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EXPERT SYSTEM SIMULATION CAPABILITY FOR RECOVERABILITY MODELING

Test & Evaluation Solutions, LLC developed the Integrated Recovery Model (IRM) software suite, a simulation tool used to evaluate the complex interaction of shipboard systems, including crew's response to damage.

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THE CHALLENGE

The Navy sought an innovative approach for the development of an expert system to provide a reasonable approximation of the impact of the "fog of war," or the uncertainty of a crew's situational awareness, on a ship's crew's ability to respond to battle damage as part of a recoverability assessment. Specifically, the objective was to develop a more accurate solution to emulate the crew as individuals whose actions may or may not be repeatable, and whose limited access to information often results in inefficient response to damage. Crew responses are informed by situational awareness. Current recoverability simulations do not emulate the development of situational awareness and miss design vulnerabilities associated with installed sensors and limited crew resources. While testing may capture some of these elements, it is expensive, occurs late in the shipbuilding program and can only address limited test cases.

THE TECHNOLOGY

Test and Evaluation (T&E) Solutions, LLC developed the Integrated Recovery Model (IRM) network connectivity time-based simulation tool used to evaluate the complex interaction of shipboard systems and identify vulnerability and recoverability design issues. The recovery simulation realistically emulates the interaction and dependency of ship systems, initial system configurations, structural and equipment damage from weapons effects, fire, flooding, stability, and crew responses over time. The simulations of crew interactions with each other and their environment over time allow a realistic development of situational awareness in different scenarios, and analyze the effectiveness of reduced manning concepts, system automation, and installed sensor systems. IRM can produce analysis based on thousands of scenario simulations. It integrates with primary and secondary damage prediction models and allows for parametric studies to reduce uncertainty.

THE TRANSITION

As T&E Solutions matured the IRM technology, the company partnered with Hughes Associates, Inc. to develop a crew behavior module that works with the IRM simulator and existing fire and flooding models. The new crew behavior module addressed the crew behavior limitations from the original IRM. T&E Solutions used the IRM software suite to support the Navy DDG 1000 and CG47 Class Modernization programs. Currently, IRM is being used to support the Littoral Combat Ship (LCS) and DDG 51 Flight III programs. Verification and validation of IRM has been performed and documented. The IRM has been accredited by both the DDG 1000 and LCS programs.

THE NAVAL BENEFIT

All new ship acquisition programs and some modernization programs are required to conduct realistic survivability testing. The costs of conducting this testing are significant but can be reduced through modeling and simulation tools. By using the IRM, a simulation tool, to assess design concepts and support cost and benefit analyses, shipbuilding and modernization programs will build more survivable ship designs, as the IRM provides impact analysis and risk reduction related to manpower and system design decisions.

THE FUTURE

In addition to DDG 51 Flight III, LCS and DDG 1000 programs, T&E has provided model and simulation based Live Fire Test and Evaluation (LFT&E) assessments for the Expeditionary Mobile Base (ESB), Mobile Landing Platform (MLP), and LPD Flights I and II programs.

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