DSI international, inc.

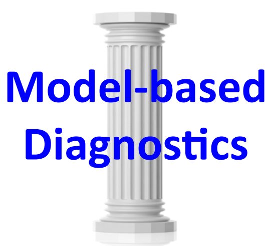
eXpress™ Newsletter

Volume 27 Number 1 | Spring 2021

The Three Pillars of ISDD

Integrated System Diagnostic Design—ISDD—is both the name of DSI's industry-leading suite of diagnostic engineering tools and an engineering philosophy that puts diagnostics at the same level as other aspects of a product's design. It is also the name of a new software module (introduced later in this newletter) that allows ***eXpress*** models to be created and accessed remotely.

In both theory and practice, ISDD is comprised of three pillars—three sets of values that have not only informed DSI's approach to diagnostic engineering for over four decades, but that are also surprisingly relevant in this new age of digital transformation.



From the earliest dependency models in the 1950s to today's multi-faceted representations of design functionality in ***eXpress***, one thing has remained constant—DSI's commitment to model-based diagnostics.

Traditionally, models created in ***eXpress*** have been used both to assess the diagnostic capability of a design and to generate procedures that can be deployed in run-time diagnostic solutions. Often forgotten is the fact that these models also constitute the primary intellectual property of diagnostic engineering.

Scalable to represent products of any size, these models become a permanent representation of a system's diagnostic design—one that can be retrieved and updated at any time (particularly useful when systems are upgraded decades after their original development has been completed).

With its model-centric approach to diagnostics, you could say that ***eXpress*** has been waiting for Model-Based Engineering to come of age, anticipating the day when diagnostic engineering and other sustainment-oriented disciplines are welcomed into the digital engineering community.

From its very inception, the ***eXpress*** software has championed interoperability as the key to rapid model creation. It is hard to imagine a major project in which failure rates were not imported into ***eXpress*** from Reliability spreadsheets. For projects requiring a diagnostics-informed FMECA, failure modes & effects can also be imported. Even the models themselves can be created from topology spreadsheets.

In 2001, the **DiagML** export was added to facilitate the transfer of diagnostic information between software applications (including DSI's own simulation and run-time diagnostic tools **STAGE** and **DSI Workbench**).

More recently, the **eXpressML** format was defined as a means of sharing ***eXpress*** model data between applications. Coupled with the new ISDD module (which allows remote access to ***eXpress*** via TCP/IP), this facilitates the incorporation of diagnostic model data into today's digital frameworks.

Inside this Issue...

Keep In the Know

- New Feature: The ***eXpress*** ISDD Module
- Accomplishment: Raytheon ACT Digital Innovations
- Celebrating: **DiagML**'s Platinum (20th) Anniversary
- Coming up: Extensive On-line Training

Latest Software Versions

eXpress	7.4	2/21
Run-Time Authoring Tool	6.0	11/20
DSI Workbench	5.0	11/20
STAGE	Act II, Scene 3	10/16

From page 1

Remote software access and permanent data repositories are just the first steps of digital transformation, however. The real benefits will come as various design and sustainment disciplines learn how to eliminate duplicate efforts by sharing engineering data stored in the repository.

Over the decades, DSI has preached that a system's diagnostic capability should be assessed using the same diagnostics that will be fielded for that system (or, if that is not possible, using the same knowledge of the design that was or will be used to develop the run-time diagnostics). This practice not only eliminates the gaps between the Testability Analysis that is performed for contract compliance and the system's actual diagnostic performance in the field, but also reduces the overall effort of diagnostic development and assessment by allowing the two activities to leverage each other's efforts.

Taking this a step further, in 1989 DSI introduced the ability to export diagnostic sequences for use in the generation of Test Requirements Documents (TRDs) and Test Program Sets (TPSs). Since 2001, when the **DiagML** export was added, the diagnostics from ***eXpress*** can be imported by any tool and used to develop TRDs, TPSs, Interactive Electronic Technical Manuals (IETMs) or other diagnostic products and/or documentation.

Being specialists in diagnostics, it was natural for DSI to identify—during the development of STAGE—a number of simulation-based metrics that could be enhanced using knowledge from the ***eXpress*** diagnostics. Taking the lead from false removals, DSI introduced the concepts of *false system aborts* (unnecessary system aborts that can result from diagnostic ambiguity) and *diagnostic false alarms* (an easily quantifiable percentage of alarms that will result from the inability of diagnostics to distinguish between the sensor and the sensed).

