Managing U.S. Air Force Aircraft Operating and Support Costs

Insights from Recent RAND Analysis and Opportunities for the Future

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Key findings

- Case studies of the KC-135R/T and C-130H fleets identified four categories of operating and support (O&S) cost growth: Fuel costs drove 31 percent of overall O&S cost growth, unit-level personnel costs 30 percent, weapon system sustainment costs 27 percent, and modifications and other costs 12 percent.
- The Air Force can affect some but not all drivers of O&S cost growth.
- Unit personnel costs might be reduced by consolidating many maintenance activities within a global network of maintenance facilities and by increasing the size of operation squadrons.
- Various fuel-efficiency initiatives can help reduce fuel costs, as can efforts to reduce total flying hours.
- The root causes of weapon system sustainment costs are war-related effects and aging effects; while the former will diminish with the end of overseas contingency operations, the latter are more difficult to mitigate.
- The Air Force's Cost of Logistics and Cost Effective Readiness efforts seek to help address O&S costs through better understanding of the interactions between readiness requirements and the costs they drive.

Air Force aircraft operating and support (O&S) costs grew at an average rate of 6.5 percent per year[1] between fiscal years (FYs) 1996 and 2011 despite a reduction of over 1,000 aircraft in the Air Force fleet and minimal increases in total flying activity. Aircraft O&S costs climbed from 23 percent of the Air Force's total obligational authority in FY 1996 to 28 percent by FY 2011. While O&S costs have declined somewhat since FY 2011, they continue to threaten to crowd out future force modernization efforts, including research and development and procurement. Detailed data to illuminate the full set of drivers of these trends are not widely available or consistently analyzed by Air Force analysts. As a result, there is a lack of understanding among Air Force leadership about the primary drivers of recent O&S cost growth and the linkages between mission readiness and O&S costs. This presents challenges as the Air Force works to mitigate and even reverse these cost trends while balancing mission readiness going into the future.

Analysis conducted by RAND Project AIR FORCE (PAF) during FY 2012 found that, based on the size, fleet mix, and activity level of the Air Force and economy-wide inflation, only a 0.8 percent rate of growth would have been expected. Thus, costs grew 5.7 percent per year faster than can be accounted for by these underlying factors.

To better understand the drivers of this cost growth above inflation, we conducted detailed case study analyses of the KC-135R/T and C-130H fleets, platforms selected by our research sponsors to inform Air Force leaders about the root causes of the cost growth experienced for these large and costly fleets, with a particular focus on weapon system sustainment (WSS) costs.[2] We focused on WSS costs because the available

data did not enable a clear understanding of the reasons for growth in this category, as they did in the other key areas of fuel and personnel. The analysis involved a two-step approach. First, we coordinated across multiple Air Force organizations to identify and compile relevant data from a number of different Air Force cost information systems for analysis. We decomposed O&S cost information as much as possible and linked to known drivers. We also engaged with the product support managers and their staff and other subject-matter experts to interpret data and provide additional understanding of factors that may have contributed to O&S cost growth. Here, we describe key findings from the analysis, discuss strategies for reducing O&S costs, and recommend additional actions for consideration.

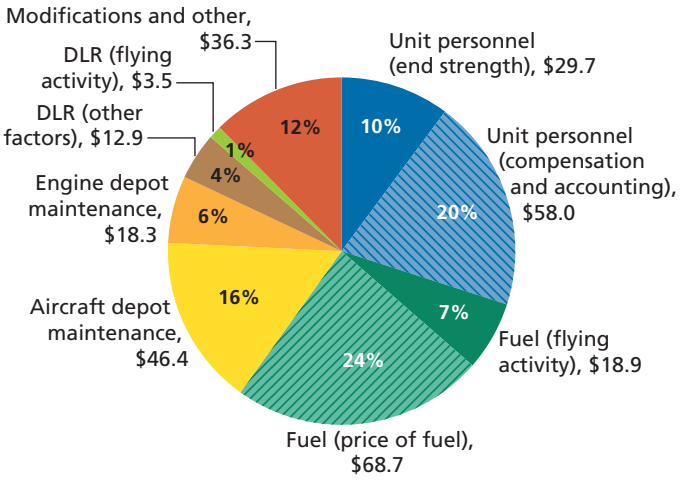
KC-135R/T and C-130H O&S Cost Growth Findings

The rate of growth in total O&S costs between FYs 1996 and 2011 for both fleets has averaged 8 percent per year—slightly above the rate of O&S growth for all Air Force aircraft over the same time period—or an average of $293 million per year.[3] We analyzed O&S cost in the following four areas, which are listed in order of their contribution to cost growth: fuel; unit-level personnel; WSS, which is composed primarily of aircraft and engine depot maintenance and depot-level reparables (DLRs); and modifications and other expenses. The figure shows the average annual and percentage contribution to KC-135R/T and C-130H O&S cost growth by cost category between FYs 1996 and 2012. Without additional detailed analyses of other platforms, we cannot specify whether the precise breakdown of these cost growth categories are more broadly applicable, but the *general trends* in cost increases for personnel compensation, fuel, and material and repair costs are applicable to other programs.

