

Department of Defense

Integrated Natural Environment

Strategy

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1 Introduction

1.1 References

- a. DoD Directive 5000.59, “DoD Modeling and Simulation (M&S) Management,” January 4, 1994
- b. DoD Pamphlet 5000.59-P, “Modeling and Simulation (M&S) Master Plan,” October 1995

1.2 Situation Statement

The DoD Modeling and Simulation (M&S) Executive Agents (MSEAs) for Oceans, Air & Space Natural Environment, and Terrain along with other representatives from the M&S environmental community joined forces on the Integrated Natural Environment (INE) Tiger Team to develop the INE Strategy, Concept of Operations (CONOPS), and Implementation Plan. The INE Strategy and CONOPS identifies for the entire M&S community what needs to be done to achieve DoD M&S Master Plan Objective #2: “Provide timely and authoritative representations (ARs) of the natural environment.” In addition, The INE Strategy directly supports the DoD M&S vision to “provide readily-available, operationally-valid environments for use by DoD components” where the natural environment is a critical component of the overall environment required for DoD simulations.

Warfighters require authoritative environmental ground truth for M&S. To build this ground truth, the DoD needs a repeatable, cost-effective infrastructure and process to generate integrated, cross-domain ARs of the natural environment. In February 1999, the DoD Modeling and Simulation (M&S) Executive Agents (MSEAs) for Oceans, Air & Space Natural Environment, and Terrain along with other representatives from the M&S environmental community joined forces on the Integrated Natural Environment (INE) Tiger Team to tackle this important and complex problem. Between March and July 1999, this team developed an INE Strategy and Concept of Operations (CONOPS) which will revolutionize the use of natural environment information for the entire range of M&S applications.

The INE Strategy and CONOPS are living documents which support a spiral development process. Changes are anticipated to these documents based on user input and as the development of the INE strategy progresses.

1.3 Purpose

The INE Strategy documents how natural environmental data will flow from producers to users via an infrastructure. Beginning with the DoD 5000.59-P objective and the DoD M&S vision, we first developed an MSEA Vision Statement, followed up with a detailed Concept of Operations (CONOPS) to achieve that Vision. Execution of the INE Implementation Plan will ensure that the individual projects of the natural environment

MSEAs as well as the DMSO Tri-MSEA projects are coordinated in both function and time to provide the capabilities required to generate inter- and intra-domain integrated environmental representations required by DoD's models and simulations.

1.4 Vision

The INE Strategy supports the *DoD Modeling and Simulation Vision found in DoD 5000.59-P*:

“Defense modeling and simulation will provide readily available, operationally valid environments for use by the DoD components:

- To train jointly, develop doctrine and tactics, formulate operational plans, and assess warfighting situations.
- To support technology assessment, system upgrades, prototype and full-scale development, and force structuring.

Furthermore, common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.”

In support of the DoD M&S vision, the MSEAs developed the following vision to define the infrastructure that will provide readily available, valid *natural* environments that support, for example, the warfighters vision of ‘train as you fight, fight as you train’:

"DoD M&S activities will have a readily accessible infrastructure for obtaining authoritative representations of the natural environment. Users will have a robust capability to cost-effectively acquire environmental scenarios customized to their requirements. When needed, providers will use approved standards to produce and deliver data that are physically consistent both within and among the Air, Ocean, Space, and Terrain domains. This M&S integrated natural environment support infrastructure will promote simulation interoperability, data re-use, and customer confidence."

1.5 Scope

This strategy encompasses development and provision of authoritative environmental data representations prior to simulation runtime. This strategy does not address runtime requirements for development, identification and ready access of authoritative algorithms, tools, and models needed by M&S users. MSEA Vision Statement Analysis

- a. "DoD M&S activities": This refers to any DoD model or simulation wherever it is used within the department. Key customers include the acquisition, training, analysis, and operational communities to include those performing mission

planning and rehearsal; JWARS; JSIMS; JMASS; wargamers; the intelligence community; logistics community; simulation developers; and the education community.

- b. "will have a readily accessible infrastructure": In order to fulfill their management responsibility for "common and general-use M&S applications" as delineated in DoDD 5000.59, the MSEAs must ensure the common and general-use infrastructure is put in place to provide the application (i.e., the environmental representation) to DoD Components for use in their models and simulations.
- c. "for obtaining authoritative representations of the natural environment.": DoDD 5000.59 states, "Models of military operations depend on interaction with representations of the natural environment including permanent and semi-permanent man-made features. This requires authoritative three-dimensional representations of the terrain, oceans, atmosphere, and space. These representations are complex in design and require significant funds and time to build. Therefore the complexity should be commensurate with the simulation's functional requirement for detail given the scope of what is being modeled."
- d. "Users will have a robust capability to cost-effectively acquire environmental scenarios customized to their requirements." This generically describes the capabilities needed to provide users the ability to specify and acquire data, which meets their specific needs, for their models and/or simulations. The infrastructure will have a robust user interface to allow customers to specify the environment they need. They will be able to acquire this information at greatly reduced cost for DoD.
- e. "When needed,": The infrastructure being developed will provide timely production (if necessary) and delivery of the requested information.
- f. "providers will use approved standards to produce and deliver data": These are the providers whose data and JiT services are available through common library services. Implementation of a common environmental data representation model will promote interoperability and reuse by providing a uniform and effective standard mechanism for interchanging environmental data among M&S applications.
- g. "that are physically consistent both within and among the Air, Ocean, Space, and Terrain domains.": This is where the subject matter expertise of the MSEAs has the greatest import and where tremendous strides can be made over today's capabilities. Environmental information is being provided to simulations; however, there has been insufficient effort to ensure physical consistency both within and among the four environmental domains. Without physical consistency, there is no assurance of fair play within a multi-Service simulation. For example, if strong atmospheric winds do not produce a commensurate sea

