

DSI's eXpress : FCS for FCS

Full Circle Software for Future Combat Systems

eXpress is proving to be the diagnostic engineering tool of choice for the Army's Future Combat Systems (FCS) program—a joint, networked “system of systems” that is currently targeting fiscal 2008 for its initial fielding and is expected to exceed \$120 Billion by 2014. FCS combines and integrates several technologies, including the non-line-of-sight (NLOS) cannon, NLOS launch system, unattended ground sensors, and two classes of unmanned aerial and armed robotic vehicles. Advanced modeling and simulation (M&S) is expected to support both live operational testing and FCS ballistic survivability evaluations. Furthermore, FCS is expected to adhere to the new DOD acquisition model of spiral development, which allows developers to insert emerging technology into systems as they mature over time. Because the ability to interface with other military services, government agencies and multi-national partners will have been built into the FCS network from the ground up, the system will be relevant to regional combatant commanders.

Because DSI's **eXpress** software has been designed precisely to aid engineers in developing and assessing the health



management capability of large-scale integrated projects, it is not surprising that **eXpress** is already being widely used by FCS developers. Not only are all of the major FCS land vehicle contractors using **eXpress** for the integration of diagnostics/prognostics information, but many of the other programs supporting FCS (such as NLOS and Joint Tactical Radio Systems, or JTRS) are also working with **eXpress**. Although it is still early in the FCS development cycle, **eXpress** is already on the job—in fact, when all is said and done, **eXpress** will have provided FCS diagnostic engineers with useful (and often essential) feedback during nearly all phases of the product “spiral” development cycle.

The ability to contract DSI's expert services is a key consideration behind many companies' decision to use the **eXpress** software on large-scale projects like FCS. DSI's modeling and analysis experts not only have the trust of industry, but are one of the main reasons behind DSI's enormous success over the years. When you have a tough or time-critical diagnostic activity, consider having an expert DSI “coach” in your corner – our first-class services will help you go the Full Cycle!

Future Combat Systems
ONE TEAM-THE ARMY/DEFENSE/INDUSTRY

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New eXpress Release sets Higher Standard

A Higher Standard - DSI International has just released a very significant upgrade of its **eXpress** Software to all of its Licensees, instantly making the new **eXpress** 5.10 the industry's most widely used Diagnostic Modeling tool.

As a world-wide audience of over 450 people witnessed during our 15 Web Conferencing Previews conducted during the month of July, **eXpress** 5.10 offers many new capabilities and user-friendly features, many of which are in direct response to requests by industry.

Just a few of the new features in **express** version 5.10 include:

- **Enhanced State Handling**
- **Spreadsheet-like Editing using Grid View**
- **Modification of Failure Rates using Duty Cycle Lists**
- **Strategy Automation / Fault Insertion**
- **Manual Manipulation of Test Sequences**
- **XML Formats for Main Analysis Reports**
- **New DiagML Options Dialog**

Ease-of-Use Enhancement - With a primary focus on ease-of-use enhancements, software design engineering at DSI has listened to the **express** user community and addressed many of the more time intensive operations associated with model development, editing and diagnostics generation. These enhancements provide the user significant time saving capabilities to streamline workflow, globally edit / update model attributes and perform “single-click” operations.

Grid View - One of the most powerful features in **express** 5.10 is Grid View—a new editing mode that allows design data to be viewed and modified in a spreadsheet-like grid (shown in yellow below).

Object Abbreviation [+]	Item Reference	Description	Cost (in US Dollars)	Reliability (MTBF)	Time
2	ABS LED	ABS Warning Light-Emitting-Diode	5.00	1.47 decades	0.22 hours
3	Battery	Battery	80.00	3.2 years	45 min
4	BL Sw	Brake Light Switch	15.00	9.2 years	30 min
5	BL Sw Adj	Brake Light Switch Adjuster	15.00	1.37 decades	30 min
6	Brk Pedal	Break Pedal	40.00	1.33 decades	30 min
7	CKV 1	Check Valve 1	30.00	2.3 decades	30 min
8	CKV 2	Check Valve 2	30.00	2.3 decades	30 min
9	CKV 3	Check Valve 3	30.00	2.3 decades	45 min
10	CKV 4	Check Valve 4	30.00	2.3 decades	30 min
11	D1	Rectifier Diode 1	3.00	1.5 decades	2 hr
12	Diag Conn	Diagnostic Connector	10.00	1.5 decades	2 hr
13	ECU	Electronic Control Unit (ECU)	200.00	3.22 years	2 hr
14	F Damp Chmbr	Front Damper Chamber	20.00	5.7 years	2 hr
15	F Pump	Front Pump	45.00	5.7 years	30 min
16	FR Line	Front Return Line	20.00	8.0 years	30 min
17	FS Line	Front Supply Line	20.00	8.0 years	30 min
18	Fuse	Fuse	1.00	120.0 centuries	5 min