Taking this show on the road, so to speak, DSI developed modules in ***eXpress*** that perform diagnostics-informed versions of standard Reliability, Risk and Safety assessments. By including standard and specialized diagnostic metrics in Failure Mode, Effects & Criticality Analyses (FMECAs), Fault Tree Analyses (FTAs), and Sneak Circuit Analyses (SCAs), the ***eXpress*** versions of these deliverable products allow analysts in other disciplines to determine the impact that less-than-perfect diagnostics have upon the reliability, risk and safety of a system.

Finally, as full-scale digital repositories become the norm—with engineering data from multiple development and sustainment disciplines exposed to all of a project's stakeholders—the next phase of digital transformation will commence. This involves deeper dives into the various models and databases stored in the repository, identifying elements that they have in common. This will of course require some sustained collaboration, as representatives from different organizations work through the semantics (attempting to understand, for instance, what data elements labeled "function" mean for each discipline) to develop an ontology unique to that digital framework.

Locked, loaded and ready for the digital *revolution*, DSI is also fully committed to participating in the subsequent *evolution*, when the different providers that contribute to an organization's long-term digital solution not only expose and explain their data to interested stakeholders, but also work to better understand the data stored in the digital repository by others. Armed with this knowledge, DSI can then help its customers maximize efficiency through the multi-purposing of contributions across the design and sustainment spectrum.

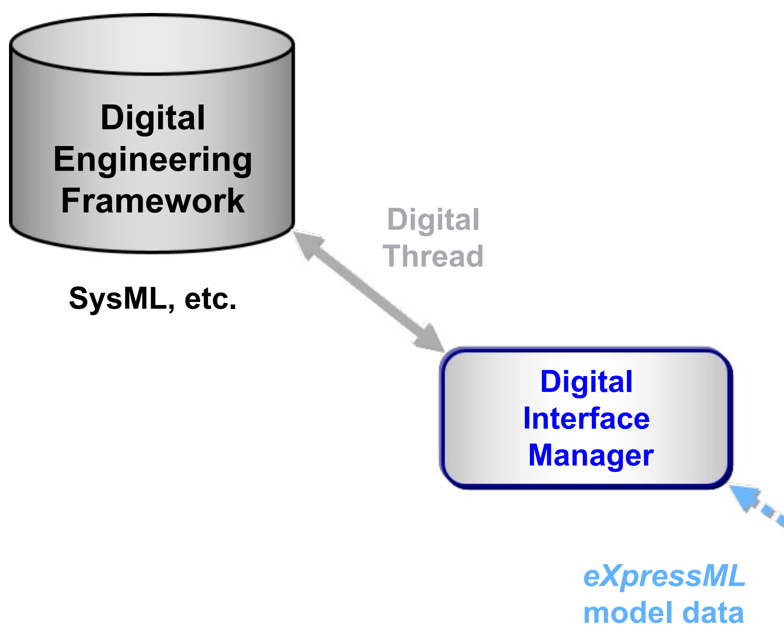
The ISDD Module:

DSI's new ISDD module allows ***eXpress*** models to be created and accessed remotely, thereby providing the mechanism for integrating diagnostic design data from ***eXpress*** into Model Based System Engineering (MBSE), Product Lifecycle Management (PLM) and other digital engineering platforms.

When the ISDD module is enabled in ***eXpress***, diagnostic model & analysis data can be accessed from another process by sending commands to ***eXpress*** using TCP/IP (or some other digital communication protocol). In the diagram below, the Digital Interface Manager represents the portion of the digital engineering solution that sends and receives messages & data from ***eXpress.*** It also acts as a translator between **eXpressML** (the XML-based format in which ***eXpress*** model data is shared with the world) and the format desired by the digital thread.

