

# STUDIES AND ANALYSIS

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## THE CHALLENGE

CSCI conducts modeling and simulation studies for its customers to identify and resolve engineering and operational issues and compare the utility of advanced air and missile defense systems. Both mathematical modeling and operational concept development require that leaders and operational developers participate in assessing the value of these advanced systems. These operators, however, tend to rely on their experience with legacy weapons systems and assess the performance of advanced systems using lower technical performance metrics such as depth penetration of threat targets. While this type of metric works well for legacy systems, these technical metrics fail for advanced area defense systems working in a system of systems. A methodology is required that allows for the effective analysis of the contributions of advanced systems to air and missile defense capabilities based on the logical consideration of the factors and tradeoffs involved.

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## THE STRATEGY

CSCI uses discrete event simulation and decision theory tools to enable operators to define and assess countervailing “value-based” operational metrics to evaluate the contributions or value of each. This allows operators to effectively distinguish the relevant metrics data based on analysis of the operational data.

CSCI has developed a suite of tools that includes the Data Analysis Visualization Environment™ (DaVE) and operational discrete event simulations written in a flexible simulation tool called Extend. These tools and simulations allow the integration of complex engineering and operational logic into a discrete event simulation. Advanced weapon capabilities are simulated using realistic engineering-level capabilities and specific operational force employments. Analysts acting as enemy (Red) teams and friendly (Blue) teams use the visualization capabilities of DaVE to plan attack routes and locate defensive positions on realistic terrain to protect time-sensitive critical assets.

Blue team members use a decision theory tool, Logical Decisions, to assess the relative value of protected assets subject to a realistic operational

plan. The data presentation capabilities of Logical Decisions supports assigning time-sensitive relative values to countervailing operational metrics; for example, comparing the value of preventing friendly air fratricide with allowing a successful cruise missile attack on an active sea port of entry. In other words, there is an emphasis on measuring results, rather than measuring measurements. The discrete simulation is iteratively run with Blue team operators and analysts reviewing output data as rendered with the DaVE’s detailed graphics. The Blue team adjusts force plans and reviews the values/weights of their value metrics based on the outcome of the specific simulation scenario.

Through the study of a number of operational events in the discrete event simulation, operators can come to agreement about the difficult tradeoffs between various value metrics. Priorities can be adjusted and reevaluated in order to highlight a number of possible outcomes. The decision theory model provides the basis for this evaluation of operational and engineering alternatives and for making informed decisions about the value of each.

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## THE RESULTS

Addressing the need for an improved method of analyzing the contributions of advanced systems to air and missile defense capabilities, CSCI uses a combination of discrete event simulation, decision theory, and visualization tools to provide value-based analysis of operational metrics. This approach enables key operational decision makers, or their staffs, to participate in defining more relevant metrics for advanced system analyses, increasing trust in the results of mathematical analyses while allowing operators to focus more on operational capability and overall effects instead of individual system technical performance. Through the use of these simulations and decision theory tools, issue resolution and program/system development decisions can now be based on analysis of operational decision values rather than complicated combinations of technical metrics. In this way, CSCI helps its customers to produce more balanced, operationally grounded strategy determinations that increase battlefield efficiency while reducing redundant spending.