The Eyes of the Fleet

An Analysis of the E-2C Aircraft Acquisition Options

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SUMMARY

The E-2C Hawkeye is the U.S. Navy's all-weather, carrier-based airborne early-warning (AEW) aircraft. Additional missions for which the E-2C is used include surface surveillance coordination, strike and interceptor control, search and rescue guidance, and communication relay. It is an integral component of the carrier air wing.

The basic E-2C model is a relatively old design, having joined the fleet in the early 1970s. However, it has been improved several times, and the most current version, the Hawkeye 2000 (HE2000) now in production, represents the fifth E-2C model. The current production model adds a sensor networking system known as cooperative engagement capability (CEC), which provides all members of the network (ideally all members of the carrier battle group) with a real-time combined radar/identification friend or foe (IFF) picture of the tactical air environment. Northrop Grumman Corporation (NGC) is under contract to deliver 21 of these aircraft to the Navy. The first of these aircraft was delivered in October 2001, and the final one is scheduled to arrive in 2006.

E-2C FLEET MODERNIZATION AND ACQUISITION OPTIONS

Meeting the Navy's day-to-day operational needs requires 63 active or deployable E-2Cs. The Navy also asserts that it must have a minimum fleet of 75 aircraft to have at least 63 E-2Cs operational at any one time. The extra aircraft are needed because not all aircraft are always available to fly. Some are undergoing periodic maintenance or repair, and others are used for research and development. The current E-2C fleet comprises several different models and several variants within some models. Currently, the Navy has only 67 E-2C aircraft, which is far fewer than the 75 required.

The current E-2C fleet will not satisfy all the future requirements the Navy projects it will have to meet, even with the CEC capability. The Navy's analysis of future threats and missions indicates that its aircraft will have to operate over littoral areas and over land (Navy Public Affairs Library, 1993). The current radar on the E-2C (radar model APS-145), while adequate for operations over water, does not deal well with the ground clutter associated with littoral regions and land. Thus, the Navy has been investing in a radar modernization program (RMP) with an eye to either replacing the radar and other electronics on the current fleet of aircraft or procuring new aircraft that are equipped with the new radar.

However, the RMP technology has to mature before the Navy can employ it; therefore, it is not expected to be available before 2008. As with any new development, the RMP technology has certain risks associated with it—for example, the airframe modification and qualification may require additional time and resources. A further complication is that the RMP will add about 2,500 pounds[1] to the aircraft. This added weight has important implications for any modernization program because it is not clear whether the current airframe can sustain the additional weight. Therefore, considerable airframe modification and requalification[2] may be required. Simultaneously, the Navy would like to retrofit the non-HE2000 aircraft with the CEC capability.

Further complicating the issue is that a number of the aircraft in the current E-2C fleet are aging and nearing the end of their projected service life of 10,000 flying hours. These aircraft either need to be replaced with new aircraft or have their life extended by means of a life extension program that involves replacing and upgrading selected components.

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[1]This weight is an NGC estimate and the Navy had not assessed the weight increase independently when this study was completed.

[2]*Qualification* refers to the series tests to approve the aircraft for military and aircraft carrier operations.

Thus, the Navy has several options for modernizing or extending the life of the E-2C fleet:

- Extending the service life of aircraft approaching the 10,000-hour limit and retrofitting E-2Cs with CEC if they don't already have that capability
- Procuring new HE2000 aircraft
- Extending the service life of older aircraft by modernizing them through the addition of CEC capability (for those that lack it) and the addition of RMP radar and electronics
- Procuring new aircraft with RMP radar and electronics and CEC capability
- Or using some combination of service-life extension, retrofitting, and procuring of new aircraft.

Each option has different costs and benefits, and weighing one against the others is a fairly complex undertaking. Two additional factors complicate the situation even further. First, any option selected must enable the Navy to meet its operational requirements. That is, the Navy must have 63 aircraft operationally available at all times. Second, industrial base issues must be factored into the selection process. Presently, E-2C aircraft are built at only one facility: NGC's factory in Saint Augustine, Florida. The future of this facility depends almost entirely on the E-2C production; therefore, any option must take into account the industrial base implications.

