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# Modernizing the Mobility Air Force for Tomorrow's Air Traffic Management System

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## Summary

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As airspace systems around the world are transformed to accommodate growing air traffic demands, the U.S. Air Force must decide whether to modernize its fleets to comply with new equipage mandates. Without avionics modernization, the Mobility Air Force's C-5, C-17, KC-135, and C-130 fleets would lack some of the capabilities required to meet these forthcoming mandates. Modernization ensures continued access to fuel-efficient cruising altitudes and congested airspace, but these future benefits require an upfront investment in avionics upgrade programs.

The Air Force plans to operate legacy aircraft well into the future. As they age, these fleets will require modernization to maintain their capabilities. In a fiscally constrained environment, investment decisions must be made in a way that maximizes the benefit of each dollar spent. This analysis looks at a subset of these potential investments, assessing their cost-effectiveness based on quantifiable future costs that would be avoided by modernization. For some programs, there may be additional benefits beyond those resulting from communication, navigation, and surveillance/air traffic management (CNS/ATM) cost avoidance. In many cases, these outcomes reinforce the results presented here. In others, the broader potential benefits must be weighed carefully against program costs that are not fully offset by CNS/ATM cost avoidance.

Throughout this monograph, *cost avoidance* refers to the net present value of all operating and support costs that would be avoided over the remaining service life of an aircraft by modernizing to comply

with CNS/ATM mandates. In addition to these steady-state operating costs, we considered the impacts of noncompliance on the warfighting mission separately, based on the additional equivalent aircraft capacity required each year to maintain the same capability level as a fully compliant fleet.

After this research was completed, the Air Force, in its FY 2013 proposed budget, communicated its intent to make changes to the mobility fleets. The changes proposed by the Air Force included retiring the 65 oldest C-130s, reducing the scope of the C-130 avionics modernization program (AMP), retiring all C-5As, and retiring 20 KC-135s. As of this writing, Congress had not responded to the proposal; therefore, this monograph refers to the existing fleets and programs as presented in the FY 2012 President's Budget. If the changes are implemented, the total cost-avoidance values presented here would be reduced. However, the overall findings would remain the same qualitatively.

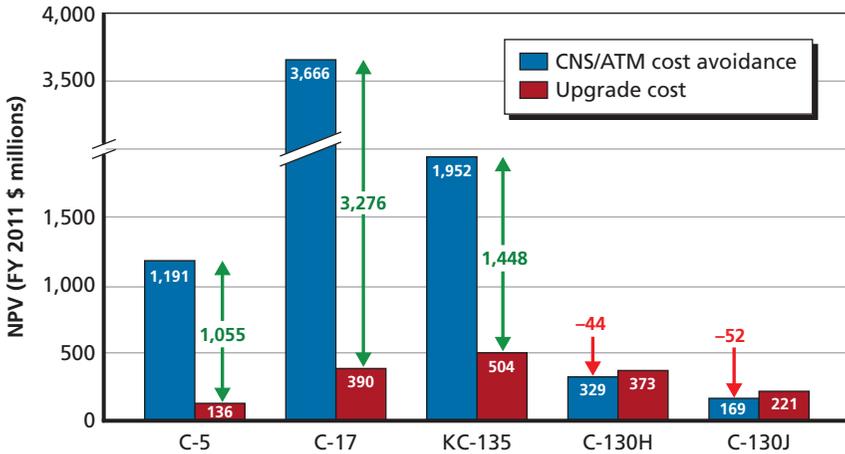
Much of the cost avoidance is due to preventing the increased fuel usage that would result from mandates that restrict aircraft from cruising at the most fuel-efficient altitudes. The most severe flight-level restriction would result from noncompliance with the mandate for Automatic Dependent Surveillance–Broadcast Out (ADS-B Out), a surveillance capability that will be required in the United States starting in 2020 for aircraft to fly above 10,000 feet and access the nation's busiest airports.<sup>1</sup> None of the aircraft examined in this study are currently ADS-B Out–capable. Figure S.1 compares the upgrade cost for compliance and the resulting cost avoidance for each aircraft fleet. The cost avoidance exceeds the upgrade cost for the C-5, C-17, and KC-135; therefore, upgrade programs are cost-effective for these aircraft based on CNS/ATM cost avoidance alone, netting more than \$5.7 billion over their remaining service lives.

In contrast, C-130 noncompliance would result in far lower operating cost penalties, since these fleets fly at lower altitudes and burn

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<sup>1</sup> The ADS-B Out rulemaking allows noncompliant aircraft to climb above 10,000 feet if they would otherwise be within 2,500 feet above ground level. This would allow these aircraft to transit large mountain ranges.

**Figure S.1**  
**CNS/ATM Cost Avoidance Versus Upgrade Cost for ADS-B Out Modernization**



RAND MG1194-S.1

less fuel than the heavier aircraft. C-130 ADS-B Out modernization is cost-effective only if the upgrade can be accomplished for no more than \$1.5 million per aircraft for the H model and \$1.3 million per aircraft for the J model—less than the conservative estimates used in this study—or fuel prices increase to \$3.50 per gallon for the H model and \$4.00 per gallon for the J model. However, failure to modernize would restrict access to Class B and C airspace, which surrounds many of the busiest airports in the United States. This includes several joint civil-military bases where C-130s are currently stationed. If these aircraft must be rebased due to ADS-B Out noncompliance, the case for modernization would be strengthened, since the upgrade would result in additional cost avoidance.

There are ongoing modernization programs in place to address the other CNS/ATM capability shortfalls for the C-5, C-17, and C-130. This study found that the C-5 AMP and the C-17 Global Air Traffic Management/Required Navigation Performance-1 (GATM/RNP-1) programs are cost-effective, netting \$10 million and \$219 million, respectively. The C-130H AMP costs are estimated to exceed

the CNS/ATM cost avoidance by more than \$3.2 billion. The cost-effectiveness of this program may be justified by other benefits, including reduced manpower costs, increased reliability and maintainability, and fleet commonality, but their examination was beyond the scope of this study. Similarly, the C-130J Block 7 upgrade program cost was found to exceed the CNS/ATM cost avoidance by \$80 million under the baseline fuel price assumptions.

In addition to steady-state operating cost avoidance that exceeds the upgrade costs, the ADS-B Out and ongoing modernization programs for the C-5 and C-17 are required to maintain the wartime capability of the strategic airlift fleet, which would otherwise be degraded by flight restrictions resulting from noncompliance. The C-130 intra-theater airlift mission would not be affected by noncompliance with CNS/ATM mandates because the military would control the airspace in which C-130 combat operations would take place. While some tanker missions would be affected, the KC-135 will retain full wartime capability based on planned compliance with all mandates by their implementation dates.