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United States Government Accountability Office  
Washington, DC 20548

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April 26, 2010

Congressional Committees

*Subject: Depot Maintenance: Sustainment Strategy for Harrier Aircraft Could Be Enhanced with Additional Metrics*

This report formally transmits the attached briefing (see enc. I) in response to section 343 (a) of The National Defense Authorization Act for Fiscal Year 2010 (Pub. L. No. 111-84). The Act requires the Comptroller General to provide a report on the sustainment strategy for the AV-8B Harrier aircraft and provide the results to the congressional defense committees no later than 180 days after the enactment of the Act. On April 26, 2010, we provided the briefing to your offices to satisfy the mandate. Because the AV-8B Harrier aircraft sustainment strategy does not detail how the Navy will measure the execution of all the responsibilities of the organizations accountable for coordinating AV-8B maintenance events, the Single Process Owners; we are recommending that the Navy develop and implement metrics for evaluating the execution of all the stated Single Process Owners' responsibilities. A draft was sent to the Department of Defense and no comments were provided. The Related GAO Products section at the end of this report lists additional GAO publications on this issue.

We are sending copies of this report to the appropriate congressional committees. We are also sending copies to the Secretary of Defense; the Deputy Secretary of Defense; the Under Secretary of Defense (Acquisition, Technology and Logistics); the Secretary of the Navy and the Commandant of the Marine Corps. This report will also be available at no charge on our Web site at <http://www.gao.gov>. Should you or your staffs have any questions concerning this report, please contact me at (202) 512-8246 or [edwardsj@gao.gov](mailto:edwardsj@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report were Carleen Bennett, Assistant Director; Yong Song; and Jessica Drucker.

Jack E. Edwards  
Director, Defense Capabilities and Management

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# **Sustainment Strategy for Harrier Aircraft Could Be Enhanced with Additional Metrics**

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**Briefing to the Defense Committees**

**April 26, 2010**

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Figure 1: AV-8B Harrier Aircraft



Source: Fleet Readiness Center – East, Cherry Point, North Carolina.



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## Introduction: AV-8B Harrier

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- The high pace of operations in Iraq and Afghanistan has increased the utilization of the Marine Corps<sup>1</sup> AV-8B aircraft above planned usage.
  - The first of the current model II version of the AV-8B entered service in 1981.
  - AV-8Bs utilize vertical, short takeoff and landing capability.
  - AV-8Bs are expected to fly longer than intended because of the delays in acquiring the replacement aircraft – the F-35 Joint Strike Fighter.
  
- Scheduled depot-level maintenance is needed to prolong the life of the AV-8B.
  - The AV-8B maintenance acquisition strategy, updated in 1994, did not include scheduled depot-level maintenance.
  - To maintain the AV-8B's operational capability until the transition to the F-35, the Navy identified the need for scheduled depot-level maintenance to sustain the AV-8B and began transitioning AV-8Bs to its Integrated Maintenance Concept in late fiscal year 2003.

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<sup>1</sup>The Marine Corps are the users of the AV-8B aircraft while the Navy manages the maintenance for the weapon system.



## Introduction: AV-8B Sustainment Strategy

- Three key elements of the AV-8B sustainment strategy include:
  - The Integrated Maintenance Concept,
  - Assignment of workload, and
  - Single Process Owners.
- The AV-8B's Integrated Maintenance Concept consists of:
  - Three maintenance levels – depot, intermediate, and organizational – where repair tasks are integrated to maximize the efficiency of work performed and minimize the time when the aircraft are not operational<sup>1</sup> and
  - A 15-year, scheduled maintenance cycle involving periodic Planned Operating Intervals and Planned Maintenance Interval (PMI) events.
  - The three types of AV-8B PMI events are as follows:
    - **PMI-1 events:**
      - Are performed by depot personnel and
      - Consist of maintenance tasks that require special depot-level facilities for major overhaul and/or the complete rebuild of parts.
    - **PMI-2 and PMI-3 events (PMI-2/3):**
      - Are performed by depot personnel and private-sector contractors and
      - Consist of maintenance tasks that do not require the special depot-level facilities necessary for PMI-1 events.
  - The AV-8B's maintenance acquisition strategy:
    - Outlines how AV-8B maintenance will be conducted using the Integrated Maintenance Concept,
    - Contains guidance on assigning maintenance workload, and
    - States the maintenance readiness<sup>2</sup> goals (e.g., turnaround time<sup>3</sup> goals) to be achieved.