Grid Control

Contents Type: Objects

Color Coding:

- Text Coloring (duplicate labels/data sources)
- Cell Coloring (entity type identification)

- Object Details
- Object Type
- Item Reference
- Failure Prob. Calculation Meth
- Description
- Object Attributes
- Cost
- Reliability
- Time

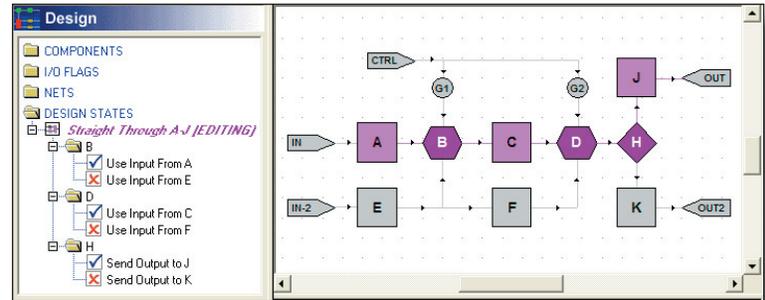
- Convert MTBFs
- hours
- Convert Time Attributes
- hours

By copying and pasting values within Grid View, the analyst can rapidly make batch changes that would otherwise be repetitive and labor-intensive to perform. Likewise, Grid View's *Find and Replace* operation provides a powerful ability to make text changes across an entire design. And if you make a mistake, the Undo operation is only a right-click away.

Grid View is particularly useful for reviewing data for accuracy. Attributes are color-coded based on source (imported values are green, default values are blue). Color-coding is also used to point out duplicate abbreviations—red is used when the duplication is potentially serious (such as ports on an object with the same name) and blue when it is benign (such as the same test name appearing in two different test sets).

Not only is Grid View a powerful editing tool, but data can also be easily exported to Microsoft Excel where it can then be incorporated into reports, imported into other Systems Engineering tools, or even edited and re-imported into **express**.

Enhanced State Handling - The object states capability has been extended through the introduction of design states, hierarchical states, and mutually-exclusive object states. A design state is a new **express** element that defines a particular combination of object state settings for a given design. The example below depicts a design state that constrains functional flow to the path between the input flag IN and the output flag OUT. Design states can be used locally (in test definitions) or inherited hierarchically for use in higher design levels. Design states can be manually created for each configuration of interest or automatically created using the *Auto-Create* feature.



Strategy Automation / Fault Insertion - The new Strategy Automation feature allows the analyst to verify and demonstrate the accuracy of a diagnostic strategy by inserting faults and then either walking through the test strategy step-by-step or asking **express** to automatically isolate the inserted faults. When this feature is invoked, the following Diagnostic Session dialog displays:

Diagnostic Session

Restart Session | Current Step | Inserted Faults | Repair/Replace | Session Stats

Pass | Fail

Enter Test Outcome

Test 1-0: Code 61 Engine Control System Malfunction

Previous | Next

Diagnose Fault

Done

The analyst can walk through a diagnostic strategy step-by-step by clicking on the *Pass* and *Fail* buttons to respond to each test until a fault group is isolated. As test outcomes are entered, the corresponding node is highlighted in the Diagnostic Flow Diagram and the colors in the drawing window are updated to reflect the current status of each object.

