



**Toward a New National Weather Service:
Preliminary Assessment of the Operational Test and
Evaluation Process for the Advanced Weather
Information Process Systems**

Letter Report from the National Weather Service
Modernization Committee, National Research Council

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Toward a New National Weather Service

Preliminary Assessment of the Operational Test and Evaluation Process for the Advanced Weather Interactive Processing System

Letter Report from the National Weather Service Modernization Committee Commission on Engineering and Technical Systems

**National Research Council
Washington, D.C. September 1996**

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competencies and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Toward a New National Weather Service

Preliminary Assessment of the Operational Test and Evaluation Process for the Advanced Weather Interactive Processing System

Since 1991, the National Weather Service Modernization Committee of the National Research Council (NRC) has been continuously involved in reviewing the plans for and development of the Advanced Weather Interactive Processing System (AWIPS). In 1995, the National Oceanic and Atmospheric Administration (NOAA) asked the NRC to “review plans and progress on the development and implementation of the Advanced Weather Interactive Processing System.”¹ This letter report specifically addresses the subtask of “evaluat(ing) the adequacy of the conduct of the AWIPS operational test and evaluation [OT&E] and the results or actions taken by NOAA and NWS [National Weather Service] in response to the tests and evaluations.” A more comprehensive and detailed study by the committee is under way, which will include a full description of the AWIPS OT&E process, the results of NOAA and NWS responses to OT&E, and extensive background information and justification for the committee's findings and recommendations. Although the observations, findings, and recommendations presented here are preliminary, the committee welcomes this opportunity to advise the NWS early in the AWIPS deployment process.

BACKGROUND

AWIPS consists of 130 geographically dispersed sites connected by a network. The sites include weather forecast offices (WFOs), river forecast centers (RFCs), and National Centers for Environmental Prediction (NCEP). The network includes a satellite broadcast network (SBN) for disseminating satellite images and the output (gridded data products) from weather prediction models produced by the NCEP, a wide area telecommunications network that connects the sites, and a network control facility (NCF). The NCF monitors the health and status of all AWIPS sites and can transfer software upgrades to the sites.

According to the original AWIPS contract, development of the system, culminating in the delivery of full AWIPS capability to all sites, was scheduled to take five years. Several independent review bodies recommended that NWS adopt an evolutionary process, which requires incremental deployment of components of the system. Operational feedback could then be used to guide the development of the final system.² ; Incremental deployment is crucial in this

¹ Statement of Work for National Weather Service Modernization Committee. NOAA Contract 50-DGNW-5-00004. March 16, 1995.

² Kottler, Herbert. AWIPS Independent Review, Final Report. Massachusetts Institute of Technology, Lincoln Laboratory, June 29, 1994.

case because the NWS is evolving new operational practices and procedures in parallel with AWIPS deployment.

The incremental deployment of AWIPS began with an operational prototype known as Pathfinder. For the past year, Pathfinder has been undergoing evaluation at the WFO in Pittsburgh, Pennsylvania, the co-located WFO/RFC in Taunton, Massachusetts, and the NCF. In addition to demonstrating the early functional capability of AWIPS in an operational setting, Pathfinder has demonstrated the functionality of the AWIPS SBN and the interaction between the NCF and operational sites. Pathfinder has also demonstrated the NCF's ability to detect faults in the system and to transfer new software to field sites with a minimum of disruption.

For the next several years, incremental development and deployment will continue with a series of software upgrades (called "builds") that will increase the functional capacity of AWIPS. The process for verifying the functionality and performance of each build is well defined. First, a build undergoes a period of testing at the factory of the contractor to verify that the functionality and performance of the software meet specified requirements for that build. This testing is followed by OT&E at field sites to confirm that the functionality and performance are retained in the deployed system, to establish that NWS personnel at the sites can use the system, and to identify operational problems or deficiencies that must be addressed in subsequent builds or software corrections.

The initial installation of AWIPS includes the initial software release (Build 1) and the hardware. Once the hardware and Build 1 software have been deployed, OT&E will be conducted to obtain feedback from forecasters on the functionality, performance, and utility of the system. The OT&E plan calls for Build 1 to be deployed and evaluated at nine field sites. The results will be evaluated as part of the AWIPS production decision to authorize the full-scale deployment of AWIPS at all 130 sites.

Prior to observing the OT&E of Build 1, the committee observed the performance of the WFO advanced meteorological applications software (WFO-Advanced), which was developed by the Forecast Systems Laboratory of the NWS as part of the risk reduction for AWIPS. WFO-Advanced software runs on the AWIPS hardware and ingests the same data sets as AWIPS. The Forecast Systems Laboratory has stated that WFO-Advanced is functionally equivalent to the AWIPS Build 4.³ Although the detailed functional specifications for Build 4 were being revisited at the time of this report, the AWIPS program office verified the Forecast Systems Laboratory characterization of the functionality of WFO-Advanced.