<sup>1</sup>NAVAIR 4790.33A (February 2007) provides overarching guidance for naval aviation platforms using the Integrated Maintenance Concept.

<sup>2</sup>Navy documentation states that readiness is directly impacted by meeting turnaround time goals.

<sup>3</sup>Turnaround time is defined as the number of days from the induction of the aircraft into a scheduled maintenance event to the return of the aircraft to the Fleet.

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## Introduction: AV-8B Sustainment Strategy (continued)

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- Department of Defense (DOD) and Navy documentation define different types of workload.
  - DOD Instruction 4151.20 defines two types of workload: core and non-core.
    - **Core workload** is workload required to maintain the core logistics capability (including personnel, equipment, and facilities) as a ready and controlled source of technical competence and resources at government-owned, government-operated facilities necessary to ensure effective and timely response to a mobilization, national defense contingency situations, and other emergency requirements.
    - **Non-core workload** is workload that is not needed to support core capability requirements.
  - Navy documentation defines a type of non-core workload<sup>1</sup> called above core workload:
    - **Above core workload** is workload that refers to the number of platforms scheduled for maintenance that are beyond the number required to sustain the core capability.
- Single Process Owners:
  - Are the organizations responsible for coordinating AV-8B PMI-2/3 maintenance events.
  - Were created in late fiscal year 2009 because of the challenges identified through the implementation of the Integrated Maintenance Concept and the assignment of non-core workload.
  - Were established to:
    - Reduce maintenance turnaround time to 90 days and costs for PMI-2/3 events and
    - Coordinate all maintenance activities between the depot and private-sector contractor.

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<sup>1</sup>As defined in DOD Instruction 4151.20, non-core workload is workload that is not needed to support core capability requirements.



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## Objectives

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- The National Defense Authorization Act for Fiscal Year 2010 mandated that GAO report on the sustainment strategy for the AV-8B within 180 days of the enactment of that act (October 28, 2009).<sup>1</sup>
  
- Specifically, our objectives were as follows:
  1. Assess the AV-8B Integrated Maintenance Concept, including the acquisition strategy developed to conduct planned maintenance interval events.
  2. Evaluate the process and criteria established to determine the assignment of non-core workload.
  3. Examine the role of the Single Process Owner in implementing the Integrated Maintenance Concept and executing its responsibilities to reduce planned maintenance interval turnaround time, to reduce cost, to improve material availability, and to ensure that the necessary logistics and engineering functions are in place to meet objective goals.

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<sup>1</sup>Pub. L. No. 111-84, § 343 (2009).



## Scope and Methodology

To conduct our work, we did the following:

- Reviewed laws, regulations, reports (e.g., DOD's and GAO's reports on aviation maintenance and determination of core and non-core workload), AV-8B-specific documents, and other related materials.
- Conducted a site visit to Fleet Readiness Center (FRC)<sup>1</sup>-East to observe PMI-1 and PMI-2/3 events and learn about how those PMIs vary.
- Interviewed officials and obtained additional documents (e.g., those addressing the AV-8B's maintenance acquisition strategy, determination of core and non-core workload, the role of the Single Process Owner, and the execution of the Single Process Owners' responsibilities). The officials represented
  - Naval Air Systems Command (NAVAIR),
  - FRC-East,
  - Marine Corps Headquarters,
  - Naval Aviation Inventory Control Point,
  - FRC-Southwest,
  - Marine Corps Air Station Yuma, and
  - a private-sector contractor.
- Compared information obtained from DOD officials and other sources against processes and criteria provided in laws and regulations.
- Met periodically with agency officials to discuss our preliminary observations.