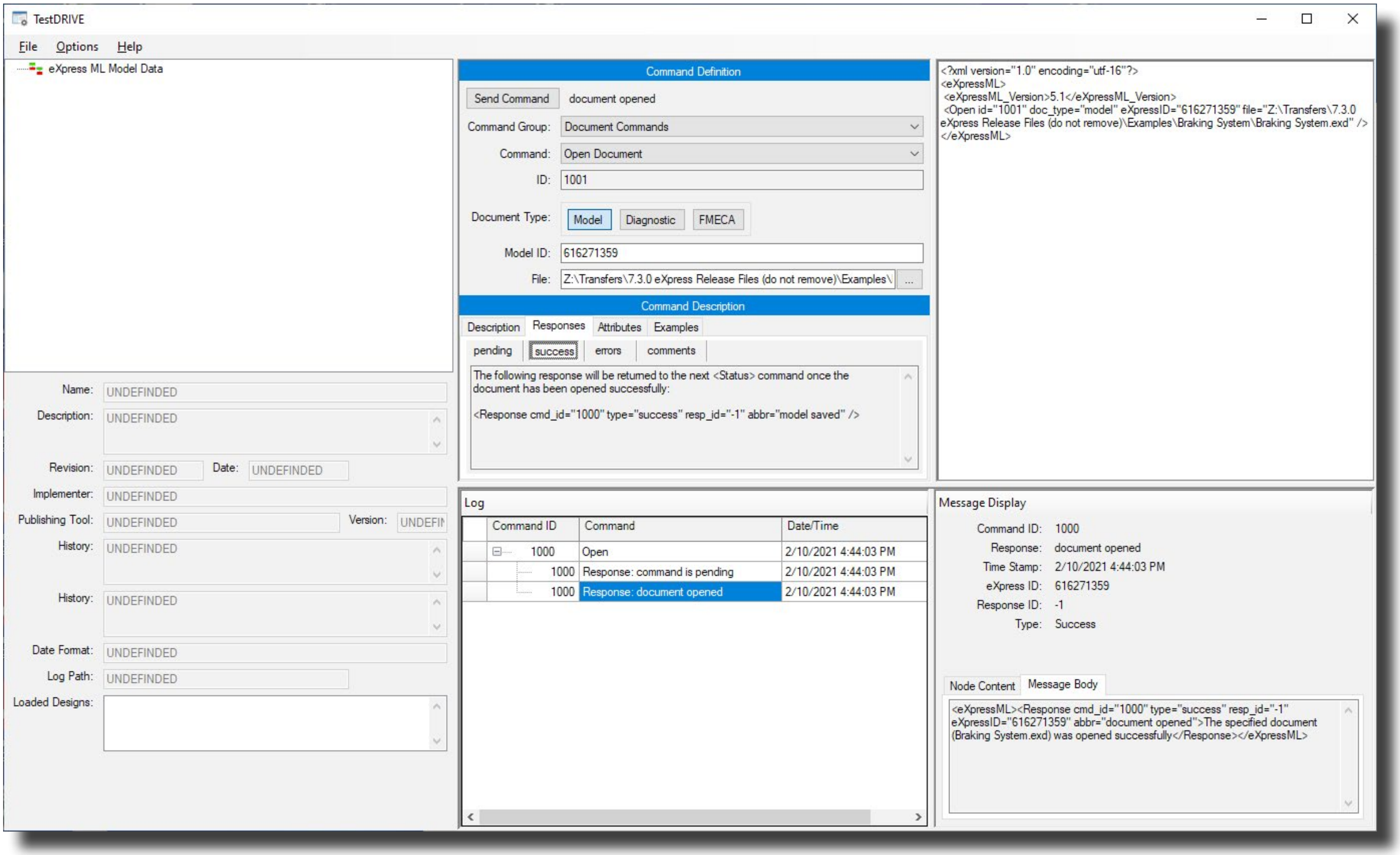
The Digital Interface Manager (or whatever software is playing that role in the digital framework) communicates with the ISDD module of ***eXpress*** using a set of commands defined within the ***eXpressML*** schema. Currently supported are document commands that let you create, load, save & close models in ***eXpress***, as well as model commands that let you import, modify, export & retrieve data for a given ***eXpress*** model.

Future versions of the ISDD module will allow diagnostic sequences and FMECA charts to be generated remotely, as well as various ***eXpress*** analyses & reports.

