

DATA AND KNOWLEDGE ACQUISITION, ENGINEERING, AND MANAGEMENT

The Information Sciences Division (ISD) has been on the forefront of technology for capturing, structuring, and managing information about the military domain since the early 1990s. ISD's data and knowledge engineering solutions support the modeling and simulation (M&S) community by providing a structured way of representing military domain knowledge such that it can be expressed and understood by warfighters and used for systems implementation by software and simulation engineers. Using these techniques and tools to integrate data from numerous heterogeneous sources, we construct representations of the domain that support the design of valid and credible models and simulations for use in areas that include research, development, test, and engineering (RDT&E); acquisition; and training. In all of these areas, M&S is a proven approach for reduction of cost and risk, and ISD's data and knowledge engineering techniques ensure that M&S development has a sound basis and uses trusted, appropriate data.

ISD's techniques utilize structured modeling languages for information and processes as an integration point to construct integrated databases and define information exchange specifications. These technologies have been applied to multiple domains and have been used in data integration efforts that involve thousands of data elements supporting dozens of information sources and models and simulations. Our current research thrusts include:

- C4I and simulation integration
- Integration of technologies for mission rehearsal
- Modeling and simulation for defense acquisition
- Simulation interoperability standards
- Formalized knowledge specifications



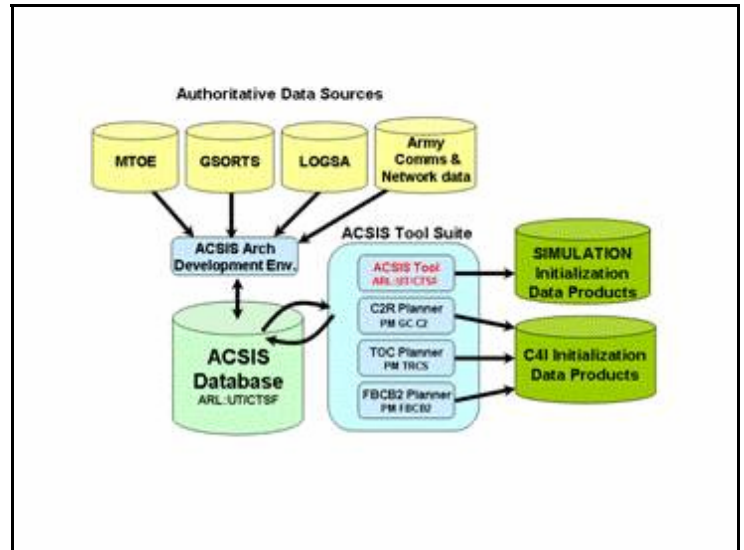
**Multi-mission Maritime Aircraft
(photo courtesy of Boeing Integrated
Defense Systems)**

C4I and Simulation Integration

ISD is a developer of the US Army's Command, Control, Communication, Computers, and Intelligence (C4I) and Simulation Initialization System (ACSIS). ISD staff members designed a unified data repository and toolset that takes data from authoritative DoD sources and allows users to build custom data loads for C4I and simulation systems. Before ACSIS, the preparation of consistent C4I data loads across multiple systems took months. Since these C4I systems are commonly used with simulations to conduct training and testing, additional time and manual translation was needed to ensure that the C4I systems and simulations were operating with a common set of data. ISD staff, working with the Army C4I community, has shown that these data loads can now be built in a matter of days, and sometimes hours. We are currently working with the Joint community to extend these capabilities.



ACSIS: Supporting Operations in Iraq



ACSIS System Architecture

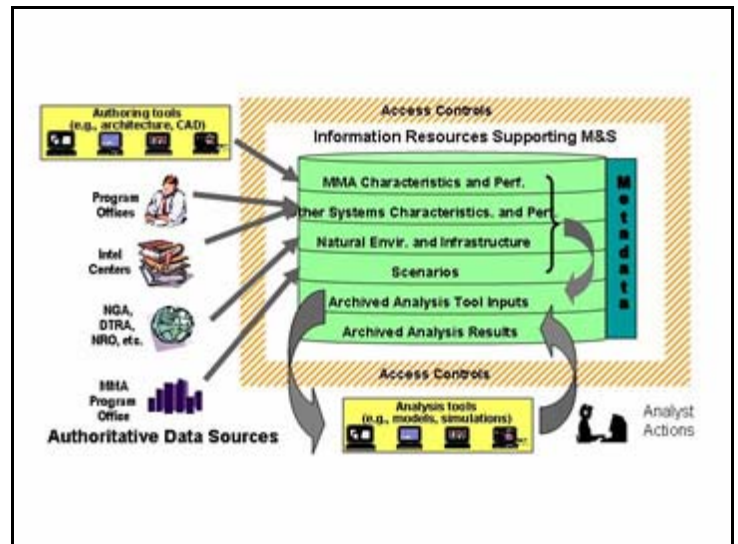
Integration of Technologies for Mission Rehearsal

Military mission rehearsal exercises conducted prior to deployment or en route to a theater of operation require a capability to rapidly generate scenarios as well as initialize C4I and simulation systems with a common set of authoritative data. Key elements of this process include the battle management information contained in tactical operations plans, operations orders, and other battle management products. The Army's Battle Management Language (BML) initiative is intended to provide a standard, unambiguous, and automated means to exchange individual data elements related to the "5Ws" (Who, What, When, Where, and Why) of battle management.

ISD has been a core contributor to the integration of ACSIS and BML technologies in order to further reduce C4I database preparation time and costs as well as to reduce data errors and inconsistencies. This integration project leverages these two technologies and standards to enable the rapid and accurate initialization of both C4I systems and federations of simulations with mission-specific or scenario-specific data from a common data set before the start of an exercise or testing event.

Modeling and Simulation for Defense Acquisition

ISD was involved in two major DoD aircraft acquisition programs—the Joint Strike Fighter and the Multi-Mission Maritime Aircraft (MMA)—both of which rely heavily on M&S to perform analysis and trade-off studies during the design and development of the aircraft. ISD has been a leader in data engineering activities to support both of these programs, working closely with the government and contractor teams to define a data management strategy that will lead to verifiable and validated M&S use. For the MMA programs, we are constructing the integrated data environment that will initially manage all data used for government M&S activities.



**MMA Modeling and Simulation
Integrated Data Environment**

Simulation Interoperability Standards

Researchers in ISD are key participants in the development of M&S standards. We were involved in the initial Institute for Electronic and Electrical Engineers (IEEE) High Level Architecture (HLA) for M&S as well as the Federation Development and Execution Process (FEDEP) for HLA. An area of significant current emphasis has been related to DoD information exchange standards, including discovery metadata specification, the Military Scenario Definition Language, and the Joint Command, Control, and Consultation Information Exchange Data Model, a NATO standard which has now been adopted by the U.S. Army and the Marine Corps. Additionally, ISD is involved in the data discovery, data translation, and data exchange standards associated with DoD Web Services Oriented Architectures.

Formalized Knowledge Specifications

ISD personnel are engaged in establishing formal specifications for capturing domain knowledge. These specifications of domain knowledge provide consistent views for the domain expert and the implementer of information systems. Our approach will ensure that the resulting knowledge specifications are directly executable, in addition to providing traditional static representations, so that they can most effectively be exercised, examined, and validated by the subject matter experts.

For further information regarding the Data and Knowledge Acquisition, Engineering, and Management program, please contact:

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