At the completion of each diagnostics session, the session statistics are readily available:

Diagnostic Session

Restart Session | Current Step | Inserted Faults | Repair/Replace | Session Stats

Pass | Fail

Previous | Next

Diagnose Fault

Done

	Previous	So Far	To Go
Total Tests	8	11	0.00
Total Replaced	1	0	8.00
Cost to Repair	890.00	770.00	635.00
Time to Repair	340.50	145.50	600.00

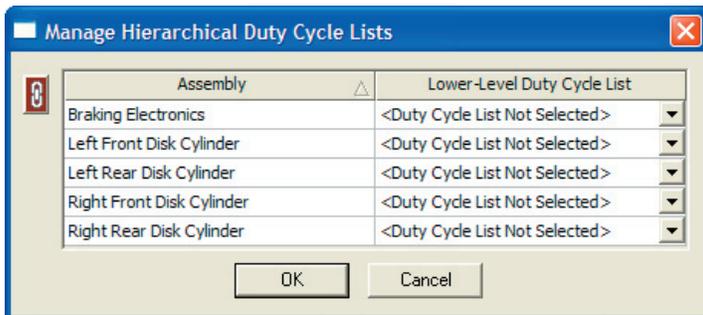
Duty Cycles - Duty cycle lists are a feature new to **express** 5.10 that allow the analyst to define sets of factors by which raw failure rates can be multiplied to account for different levels of usage within a design. If

a component's failure rate is given in terms of *that component's usage* (for instance, when an engine's MTBF is defined in hours of engine use), a duty cycle list can be used to define the overall percentage of time that the object or function is used. An operating mode can then be set up to use that duty cycle list. When the operating mode is used in a Diagnostic or FMECA study, the "raw" failure rate will be multiplied by the corresponding percentage in the duty cycle list. With this feature, different failure rates can be established for an object or function in different operating modes. In previous releases of **eXpress**, the user had to "cook" the failure rates externally and could only modify these values "automatically" by changing data sources.

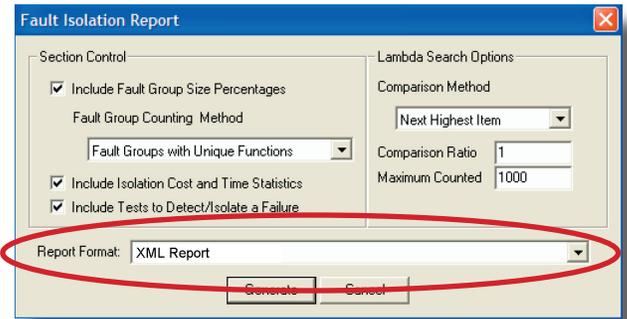
The individual usage percentages in each duty cycle list can be edited in Grid View (as previously discussed) or, when the duty cycle list has been associated with an operating mode, on the Reliability window on the *Attributes* panel as shown.



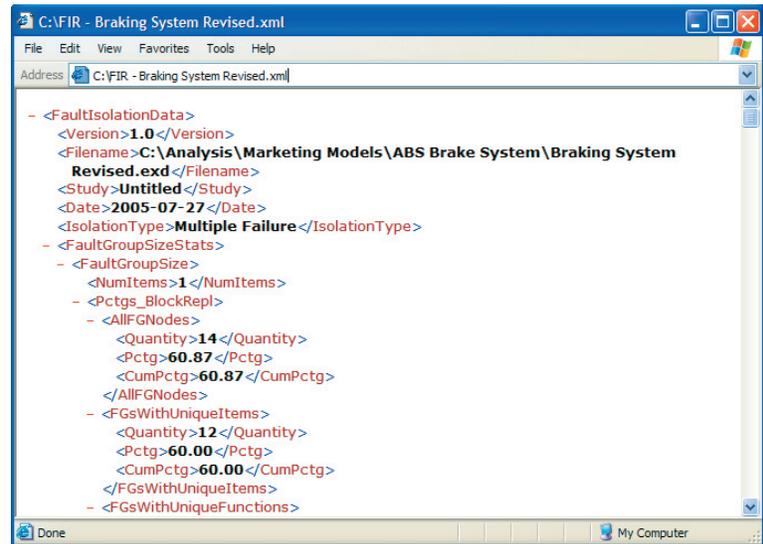
Duty Cycles can also be established hierarchically and selectively invoked for lower level assemblies and linked.



XML Output Formats for Analysis Reports - The Detection Order, Detection Coverage, Fault Isolation and Fault Group Details reports can now be generated in alternative formats. When each of these reports are invoked, a new *Report Format* drop-box appears on the report option dialog as shown in the red oval.