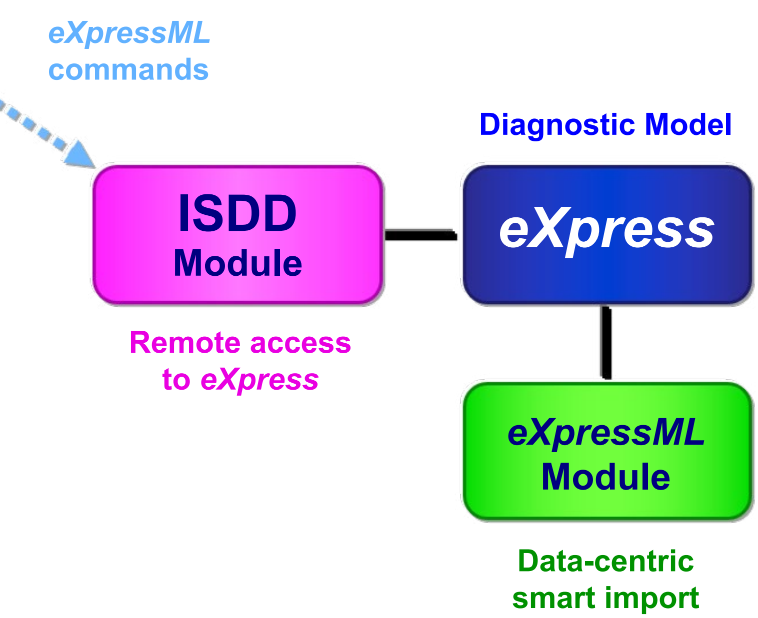


In addition to being formally defined within the **eXpressML** schema, commands currently supported by the ISDD module are also documented in **TestDRIVE**—a stand-alone tool currently available with a complementary license for licensees of the ISDD module. With its full-feature GUI (depicted above right), **TestDRIVE** helps developers to construct **eXpressML** commands, send the commands to ***eXpress*** and then view the responses. Designed as an aide to the engineers who will be developing the Digital Interface Manager (or other software that will communicate with ***eXpress***), **TestDRIVE** can also be used to explore the ISDD module's capabilities.

eXpress's Key to Digital Transformation



TestDRIVE allows engineers to take the ISDD module for a spin



When accessed using the ISDD module, ***eXpress*** can play different roles within different digital engineering paradigms. First, when ***eXpress*** is considered a core application, models saved in ***eXpress*** will constitute the enduring, authoritative intellectual property for the diagnostic design. Following this approach, only data elements that are intended to be shared with other stakeholders need to be represented within the common digital engineering repository.

Another approach is to use ***eXpress*** as a remote diagnostic processing engine within an overall digital engineering solution. Here, all data would be stored in the digital engineering framework (which would then be the sole enduring and authoritative "source of truth" for the design). Of course, with this approach, the digital framework must be sufficiently robust to store all ***eXpress***-related diagnostic design data.

No matter how you choose to integrate ***eXpress*** diagnostics into your digital engineering framework, the ISDD module will be your key. For many projects, ***eXpress*** models constitute the only thorough documentation of the diagnostic design (information that, if not preserved, must be derived from scratch if the design is to be upgraded somewhere down the line). Moreover, since effective Life-cycle Sustainment Planning (LCSP) takes diagnostic behavior into account, your organization's digital transformation will be incomplete if your permanent data repository—be it based on MBSE, PLM or some other digital engineering framework—does not include diagnostic data (and knowledge) from ***eXpress***.

Life Cycle Sustainment in the Age of Digital Expansion

The digital transformation movement is spreading like a virus (okay, not funny). Initially focused on the development cycle, MBSE and other digital engineering platforms are transitioning to include data & processes associated with Life Cycle Sustainment.

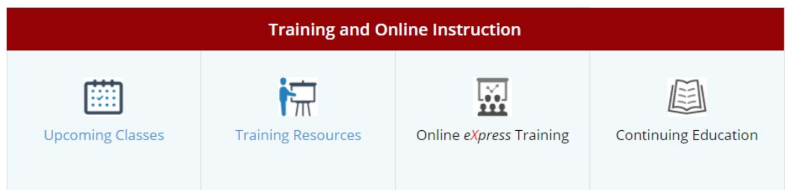
The U.S. Navy is playing an important role in this second wave of the digital engineering revolution—and DSI is positioning itself to become a significant player as diagnostic engineering and design-for-sustainment efforts are welcomed into the digital fold. A recent podcast on the Federal News Network discusses how the Navy is improving the readiness of its aviation fleets in the wake of reductions in fiscal budgets by employing processes from data analytics and various emerging technologies. The speakers stress the importance of ongoing digital transformation efforts, and how "partnerships with companies like DSI International and IBM" are helping the Navy and its contractors to bridge digital gaps in the expansion of MBSE.