state, the Navy could be operating with impunity while performance of Air Force systems is seriously degraded. Army systems might be operating believing that tactical obscurants concealed them, yet Air Force systems might have “clear conditions” for Close Air Support targeting. Appropriate simulation outcomes are dependent upon having a physically consistent environment.

- h. "This M&S integrated natural environment support infrastructure will promote simulation interoperability, data re-use, and customer confidence." The result of all of the above.

2 Strategy Components

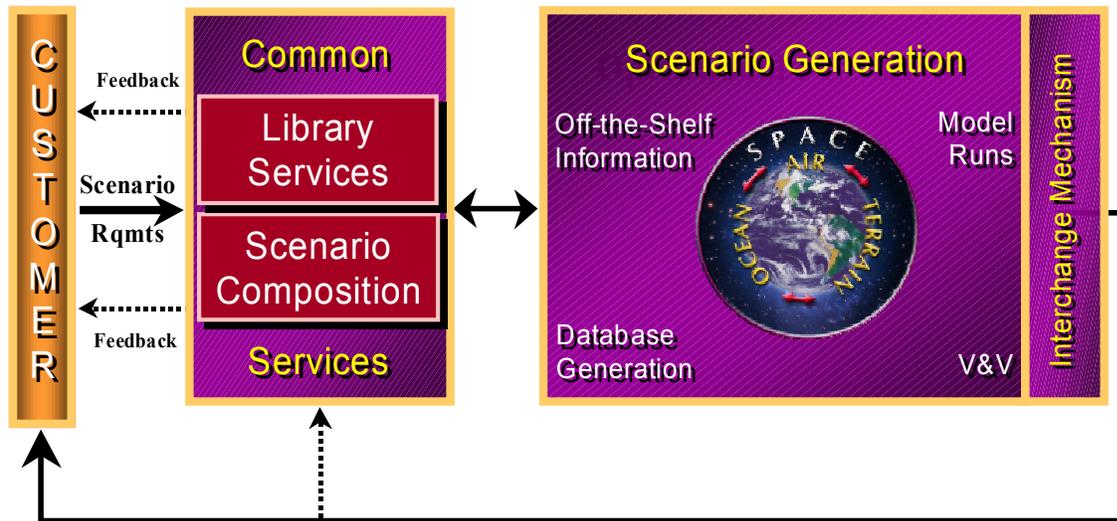


Figure 2-1. Integrated Natural Environment Authoritative Representation Process

The diagram in Figure 2-1 provides a high-level depiction of the major components that comprise this strategy.

At the heart of the INE Strategy is the concept that an infrastructure of common services, scenario generation capabilities, and interchange mechanisms can be molded into a standard process to produce integrated authoritative representations (ARs) of the natural environment. The INE infrastructure including the interconnectivity between its components is shown in Fig. 2-1. The process begins with a customer using an interface with the various common services to communicate their scenario requirements in their own terms. Environmentally aware users will then be able to order data for their application using an on-line Library Services capability.

When a complete, tailored data set needed to meet the user's requirements is not already available "off-the-shelf", then scenario composition and generation technologies are needed to take the user's requirements, translate them into technical, environmental terms, figure out what models to run or parts to assemble to facilitate the production and assembly process. Environmental Data Providers actually generate part or all of each scenario using their JiT production resources. They use the models that they have and retain complete control over their production processes. To achieve inter-domain integration, it is necessary to orchestrate the flow of the production process such that the appropriate models run in the correct sequences to ensure physical consistency between the various domain parameters, including user required derived parameters. Atmosphere data, for example, goes to the ocean provider so that the surface winds and waves are correlated, e.g., consistent; or atmosphere data goes to the terrain provider so that the temperature, precipitation, and snow cover are consistent.

There are several pillars of technological functionality required for the process described above: (1) Library Services and Scenario Composition capabilities (linked to the user via Common Services). (2) Scenario Generation , (3) Scenario production capabilities. (4) Common interchange/transmittal mechanism. The good news for the DoD is that much of the technology required for this INE Strategy already exists or is under development. In the INE CONOPS and Capabilities Assessment we discuss current and developing technology in the context of mechanisms that are fueling the INE AR Process.