. Also displayed in each block is a user-selectable piece of information about that model, such as the design version, the number of components or failure modes, or the calculated failure rate.



Analysts can easily navigate the system using this diagram. A specific model instance can be viewed or edited by right-clicking on it either in the Explorer Tree or in the System Hierarchy Diagram.

Projects can also contain instance-specific information—properties & attributes that are specific to a given *instance* of a model. This data is stored in the project file, rather than in the model itself (since it will be different not only for each instance, but also for each system in which that model is included). As you navigate the system, ***eXpress*** keeps track of which instance of a model is being edited, displaying the data specific to that instance.

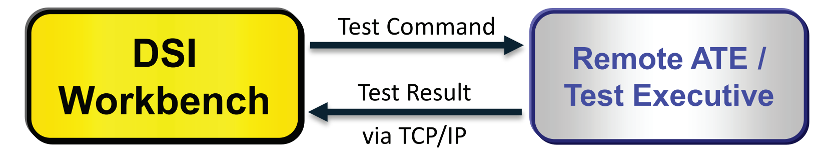
The following instance-specific data can be stored within an ***eXpress*** project:

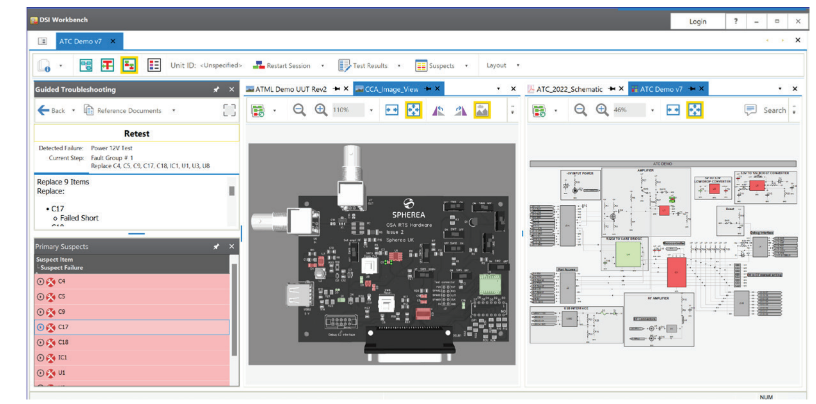
- global IDs (either manually or automatically assigned)
- item reference designators
- attribute values (including LCNs and reliability values)
- calculated failure rates (adjusted based on data in parent & child models)

New Command Interface for DSI Workbench

DSI Workbench has a new TCP/IP command and control protocol that allows Workbench to send and receive commands from other processes. Specific commands and responses are documented in the WBCommand.xsd XML schema (available on the DSI web site). These commands are also fully documented within TestDRIVE.

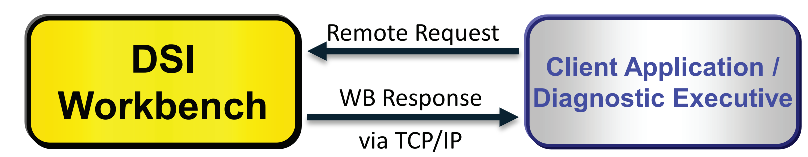
Test Commands – Send a command from DSI Workbench to a remote ATE or test executive, requesting that a specific test or test program be performed, with the results sent back to Workbench.

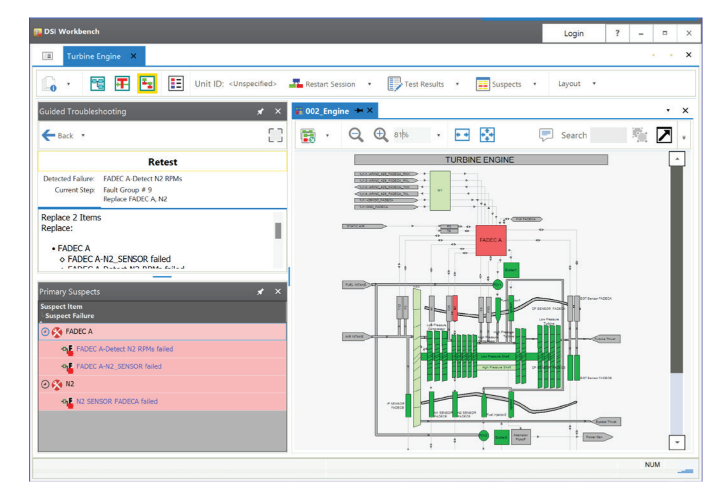




CCA level Diagnostics using DSI Workbench

Remote Diagnostics – Control DSI Workbench from an external application. Start troubleshooting, apply test results and then return the resulting diagnosis to the client process.



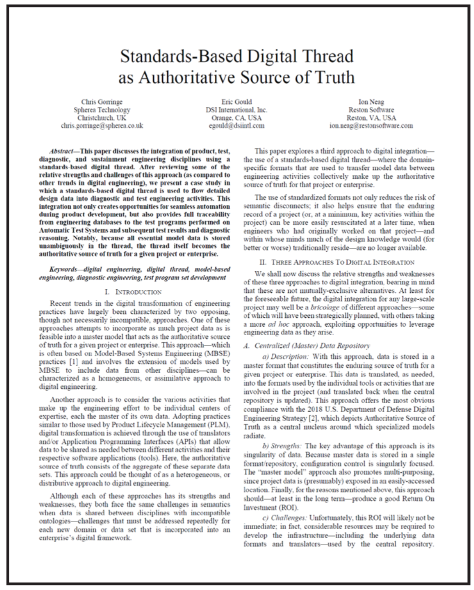


System Diagnostics using DSI Workbench

DSI Awarded Best Paper on New Technology at ATC 2023

We are pleased to announce that DSI's Eric Gould, Chris Gorringe of Spherea Technology and Ion Neag of Reston Software were awarded the Walter E. Peterson Award for Best Paper on New Technology at AUTOTESTCON 2023.