Raytheon Technologies is also blazing new trails with its digital engineering framework, which can now incorporate SysML representations of ***eXpress*** model data in its digital repository. Using DSI's new ISDD module, Raytheon has demonstrated how ***eXpress*** models can be easily imported into and exported from the central database of their MBSE solution. Thanks and congratulations to Mike Crist, Raymond Beshears, Katherine Pilat and the rest of Team Raytheon for leading the first step of this venture.

New Training Options for 2021

In response to industry changes over the last twelve months, DSI has reworked the basic ***eXpress*** training program to allow students to attend classes virtually, reducing maximum class sizes and adjusting the curriculum to accommodate hands-on training via web conferences. Similar to our in-person training, the virtual classes are instructor-led with both lecture sessions and hands-on laboratory assignments.

At the same time, behind the scenes, DSI has been developing the new ISDD training program, which will provide individuals and organizations with unlimited access to on-line self-training for a single annual subscription. The ISDD training program will allow engineers to educate themselves on their own terms—at their own pace and on their own schedule. Also included with each subscription are an annual allotment of office hours and unlimited access to the Continuing Education archive. This can all be accessed using the new Training and On-line Instruction section of their User Dashboard on the DSI Web Site.



Subscribers can access all training material from their User Dashboard

Continuing Education (CE) courses will continue to be offered virtually—both privately and in public forums—with each session dedicated to a single topic. If you have specific advanced or "brush up" training needs, contact DSI to schedule a CE course for your desired topic. Continuing Education courses offer a virtual alternative to the formal 200 and 300 series classes (which will continue to be offered in-person at the DSI offices in Orange, California). All sessions are recorded, with the video(s) made available to all attendees. Session videos will also be added to the Continuing Education archive where they can be accessed by subscribers to the ISDD training program.

To schedule virtual training or Continuing Education courses (or to take advantage of the ISDD training program at its introductory subscription price), please contact DSI.

World Wide Representatives

United States

DSI International, Inc.
(714) 637-9325
info@dsiintl.com
www.dsiintl.com

United Kingdom

Spherea Technology Ltd.
+44 (0)1202 868585
chris.gorringe@spherea.co.uk
www.spherea-technology.com

France

Spherea Test & Services
+33 (0)6 88 61 33 91
testability@spherea.com
www.spherea.com/fr

South Korea

Realtimewave Co, Ltd
+82-2-572-9471/2
sales@realtimewave.com
www.realtimewave.com

China

MTCS Systems Engineering Co. Ltd
+86-10-5881-6565
sales@mtcs.com.cn
www.mtcs.com.cn

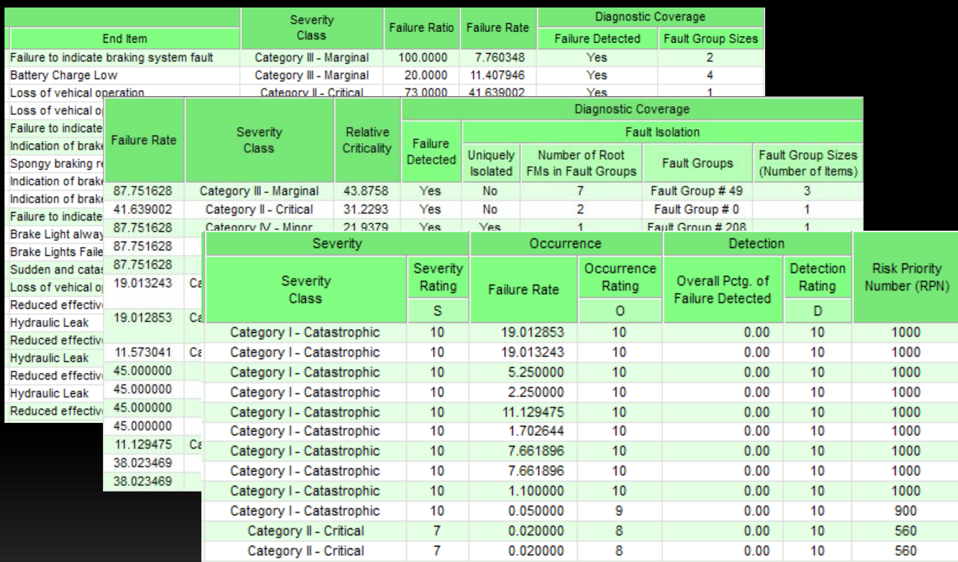
The eXpress™ Newsletter is published semi-annually by DSI International