STUDY OBJECTIVES

The Navy asked RAND's National Defense Research Institute (NDRI) to help it sort through the various options.[3] In addition to addressing issues of cost, scheduling, and technical feasibility of the E-2C fleet options, it also asked NDRI to consider the effect on the industrial base, specifically NGC's Saint Augustine facility. Accordingly, we focused our research on the following four issues:

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[3]The project was initiated in April 2001 and the final results were briefed to the project sponsor, the E-2C program manager, in August 2001.

- The engineering challenges associated with extending the life of the aircraft and upgrading the aircraft's mission capability with CEC and RMP technology
- The effect of the life extension and upgrade programs on operational aircraft availability
- The life-cycle costs of the various options
- The implications of the life extension and upgrade programs on NGC's Saint Augustine facility and key equipment suppliers for the E-2C program.

FINDINGS

The results of our analysis produced the following major findings:

- None of the life extension and upgrade programs can sustain the current minimum number of aircraft required to meet operational requirements over the service life of the program unless the Navy buys some new E-2C aircraft.
- Extending the service life of the current aircraft and upgrading them with CEC and RMP radar is not cost-effective compared with buying new aircraft with similar capability.
- The RMP poses both technical and program challenges. The technical challenge is that the capabilities of the new radar remain to be demonstrated. The program challenge is that the new radar increases the aircraft weight by more than a ton, which raises issues for any modernization program, including one for new aircraft.
- A relatively stable flow of E-2C work is essential to the survival of NGC's Saint Augustine facility, and a workflow at that level is not feasible with life-extension work alone.

Certain cost implications are inherent in each choice. Table S.1 summarizes the overall cost analysis results. The bottom row of the table shows the cost per additional hour of aircraft life for each option. The options include adding CEC or RMP through a structural life extension program (SLEP)/modification or by procuring new

Table S.1

Overall Cost Analysis Results per Aircraft (in FY2000 dollars)

	CEC		RMP	
	SLEP/ Modification	New	SLEP/ Modification	New
Aircraft service life in hours	5,000	10,000	5,000	10,000
Aircraft service hours per year	480	480	480	480
Procurement cost ($M)	47.1	80.0	74.5	90.0
Discounted operation and support cost per year ($M)	5.9	5.4	5.6	5.3
Procurement cost per hour ($K)	9.4	8.0	14.9	9.0
Operation and support cost per hour ($K)	12.3	11.3	11.7	11.0
Total cost per hour ($K)	21.7	19.3	26.6	20.0

aircraft. These figures were calculated to facilitate cost comparisons across options and should not be interpreted as budgetary costs.

RECOMMENDATIONS

Our recommendations depend on the specific goal the Navy wants to accomplish. If the Navy simply wishes to install the CEC capability on the fleet, we have one set of recommendations. If, however, the Navy wants the fleet to have the capability of operating in littoral areas, it should follow a different path.

If the Navy wants to modernize its entire fleet with CEC equipped aircraft it should consider a combination of service life extension plus CEC retrofit of two aircraft per year and procuring two new HE2000s in the short term. This is the most cost-effective option, and also maintains the operationally available aircraft levels of the fleet at or above 63 and helps to address the NGC–Saint Augustine industrial base issue.

If the Navy determines that littoral capability is necessary for its future operations, then it should use a combination of service life extension plus CEC retrofit of the fleet and new production. This option should be used only as a production-gap mitigation strategy to maintain the fleet readiness level and preserve the Saint Augustine industrial base until the RMP program development is complete. Additional airframe design and testing efforts to accommodate the RMP may require additional budgeted time and funding. Also, the Navy should buy only new RMP aircraft because RMP retrofit modification is relatively costly. This strategy would maintain an operationally available fleet of 63 aircraft, solve industrial base concerns, and provide additional performance capability to the future Navy warfighters.

However, before spending additional money to modify the current E-2C airframe to accommodate the additional weight of the RMP, the Navy should consider the costs and benefits of a new E-2C airframe design. The new airframe design could provide additional opportunities for future enhancements and incorporate producibility improvements through modern design approaches and manufacturing techniques.