

EVALUATION OF THE
MULTIFUNCTION PHASED
ARRAY RADAR PLANNING
PROCESS



NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

Second National Symposium on MPAR

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Study Background and Process

- n **Sponsor:** Office of the Federal Coordinator for Meteorology (OFCM)
- n **Other Stakeholders:** NOAA, FAA, DHS, DoD, numerous corporations
- n **Focus:** Evaluation of federal planning for a multifunction phased array radar (MPAR), including: 2006 “JAG report”; October 2007 MPAR symposium; and ongoing activities of the MPAR Working Group and National Weather Radar Testbed (NWRT)
- n **Process:** 3 meetings/4 months: D.C., Boulder, Norman. Prior participation in the October 2007 symposium. Consideration of planning documents and 15 invited presentations from government, academia, and industry.

Principal Findings

- n Phased Array technology can offer some significant technical advantages.
- n Significant technical questions for weather surveillance need to be answered, and cost estimates need to be refined
- n Implementation of a network of ~350 MPAR radars could replace 510 existing NWS and FAA radars

Principal Findings (2)

- n Agency Mission Requirements
 - n Replacement of existing systems alone cannot meet all agency mission requirements
 - n Main issue is low-level coverage of weather and non-cooperative aircraft

- n Costs and Cost-Benefit Considerations
 - n JAG Report “preliminary cost evaluation” is embryonic and does not adequately address all significant issues.
 - n Does not consider cost-benefit prospects of the legacy systems, or of other (non-MPAR) alternatives
 - n Does not consider the cost-benefit status of the MPAR risk reduction plan, and does not include an *independent* analysis

Overarching Recommendation

The committee recommends that the MPAR Research and Development (R&D) program be continued with the objective of evaluating the degree to which a deployable MPAR system can satisfy the national weather and air surveillance needs cost-effectively. This program should incorporate the following features:

- n Full evaluation of the unresolved technical issues
- n An evaluation of the full operational requirements of all participating agencies and the ability of MPAR to meet these requirements
- n Development of the basis for reliable and realistic estimates of acquisition and lifecycle costs of a nationally deployed MPAR System
- n Independent assessment of the cost effectiveness of the R&D program itself, especially prior to commitment of major funding for the full-scale prototype.

Recommendations: R&D Plan

- n The R&D Plan outlined in the JAG/PARP Report should be expanded to provide more details concerning the tasks to be undertaken and the associated costs
- n The WG-MPAR planning process for the MPAR R&D program should implement frequent updating and improvement of the MPAR program plan, to include annual *external* reviews.
- n The FCMSSR should seek a reasonable and continuous funding stream to support the R&D Program.

Recommendations: R&D Plan (2)

- n Probability estimates of the likelihood of success/failure of achieving objectives at critical decision points in the R&D program should be developed.
- n The committee would like to see:
 - n The MPAR R&D program as open as possible, to ensure that interested parties from industry and universities are involved
 - n Engineering development and scientific applications of the MPAR prototype benefit from involvement of the broadest communities possible.

Recommendations: R&D Plan (3)

- n The MPAR R&D program should include the staged development of a prototype MPAR, proceeding through ... to *two faces, or a full four-faced prototype*. Cost effectiveness studies should be carried out to determine how many faces would be required to assess the MPAR concept.

Recommendations: Definition of Requirements

- n The MPAR R&D program should produce a fully vetted set of technical performance requirements for an operational MPAR and radar network.
 - n Ensure robustness of the R&D Program in the face of changing needs and project participation
 - n Planning process for non-weather surveillance should fully establish requirements of all participating agencies.

Recommendations: Definition of Requirements (2)

Family of Systems

- n MPAR system design studies and analysis of alternatives should consider the MPAR system as a candidate member of a *family of systems*, considering design and mission tradeoffs with existing surveillance capabilities and ones under development. Agencies must define clearly the role that MPAR will play toward meeting their needs and identify the supplemental sensing networks required to fully meet their needs.

Recommendations: Definition of Requirements (3)

T-MPAR and TDWR

- n The Airport Terminal Area or T-MPAR concept needs to be developed in sufficient detail to demonstrate that mission requirements for terminal weather and aircraft surveillance can be met.
- n Ability of a full MPAR to meet Terminal Doppler Weather Radar (TDWR) requirements must also be assessed.
 - n Beamwidth would be approximately 1 deg (instead of ½ deg)
 - n Frequency choice is S-band (instead of C-band).

Recommendations: Technical Issues

- n The MPAR R&D program should produce a procedure for calibrating the reflectivity and polarimetric measurements at all scan angles.
 - n Key decision point for the feasibility of MPAR for weather surveillance, and continuance for the R&D program, will be determination of its capability for dual polarization measurements.
 - n Evaluation of the capability of phased array radar to accurately measure polarization variables independent of scan angle needed early in the R&D program.

Recommendations: Technical Issues (2)

- n Given the high demand for bandwidth at the proposed S-band frequency, the MPAR R&D program must determine the total required bandwidth as early as possible in the research program to ensure the feasibility of the design.

Recommendations: Costs and Cost-Benefit Considerations

A thorough and complete cost analysis of the total MPAR program should be performed and compared with historical life-cycle costs for currently deployed systems that are roughly equal in performance to MPAR for air-traffic and weather surveillance.

- n A detailed baseline operations and maintenance (O&M) cost estimate should be determined for all legacy radar types.
- n Independent cost risk analyses for the acquisition of MPAR and T-MPAR should be performed by recognized methods and frequently updated.

Take-Home Message

“Development efforts for Multifunction Phased Array Radar, a system that could fulfill both weather and aircraft surveillance needs, should go forward, and continued research should resolve key technical issues and determine whether the system could operate cost-effectively, says a new report from the National Research Council.”

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