DSI International

Diagnostics-Informed Analyses

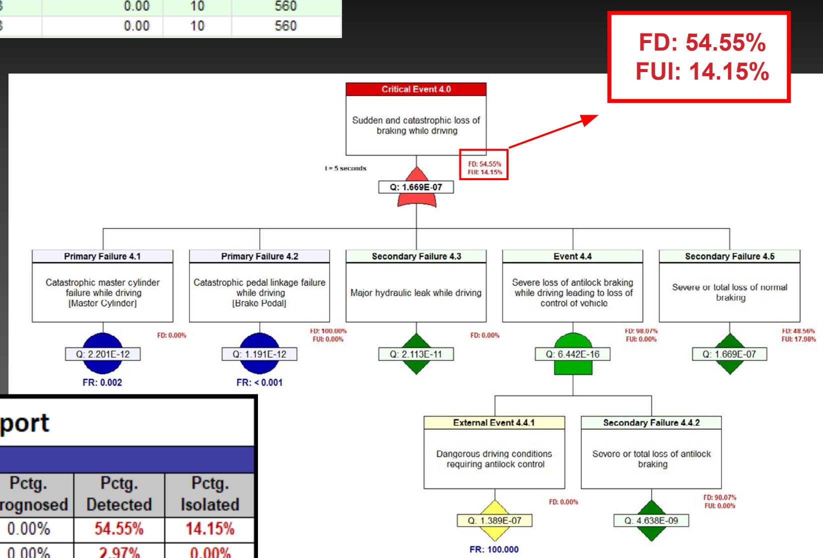
Cross-Disciplinary Assessment

Special Modules of *eXpress* perform diagnostics-informed versions of classic Reliability, Risk and Safety assessments. By including standard and custom diagnostic metrics in Failure Mode, Effects & Criticality Analyses (FMECAs), Fault Tree Analyses (FTAs), and Sneak Circuit Analyses (SCAs), the ***eXpress*** versions of these assessments allow engineers in other disciplines to determine the impact that less-than-perfect diagnostics have upon the Reliability, Risk and Safety of a system.



FMECA charts — The various charts generated by the ***eXpress*** FMECA Plus module include columns that show how failures are addressed by *actual* diagnostics from ***eXpress***, rather than a Reliability analyst's assumptions about how run-time diagnostics *should* perform.

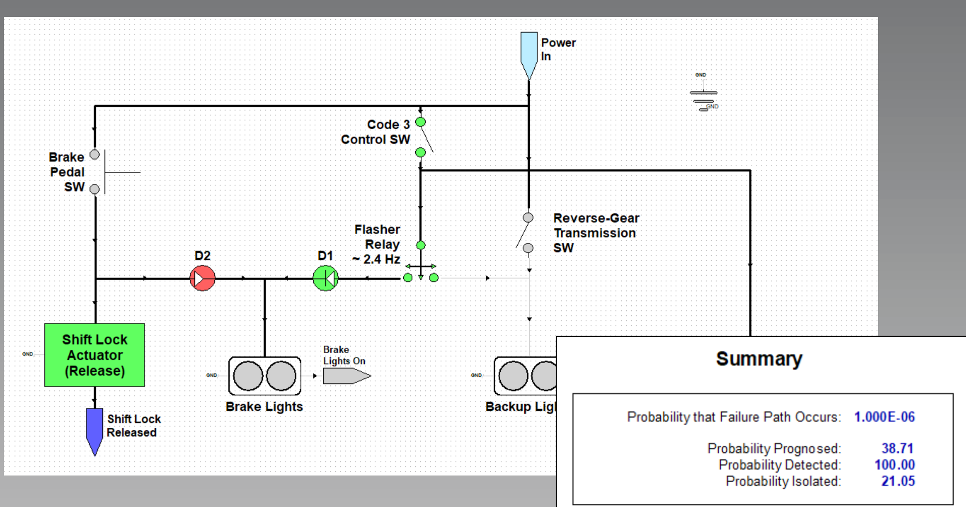
Fault Tree Analysis — The diagnostic metrics that appear in the Fault Tree diagrams & reports in ***eXpress*** indicate how well your fielded health management system will prognose, detect and isolate failures that can lead to a critical event.