As a case study, the paper presents the digital thread for diagnostic/test engineering that had been developed by DSI, Spherea & Reston Software (with contributions by NI and the UK Ministry of Defense).



Standards-Based Digital Thread as Authoritative Source of Truth

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***Abstract*—This paper discusses the integration of product, test, diagnostic, and sustainment engineering disciplines using a standards-based digital thread. After reviewing some of the relative strengths and challenges of this approach (as compared to other trends in digital engineering), we present a case study in which a standards-based digital thread is used to flow detailed design data into diagnostic and test engineering activities. This integration not only creates opportunities for seamless automation during product development, but also provides full traceability from engineering databases to the test programs performed on Automatic Test Systems and subsequent test results and diagnostic reasoning. Notably, because all essential model data is stored unambiguously in the thread, the thread itself becomes the authoritative source of truth for a given project or enterprise.**

Keywords—digital engineering, digital thread, model-based engineering, diagnostic engineering, test program set development

I. Introduction

Recent trends in the digital transformation of engineering practices have largely been characterized by two opposing, though not necessarily incompatible, approaches. One of these approaches attempts to incorporate as much project data as is feasible into a master model that acts as the authoritative source of truth for a given project or enterprise. This approach—which is often based on Model-Based Systems Engineering (MBSE) practices [1] and involves the extension of models used by MBSE to include data from other disciplines—can be characterized as a homogeneous, or assimilative approach to digital engineering.

Another approach is to consider the various activities that make up the engineering effort to be individual centers of expertise, each the master of its own data. Adopting practices similar to those used by Product Lifecycle Management (PLM), digital transformation is achieved through the use of translators and/or Application Programming Interfaces (APIs) that allow data to be shared as needed between different activities and their respective software applications (tools). Here, the authoritative source of truth consists of the aggregate of these separate data sets. This approach could be thought of as a heterogeneous, or distributive approach to digital engineering.

Although each of these approaches has its strengths and weaknesses, they both face the same challenges in semantics when data is shared between disciplines with incompatible ontologies—challenges that must be addressed repeatedly for each new domain or data set that is incorporated into an enterprise's digital framework.

This paper explores a third approach to digital integration—the use of a standards-based digital thread—where the domain-specific formats that are used to transfer model data between engineering activities collectively make up the authoritative source of truth for that project or enterprise.

The use of standardized formats not only reduces the risk of semantic disconnects; it also helps ensure that the enduring record of a project (or, at a minimum, key activities within the project) can be more easily resuscitated at a later time, when engineers who had originally worked on that project—and within whose minds much of the design knowledge would (for better or worse) traditionally reside—are no longer available.

II. Three Approaches To Digital Integration

We shall now discuss the relative strengths and weaknesses of these three approaches to digital integration, bearing in mind that these are not mutually-exclusive alternatives. At least for the foreseeable future, the digital integration for any large-scale project may well be a *bricolage* of different approaches—some of which will have been strategically planned, with others taking a more *ad hoc* approach, exploiting opportunities to leverage engineering data as they arise.

A. Centralized (Master) Data Repository

a) Description: With this approach, data is stored in a master format that constitutes the enduring source of truth for a given project or enterprise. This data is translated, as needed, into the formats used by the individual tools or activities that are involved in the project (and translated back when the central repository is updated). This approach offers the most obvious compliance with the 2018 U.S. Department of Defense Digital Engineering Strategy [2], which depicts Authoritative Source of Truth as a central nucleus around which specialized models radiate.

b) Strengths: The key advantage of this approach is its singularity of data. Because master data is stored in a single format/repository, configuration control is singularly focused. The "master model" approach also promotes multi-purposing, since project data is (presumably) exposed in an easily-accessed location. Finally, for the reasons mentioned above, this approach should—at least in the long term—produce a good Return On Investment (ROI).

c) Challenges: Unfortunately, this ROI will likely not be immediate; in fact, considerable resources may be required to develop the infrastructure—including the underlying data formats and translators—used by the central repository.

The paper—which is titled "Standards-Based Digital Thread as Authoritative Source of Truth"—presents an approach to digital integration in which the domain-specific formats used to transfer model data between engineering activities also collectively comprise the enduring, authoritative source of truth for a given project.

Beginning with data imported from SysML, this thread integrates several key tasks of diagnostic/test engineering, including: diagnostic development/assessment in ***eXpress***, ATML test/test station definition, automated test program generation, and graphic-based support for both automatic and guided troubleshooting in DSI Workbench.

Training Course Schedule

Course Number	Prerequisite	Course Description	Dates	Location	POC
CE-339	none	Continuing Education: Testing Hierarchically, Part III: Using Design States	March 5, 2024 One 90-minute session	Virtual: Webex	info@dsiintl.com
CE-340	none	Continuing Education: Testing Hierarchically, Part IV: Testing for Effects	March 26, 2024 One 90-minute session	Virtual: Webex	info@dsiintl.com
CE-341	none	Continuing Education: Testing Hierarchically, Part V: Effect-based Coverage	April 9, 2024 One 90-minute session	Virtual: Webex	info@dsiintl.com
TLS-100	2 hours home study prior to first session (video)	System Diagnostics Concepts and Applications Basic Modeling & Introduction to Testing	Starting April 22, 2024 Eight 4-hour sessions (Mon-Thu for 2 weeks)	Virtual: Webex In Person: Orange, CA	info@dsiintl.com

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