<sup>1</sup>FRCs are centers commissioned by the Navy to perform in-depth overhaul, repair, and modification of aircraft, engines, and aeronautical components.



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## Scope and Methodology

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- For each of our objectives, we assessed the reliability of the data we analyzed by reviewing existing documentation related to the data sources and interviewing knowledgeable agency officials about the data that we used. We found the data sufficiently reliable for the purposes of this briefing.
  - We conducted this performance audit from October 2009 to April 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.
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## Summary of Findings

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- **Objective 1:** The Integrated Maintenance Concept was implemented to address maintenance issues identified by the Marine Corps that stemmed primarily from the previous reactive maintenance approach – the Age Exploration maintenance program. The Integrated Maintenance Concept has led to improvements in the AV-8B aircraft's sustainability, but challenges remain in meeting readiness (e.g., turnaround time goals) to sustain the AV-8B fleet. The AV-8B maintenance acquisition strategy outlines the execution of the Integrated Maintenance Concept for PMI-2/3 events, assignment of non-core workload, and overall goals for AV-8B maintenance.
  
- **Objective 2:** DOD Instruction 4151.20 states that subject to certain exceptions, non-core workload should be allocated to public- or private-sector organizations using best value criteria. Navy documents state that NAVAIR uses a best value determination<sup>1</sup> (based on turnaround time and cost) to assign non-core workload. However, problems continued in meeting readiness (e.g., turnaround time goals) through fiscal year 2009. Until late fiscal year 2009, there was no single organization coordinating the PMI-2/3 event maintenance.

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<sup>1</sup>The Defense Acquisition Guidebook describes the best value assessment as an analysis that should consider cost and other quantifiable and non-quantifiable factors associated with any resultant investment decision. NAVAIR refers to best value assessments as best value determinations.



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## Summary of Findings

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- **Objective 3:** The Single Process Owners' role is to coordinate the efforts of multiple organizations performing PMI-2/3 workload to, among other things, distribute non-core workload, standardize workload processes, facilitate public-private partnering, implement lessons learned, and execute contracting authority. Limited performance data are available to evaluate the FRCs' execution of their Single Process Owners' responsibilities. However, initial data show improvements in readiness and aircraft availability. While Navy documentation defines the Single Process Owners' responsibilities and details performance goals regarding turnaround time and cost standards, metrics are not in place for evaluating the execution of all the Single Process Owners' responsibilities.
  - **Recommendation for Executive Action:** The AV-8B Performance Based Agreement (December 2009) is the formal agreement between the program manager and the FRCs – the Single Process Owners – that outlines performance goals for the execution of the Single Process Owners' responsibilities. However, it does not detail how the Navy will measure the execution of all the Single Process Owners' responsibilities. Thus we are recommending that the Navy develop and implement metrics for evaluating the execution of each of the Single Process Owners' stated responsibilities and incorporate these metrics into the AV-8B Performance Based Agreement.
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## **Objective 1: Integrated Maintenance Concept – Factors Leading Up to Its Implementation**

**The Integrated Maintenance Concept was implemented to address maintenance issues identified by the Marine Corps that stemmed primarily from the previous reactive<sup>1</sup> maintenance approach – the Age Exploration maintenance program.**

- The Age Exploration program:
  - Was the AV-8B maintenance program until the 2003 transition to the Integrated Maintenance Concept and
  - Consisted of examining a sample of AV-8Bs to identify maintenance requirements and monitor the condition of the AV-8B fleet.
- In Navy documentation that describes the transition from the Age Exploration program to the Integrated Maintenance Concept, the number of AV-8Bs out of operation because of maintenance issues was attributed to several factors including:
  - Not having scheduled depot-level maintenance so aircraft needing major overhaul would be out of the fleet unexpectedly and for unknown durations,
  - Not having the ability to accurately budget for maintenance because of the unscheduled nature of major overhaul requirements,
  - Aging aircraft<sup>2</sup> that were deteriorating in material condition, and
  - Aging aircraft that were requiring significant modifications and upgrades to continue operability.