Failure Diagnosis and Prognosis Report

Summary

Fault Tree	Critical Event	Aggregate Failure Rate	Probability of Failure	Pctg. Prognosed	Pctg. Detected	Pctg. Isolated
1	Sudden and catastrophic loss of braking	227.960	8.876E-008	0.00%	54.55%	14.15%
2	Indication of solenoid power failure	34.590	4.839E-008	0.00%	2.97%	0.00%
3	Failure to indicate solenoid power relay failure	0.180	2.494E-010	0.00%	99.75%	0.00%
4	ECU failure during test or configuration	0.930	2.438E-009	0.00%	80.79%	0.00%



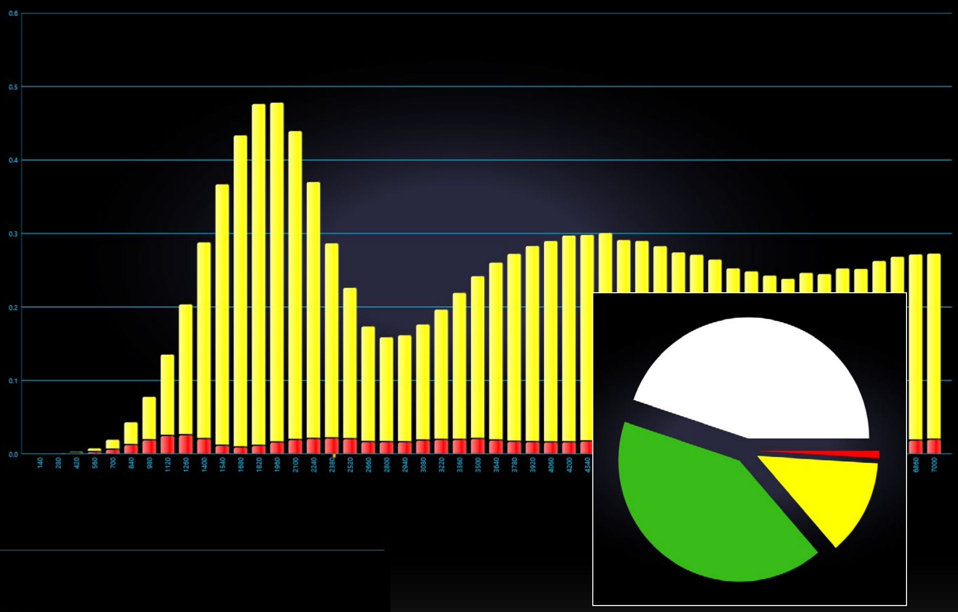
Sneak Circuit Analysis — In addition to classic sneak circuits, the ***eXpress*** Sneak Path Analysis module also identifies sneak scenarios that exist only when particular failures occur. The Failure Path Diagnosis Report analyzes how well your Prognostic Health Management (PHM) solution will prognose, detect and isolate those failures.