Once the analyst has established the destination file, **eXpress** will generate an XML file containing the report. This file can be viewed using a variety of external tools. In the following example, an XML version of the Fault Isolation report is displayed in Microsoft Internet Explorer:



These are just a few of the many new enhancements and features found in **eXpress** 5.10. Please contact DSI for additional information. For our customers who already have upgraded to 5.10, please see the release notes (on the **eXpress** 5.10 CD, or in the Login area of the DSI Website) which detail all of these new exciting capabilities.

Training Schedule

Course Number	Pre-requisite	Course Description	Dates	Location	POC
100		System Diagnostics Concepts and Applications	30 Jan, 2006	Orange, CA	Denise Aguinaga , DSI
110	100	Basic Modeling & Introduction to Testing	30 Jan, 2006	Orange, CA	Denise Aguinaga , DSI
120	110	Introduction to Testing & Analysis	2 Feb, 2006	Orange, CA	Denise Aguinaga , DSI
Specialized		On-Site Training - Raytheon	6-10 Feb, 2006	TX	Call DSI for Details
Specialized		On-Site Training - General Dynamics Land Systems	13-17 Feb, 2006	MI	Call DSI for Details
100		System Diagnostics Concepts and Applications	17 Apr, 2006	Orange, CA	Denise Aguinaga , DSI
110	100	Basic Modeling & Introduction to Testing	17 Apr, 2006	Orange, CA	Denise Aguinaga , DSI
120	110	Introduction to Testing & Analysis	20 Apr, 2006	Orange, CA	Denise Aguinaga , DSI
200	120	Advanced Diagnostic Development & Assessment	22 May, 2006	Orange, CA	Denise Aguinaga , DSI
205	200	Advanced Test Development & Importing	24 May, 2006	Orange, CA	Denise Aguinaga , DSI
210	205	Advanced FMECA Development & Assessment	26 May, 2006	Orange, CA	Denise Aguinaga , DSI



Highlights of AutoTestCon 2005

This year's Autotestcon was held in Orlando, Florida last September. DSI wishes to publicly thank all of you who stopped by our booth and had a chance to take a peek into what we have in store for the very near future!

As many of you know, DSI's concept of prognostic/diagnostic integration and interoperability has always been to encourage industry to select a tool for its unique strengths and as a result of this focus, we are currently setting up a development plan with Impact Technologies to integrate the prognostics technology with our existing diagnostics capabilities. 2006 is our target for an initial integrated capability. This will fit with our simulation capability that was demonstrated in September. DSI and Impact Technologies are teaming on a mutual booth at the 2006 Autotestcon.

To date, our focus has been on optimizing fault detection and isolation through early design studies. This, combined with the capability to take low level, subsystem, diagnostics models and roll them up to the system level, provides high confidence for FD/FI. Our integrated FMECA provides a solid base for the diagnostics development, and also provides the needed cross check for a solid design validation. This provides the ability to observe a fault, or in the case of prognostics, to observe a functional anomaly when a time domain failure starts to occur. This is where the technology from Impact comes in. They can take the anomaly and track it to determine the point where a maintenance action needs to take place to preclude a failure. The key factor here is understanding what can be best accomplished through diagnostics and what needs to be tracked through prognostics. Today, prognostics is focusing on equipment and structures that present time related failure trends that can be analyzed and predicted based on

conditions rather than failure rate. Electronics present a major challenge for prognostics. This is why we found it important to team with a company that has the other side of the health management equation.

RAMS Symposium

January 23 – 26

Newport Beach, CA

www.rams.org



DSI is honored to be moderating the Prognostics Health Management (PHM) panel discussion at the 2006 RAMS Symposium on January 25th. The panel discussions will revolve around the integration of traditional R&M with Diagnostics and Prognostics Engineering, all within the Systems Engineering process. The drive behind this discussion is to design a product for an effective Operational run-time Health Management and Logistics Support Solution.

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As the leading seller of Diagnostic Software & related Diagnostic Engineering Services, DSI understands the importance of quality service and support. To meet the needs of our customers, we offer a wide array of technical support and service programs developed to address the time-critical issues and stringent diagnostic requirements relevant on many of today's programs. DSI is ready to help with specialized software development, diagnostic modeling and analysis, prognostics and integration with any embedded Run-Time, integrated health management (IVHM, ISHM, IPHM, etc.), advanced mentoring, data management processes and a host of customizable support services to address specific customer needs.

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