<sup>1</sup>According to Navy officials, under this reactive approach, repairs were performed after the aircraft had experienced problems rather than using a preventative approach that maintained the aircraft systems (Integrated Maintenance Prototype Plan 2003, NAVAIR).

<sup>2</sup>As previously noted, the AV-8B Harrier, model II version, has been in service for approximately 28 years.



## **Objective 1: Integrated Maintenance Concept – Outcomes from Implementation**

**The Integrated Maintenance Concept has led to improvements in the AV-8B aircraft’s sustainability, but challenges remain in meeting readiness (e.g., turnaround time goals) to sustain the AV-8B fleet. The AV-8B maintenance acquisition strategy outlines the execution of the Integrated Maintenance Concept for PMI-2/3 events, assignment of workload, and overall maintenance goals.**

- Outcomes include:
  - Establishing the first scheduled depot-level maintenance program for AV-8Bs,
  - Establishing a plan to budget for maintenance,
  - Improving overall aircraft condition, and
  - Improving readiness and aircraft availability by lowering turnaround time (e.g., for PMI-2/3 events, 212 days in fiscal year 2004 to 170 days in fiscal year 2007).
- The Integrated Maintenance Concept has also provided the foundation for the current maintenance acquisition strategy – a memorandum laying out the execution of PMI-2/3 events.
- Challenges in meeting AV-8B readiness (e.g., turnaround time) have continued after the Integrated Maintenance Concept was in place for several years.
  - For example, the Navy’s 2008 business case analysis data showed that from fiscal year 2004 through fiscal year 2007, PMI-2/3 turnaround time goals of 120 days were not being met. Actual turnaround time performance averaged over 170 days.



## **Objective 2: Assignment of Non-Core Workload – Navy Process to Assign Non-Core Workload**

**DOD Instruction 4151.20 states that subject to certain exceptions, non-core workload should be allocated to public- or private-sector organizations using best value criteria. Navy documents state that NAVAIR uses a best value determination (based on turnaround time and cost) to assign non-core workload.**

- The AV-8B program manager assigns workloads as follows:
  - Core – to government-owned, government-operated facilities (depot).
  - Non-core<sup>1</sup> – to either the depots or private-sector contractors using a best value determination.
  - Above core – assigned on the same basis as other non-core workload: to either the depots or private-sector contractors using a best value determination.

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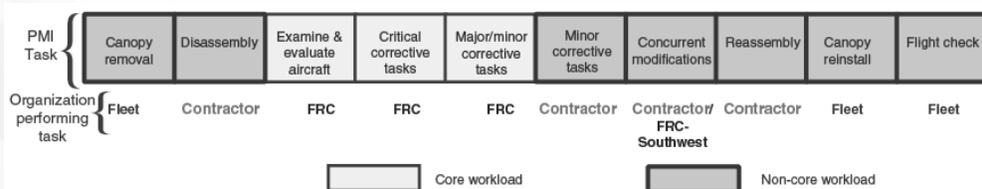
<sup>1</sup>Non-core workload other than above core workload will be assigned by the FRCs beginning in fiscal year 2011.

## Objective 2: Assignment of Non-Core Workload – Example to Illustrate Assignment of Workload

**Step 1:** In fiscal year 2008, 13 AV-8Bs were scheduled for PMI-2/3 events.

**Step 2:** NAVAIR determined that depot-level PMI-2/3 event tasks for 7 of the 13 AV-8Bs needed to be completed by government-owned, government-operated facilities to maintain core capabilities. NAVAIR identified this workload as **core workload** (see Examine & evaluate aircraft, Critical corrective tasks, and Major/minor corrective tasks in fig. 2). The remaining PMI-2/3 event tasks were identified as **non-core workload**.