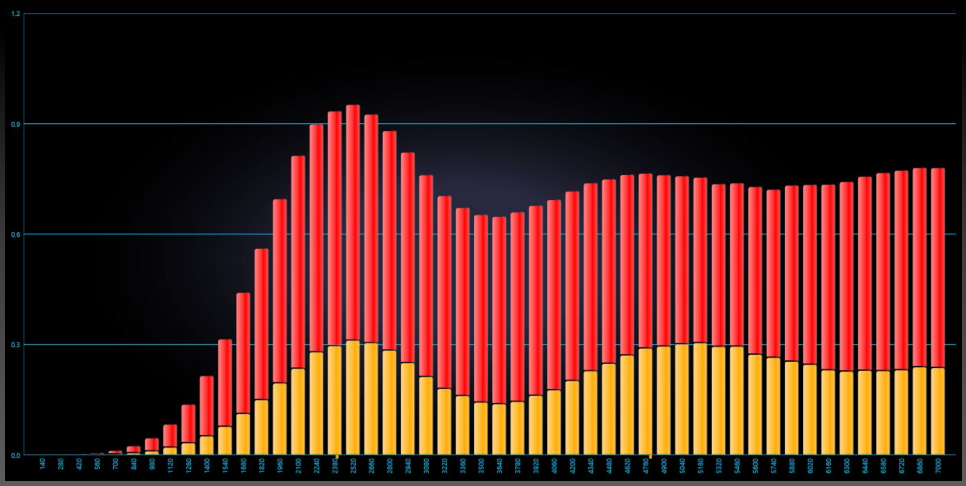
Exporting Diagnostics

Multi-purposing Diagnostics Developed in *eXpress*

The *eXpress* DiagML Export facilitates the transfer of diagnostic data—both raw and cooked—between applications. This allows diagnostic procedures developed in ***eXpress*** to be used not only by other tools in the ISDD Tool Suite (such as STAGE, RTAT and DSI Workbench), but also by third-party applications that generate Test Requirements Documents (TRDs), Test Program Sets (TPSs), Interactive Electronic Technical Manuals (IETMs), or any other process or product that can make use of diagnostics.

Diagnostic False Alarms — In STAGE, diagnostics from ***eXpress*** are used to determine the frequency of false alarms that result from sensor or BIT failures not being sufficiently isolated from operational failures. By showing that these *diagnostic false alarms* have been minimized or eliminated, analysts can confirm (quantitatively) that they have mitigated the most significant source of false alarms.

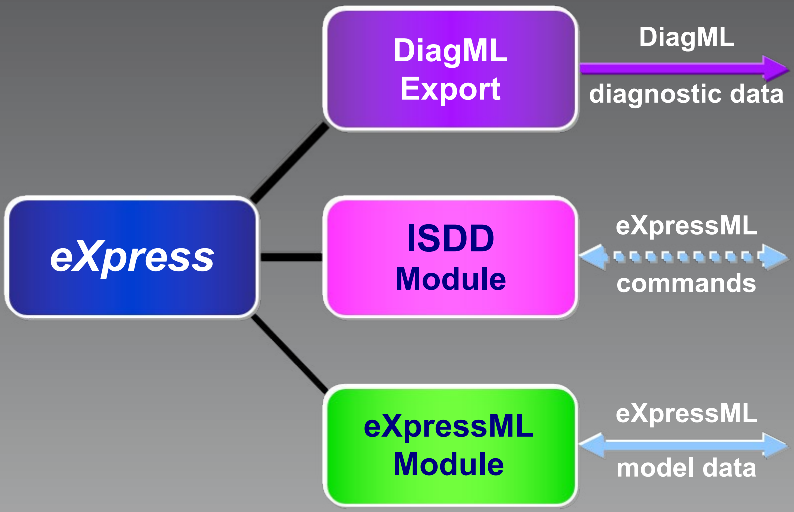




False System Aborts — When determining the frequency of system aborts over time, STAGE uses the diagnostics from ***eXpress*** to determine the percentage of *false system aborts*—aborts that would not be necessary if system diagnostics were better at identifying critical malfunctions and isolating them from more "benign" failures.

Interoperability & Multi-purposing — With ISDD, interoperability and multi-purposing go hand in hand. Using the **eXpressML** and **DiagML** modules, model data and diagnostic procedures developed in ***eXpress*** can be exported for use in other applications.

The ISDD Module allows ***eXpress*** data to be accessed by other software processes. Organizations can create models remotely, perform automated diagnostic and maintenance case studies, and incorporate diagnostic engineering data & analysis into Model Based Systems Engineering (MBSE), Product Lifecycle Management (PLM) and other digital engineering platforms.



DSI International, Inc.
1574 N. Batavia St., Bldg. 3
Orange, California 92867