PRELIMINARY FINDINGS AND RECOMMENDATIONS

The committee assessed the process being used by NWS for OT&E, including installation, training, preparation for OT&E, conduct of OT&E, and follow-up, within the broader context of the operational deployment of AWIPS. The committee reviewed the OT&E plan to ensure that the OT&E process was well documented and that evaluation criteria were clearly defined. Members of the committee observed the preparations for OT&E and its conduct at four of the nine field sites involved in the evaluation. The four sites were the RFC and WFO at Pleasant Hill,

³ Site visit by the NWSMC to the NWS office at Denver, Colorado on June 10, 1996.

Missouri, and the RFC and WFO at Salt Lake City, Utah. The committee confirmed that OT&E participants followed the documented testing procedures and noted necessary corrections. Members of the committee informally discussed reactions to AWIPS with OT&E participants at all visited sites. The committee also reviewed the results of the system evaluation and services evaluation surveys from the first weeks of OT&E, as well as documented-problem reports and action reports in response to problems. Committee members also observed operations at the NCF. On this basis, the committee presents the following preliminary findings and recommendations pertaining to the OT&E for Build 1 within the overall plan for AWIPS deployment.

FINDINGS

Finding 1. The OT&E process observed at these operational sites was well structured and in accordance with the documented plans. Based on the committee's view of what an incremental build process should accomplish (described in Background section), the OT&E process is appropriate for the introduction of AWIPS.

Finding 2. Installation of AWIPS equipment was well planned and executed and caused minimal interference with ongoing operations at the WFOs and RFCs.

Finding 3. In general, training for WFO applications was well received by site personnel. Survey responses indicate that the training for RFC hydrology applications was less effective, however, because the system was not yet configured for specific geographical areas.

Finding 4. Site installation and configuration depended on the use of numerous "scripts."⁴ Resolving problems caused by the incorrect or inconsistent application of the scripts required extensive interaction between the NCF and site personnel. It appeared to the committee that the scripts themselves and the required manual inputs had not been subject to appropriate configuration management and that the application of particular scripts was not well controlled.

Finding 5. Reactions of site personnel to the AWIPS satellite and next generation weather radar (NEXRAD) displays were positive. The display quality of radar and satellite images is much improved over the image displays of previously available operational systems.

Finding 6. The OT&E disclosed that AWIPS Build 1 software responds slowly and inconsistently to requests for model-data displays and image displays. The slow response contrasts with the rapid response by WFO-Advanced, which runs on the same hardware and displays the same imagery and model data.

⁴ Scripts are sets of executable computer system commands that can be used for configuring files and peripherals, configuring and executing system software, or for other system operations.

CONCLUSIONS

Visits to field sites and discussions with operational personnel have reconfirmed the committee's position that AWIPS is essential to the NWS modernization.⁵ The reactions of site personnel to the systems deployed to date have been positive. During the visits to OT&E sites, the committee observed site personnel using AWIPS as an operational tool to ingest and display satellite and NEXRAD data for preparing forecasts and other products. The committee noted that the functionality of AWIPS Build 1 has already significantly improved NWS operations by providing an integrated view of data from NEXRAD, the geostationary operational environmental satellite (GOES), and the gridded data products from the NCEP weather models. The introduction of AWIPS, the integrating element of the modernized NWS, already promises to facilitate new methods of operation.

Operational feedback from early deployment is critical to guiding future system development. The results of the OT&E have been encouraging so far. The process is effective in identifying significant problems early in the deployment of AWIPS. NWS and the contractor have demonstrated their commitment to resolving operational problems quickly and to improving AWIPS continuously to meet operational needs. The committee's findings and conclusions are, on the whole, positive. The suggestions for improving the OT&E process are presented below as preliminary recommendations.

RECOMMENDATIONS

Recommendation 1. Configuration scripts should be automated and, as much as possible, should be easily configurable to local conditions. Verification scripts should be developed to confirm configuration changes performed by scripts. All scripts and associated procedures should be placed under the control of a strict configuration management and change management system.

Recommendation 2. Aggressive measures should be taken to improve AWIPS response time. To meet the full operational requirements of AWIPS, the NWS should take advantage of alternative solutions such as the functional capabilities demonstrated in WFO-Advanced.

Recommendation 3. Training for AWIPS hydrological applications at RFCs should be improved. Priority should be given to providing access to applications tailored to specific geographical areas early in the training.

⁵National Research Council. 1991. *Toward a New National Weather Service—A First Report*. Committee on National Weather Service Modernization. Washington, D.C.: National Academy Press.

National Research Council. 1992. *Toward a New National Weather Service—Second Report*. Committee on National Weather Service Modernization. Washington, D.C. National Academy Press.

National Research Council. 1995. *Toward a New National Weather Service—Assessment of NEXRAD Coverage and Associated Weather Services*. Committee on National Weather Service Modernization. Washington, D.C. National Academy Press.

CONTINUING OPERATIONAL ASSESSMENT

The National Weather Service Modernization Committee will continue to monitor and evaluate the OT&E process and plans for and implementation of successive builds and system improvements. The committee will also broaden its assessment in the final report on AWIPS to include the contributions of AWIPS to the overall modernization program.