Figure 2: PMI-2/3 Event Integrated Maintenance Concept – Workload Assignment



Source: GAO analysis of DOD data

**Legend:**  
**Major corrective task** – Action to address a defect that is identifiable as critical and could result in failure or materially reduce the usability of the unit.  
**Minor corrective task** – Action to address a defect that does not, or if not corrected prior to the next PMI event, will not materially reduce or degrade the usability of the unit or part for its intended purpose or is a departure from standards.  
**Concurrent modifications** – Modifications (e.g., the 1760 wiring kit upgrades) performed during a PMI event.



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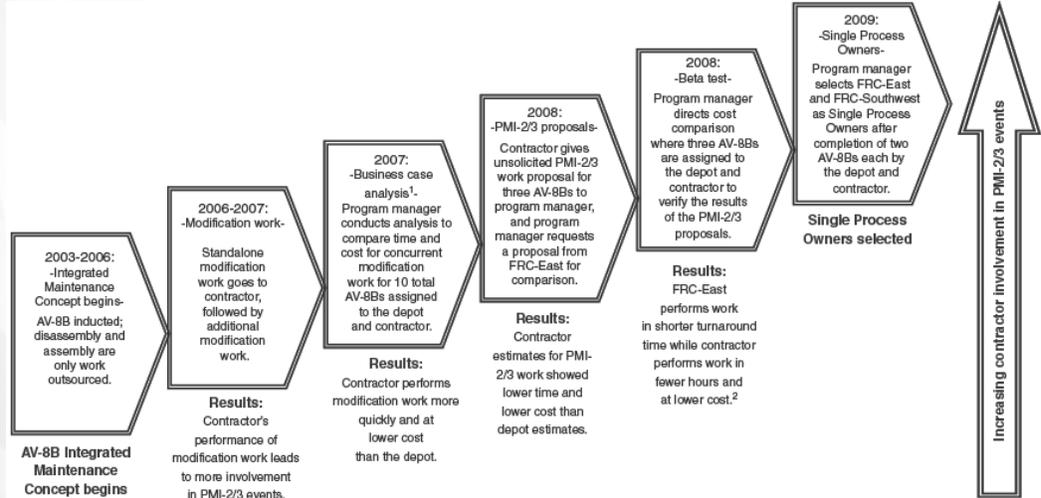
## Objective 2: Assignment of Non-Core Workload – Example to Illustrate Assignment of Workload

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- Step 3:** Navy documents state that the program manager then used a best value determination process in deciding whether to assign the **non-core workload** to the depot or to a private-sector contractor. Navy documents state that the program manager used a best value determination to award the **non-core workload** to the private-sector contractor.
- Step 4:** NAVAIR referred to the remaining non-core workload (i.e., the six remaining aircraft scheduled for PMI-2/3 events) as **above core workload**. Navy documents state that the program manager used a best value determination to assign five of the aircraft to the depot and the remaining one aircraft to the private-sector contractor.
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## Objective 2: Assignment of Non-Core Workload – Timeline of Major Events

Figure 3: Timeline of AV-8B Major Events in Workload Assignment



<sup>1</sup>Navy documentation states NAVAIR conducted this best value determination in the form of a business case analysis, which is an analysis that should consider cost and other quantifiable and non-quantifiable factors associated with any resultant investment decision (see appendix for additional information on business case analysis).

<sup>2</sup>Cost figures for FRC-East and private-sector contractor are not directly comparable because FRC-East's costs include overhead and the private-sector contractor's costs did not.



## **Objective 2: Assignment of Non-Core Workload – Continuing Problems**

**Problems continued in meeting readiness (e.g., turnaround time goals) through fiscal year 2009. Until late fiscal year 2009, there was no single organization coordinating the PMI-2/3 event maintenance.**

- Data on PMI-2/3 maintenance events show that problems continued in meeting readiness (e.g., turnaround times averaged over 150 days) prior to the establishment of the Single Process Owner concept in fiscal year 2009. During this same period, non-core workload was assigned in increasing amounts to the private-sector contractor.
- Department of the Navy officials attribute the readiness-related problems to difficulties in coordinating the PMI-2/3 tasks performed by multiple organizations. These difficulties include those related to:
  - Performing tasks sequentially rather than concurrently,
  - Material delays, and
  - A lack of communication.



## **Objective 3: Single Process Owners – Coordinating Role**

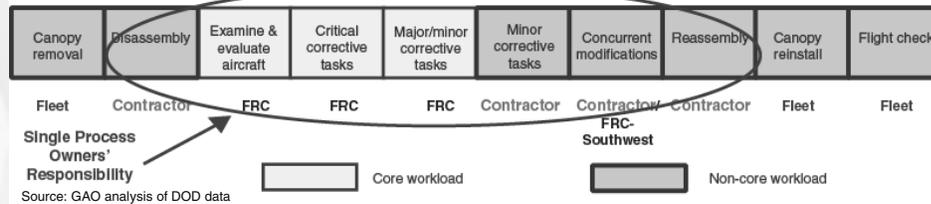
**The Single Process Owners' role is to coordinate the efforts of multiple organizations performing PMI-2/3 workload to, among other things, distribute non-core workload, standardize workload processes, facilitate public-private partnering, implement lessons learned, and execute contracting authority.**

- The Single Process Owner role was first established in late fiscal year 2009.
  - The role was first performed by the program manager. However, criteria for evaluating the execution of the responsibilities of the Single Process Owner were not established until fiscal year 2010.
- In fiscal year 2010, Navy documentation established the Commanders of FRC-East and FRC-Southwest as the Single Process Owners and provided a timeline for implementation and evaluation of the role.
  - Fiscal year 2010 – The FRCs are coordinating PMI-2/3 events with the program manager retaining contracting authority for non-core workload.
  - Fiscal year 2011 – The FRCs will be given contracting authority and responsibility for assigning the non-core workload.
  - Fiscal year 2012 – The FRCs' performance as the Single Process Owners will be formally evaluated.

### Objective 3: Single Process Owners – Overarching Responsibilities

- The Single Process Owners are responsible for coordinating the entire maintenance (or repair) process for PMI-2/3 events (see circled tasks in fig. 4),<sup>1</sup> as well as other overarching responsibilities detailed in Navy documentation, including the following:
  - Contracting authority for the distribution of non-core workload,
    - Distribution of non-core workload,
    - Facilitation of public-private partnering, and
    - Execution of contracting authority.
  - Identification and implementation of process efficiencies and best practices,
    - Standardization of workload processes, and
    - Implementation of lessons learned.

Figure 4: Single Process Owners' Responsibility



<sup>1</sup>The Fleet is responsible for the canopy removal, canopy reinstall, and functional flight check tasks for the PMI-2/3 event.



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### **Objective 3: Evaluation of the Single Process Owners' Performance – Initial Impact**

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**Limited performance data are available to evaluate the FRCs' execution of their Single Process Owners' responsibilities. However, initial data show improvements in readiness and aircraft availability.**

- The initial data show a reduction in turnaround time (e.g., from over 150 days to below the new fiscal year 2010 goal of 90 days) for the first two AV-8Bs undergoing PMI-2/3 events since the FRCs assumed the Single Process Owners' responsibilities.
- However, since the FRCs have functioned as the Single Process Owners for less than five months, the sustained effect remains to be determined.
- There may be limitations that affect the Single Process Owners' performance for fiscal year 2010 because FRC-East and FRC-Southwest are not assigned as the contracting authorities over private-sector contractors.
- The FRCs will be given contracting authority and responsibility for assigning the non-core workload in fiscal year 2011.



## Objective 3: Evaluation of the Single Process Owners' Performance – Execution of Responsibilities

**While Navy documentation defines the Single Process Owners' responsibilities and details performance goals regarding turnaround time and cost standards, metrics are not in place for evaluating the execution of all the Single Process Owners' responsibilities.**

- Navy documentation describes key responsibilities of the Single Process Owners, including:
  - Coordinating the PMI-2/3 process to meet 90-day turnaround time,
  - Integrating the workforce (FRCs, private-sector contractors, and the Fleet),
  - Identifying and implementing best practices, and
  - Sharing lessons learned.
- The AV-8B Performance Based Agreement (December 2009):
  - Is the formal agreement between the program manager and the FRCs – the Single Process Owners – that outlines performance goals for the execution of the Single Process Owners' responsibilities.
  - Includes two goals to evaluate the Single Process Owners' performance:
    - 90-day turnaround time and
    - Specific cost requirements for workload (e.g., hourly labor rates).
- The agreement does not include metrics to assess the Single Process Owners' performance in the execution of all their stated responsibilities.
- GAO has previously reported<sup>1</sup> that performance plans, among other considerations, should include metrics for measuring a program's core functions or responsibilities.
- Without additional metrics for evaluating each of the Single Process Owners' key responsibilities, the Navy may not be able to properly evaluate, monitor, and adjust the execution of the Single Process Owners' responsibilities in coordinating the PMI-2/3 workload for AV-8B maintenance.

<sup>1</sup>GAO, *The Results Act: An Evaluator's Guide to Assessing Agency Annual Performance Plans*, GAO/GGD-10.1.20 (Washington, D.C.: April 1998).

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## Conclusion

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- Progress has been made with developments in the AV-8B sustainment strategy to address readiness and aircraft availability, but readiness challenges (e.g., meeting turnaround time goals) remain. In an effort to address these remaining readiness challenges, the Navy has begun to implement the Single Process Owner concept. However, without metrics for evaluating each of the Single Process Owners' key responsibilities, the Navy may not be able to properly evaluate, monitor, and adjust the execution of the Single Process Owners' responsibilities in coordinating the PMI-2/3 workload for AV-8B maintenance.



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## Recommendation for Executive Action

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To properly evaluate the execution of all the Single Process Owners' stated responsibilities in coordinating the AV-8B PMI-2/3 workload, we recommend that the Secretary of Defense direct the Secretary of the Navy to take the following action:

- Develop and implement additional metrics for evaluating each of the Single Process Owners' stated responsibilities and incorporate these metrics in the AV-8B Performance Based Agreement.



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## Agency Comments

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We requested comments from the Department of Defense, but none were provided.



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## Points of Contact

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For more information, contact Jack Edwards at (202) 512-8246 or [edwardsj@gao.gov](mailto:edwardsj@gao.gov), or Carleen Bennett at (757) 552-8208 or [bennettc@gao.gov](mailto:bennettc@gao.gov).

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## Appendix: Overview of the Business Case Analysis

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- The Defense Acquisition Guidebook describes a business case analysis as a type of best value assessment and states that best value assessments should consider “not only cost, but also all other quantifiable and non-quantifiable factors associated with any resultant investment decision.”
  - Navy documentation states that NAVAIR conducted a business case analysis in 2008 to determine the best value assignment of AV-8B non-core workload (e.g., concurrent modifications) after identifying poor turnaround time performance in PMI-2/3 events. In determining the best value assignment, NAVAIR used cost and time (e.g., turnaround time) metrics for 10 AV-8Bs while considering the following four factors:
    - Age of aircraft,
    - Existing support infrastructure,
    - Organic and commercial capabilities, and
    - Legislative and regulatory constraints.
  - Navy documentation states that NAVAIR’s business case analysis also addressed sensitivities related to future private-public partnerships, risks (i.e., timeliness to mitigate contract workload), and contingencies (none identified).
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## Related GAO Products

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- *Depot Maintenance: Actions Needed to Identify and Establish Core Capability at Military Depots.* GAO-09-83. Washington, D.C.: May 14, 2009.
- *Military Readiness: DOD Needs to Identify and Address Gaps and Potential Risks in Program Strategies and Funding Priorities for Selected Equipment.* GAO-06-141. Washington, D.C.: October 25, 2005.

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