Fuel

Fuel costs are a direct function of the price of fuel and fuel consumption. Fuel prices rose from a base of $0.88 per gallon in the FY 1996–1998 period to $3.89 per gallon in the FY 2010–2012 period.[4] Fuel costs drove 31 percent of O&S cost growth on the two platforms, with increased fuel prices accounting for 24 percent of total growth and increased flying activity accounting for the remaining 7 percent.

KC-135R/T and C-130H O&S Cost Growth Areas (FY 1996–2012)



NOTE: Dollars represent annual growth in millions of then-year dollars (FY 1996–2012); percentage figures represent the share of O&S cost growth of the FY 1996–2012 period. Modification cost growth was negative and added to "other" costs for presentation purposes.

Unit Personnel

Unit personnel costs include the costs associated with operational, maintenance, and other direct support personnel employed at airbases. Unit personnel costs have been growing at a rate of between 6 percent and 7 percent per year for our case study platforms. Unit personnel headcounts have increased over time for both fleets, accounting for 10 percent of total O&S cost growth.[5] The majority of growth in personnel costs for these fleets, and 20 percent of overall O&S cost growth, is due to military compensation increases and accounting changes, such as the inclusion of a Medicare accrual charge. Military compensation has been growing approximately 1 percent per year faster than wages in the overall U.S. economy.[6]

Weapon System Sustainment Costs

Aircraft Depot Maintenance

Aircraft depot maintenance costs for the KC-135R/T and C-130H fleets have been increasing at a rate of 10 percent and 13 percent per year, respectively, since 1996. Increases have been driven primarily by repair or replacement of parts damaged by corrosion or fatigue and attributed to aircraft aging, accumulated flying hours, and increased flying activity in more stressful environments overseas. This element accounts for 16 percent of total O&S cost growth.

Engine Depot Maintenance

Engine depot maintenance costs for the KC-135R/T and C-130H fleets have been increasing at a rate of 16 percent and 12 percent per year, respectively, since FY 1996. The F108 engine that powers the KC-135R/T fleet is primarily organically maintained and has experienced an increase in engine removals due to cumulative usage and harsher operating conditions in overseas contingency operations (OCOs) and an increase in the work scope during overhauls to incorporate Reliability Centered Maintenance changes. Growth in depot-level maintenance costs for the C-130H's T56 turboprop engine, which is contractor-maintained, was linked to a range of factors, including terms of the contract and incorporation of improvements to the engine.[7]

Depot-Level Reparables

DLR costs are driven by the demand for DLRs and the exchange prices paid by customers. DLR demand is strongly influenced by flying activity. The exchange price paid by customers is composed of the cost to repair items plus surcharges to recover the cost of operating the supply system and to recover the cost of buying replenishment spares. For the case study programs, two-thirds of the increase in DLR costs was due to increased repair costs, with the remainder due to increases in the surcharges. The surcharge to recover the cost of buying replenishment spares increased more than the overhead surcharge, and this was due to a change in accounting procedures that allocated the replenishment spares surcharge evenly across all programs, rather than charging each program for the cost of its own spares. Flying hours for the KC-135R/T increased by approximately 50 percent during this period, and drove roughly 60 percent of the increase in its DLR costs. Other reasons for repair cost increases that were noted by subject-matter experts include a change in aircraft operating environments, which drove up part failure rates; increases in Working Capital Fund repair cost rates to recover losses in prior years; and aging component issues.[8]

DLR costs for the C-130H grew at a faster rate than for most other weapon systems, yet flying hours—the primary driver of DLR failures—declined slightly from the beginning to the end of the period we studied, and sorties increased only 17 percent in total. C-130H DLR cost growth was concentrated in the 2000–2005 time frame and occurred in all major categories of DLRs. Our analysis suggests that both increases in working capital fund prices and increases in failure rates during this time period (which subsequently leveled off) were major factors in the cost growth.

Modifications

Modifications to the KC-135 fleet have focused primarily on its avionics systems. The spending for avionics upgrades to the KC-135 fleet was sequenced in a way that more was spent in the late 1990s and less was spent recently. Modification costs for the C-130H fleet grew at a modest rate over this period and included the Large Aircraft Infrared Countermeasures to counter the threat from ground-launched missiles in the OCOs; replacement of the center wing box, driven by accumulated equivalent flying hours; and the Avionics Modification Program.

Other Operating and Support Costs

There are a number of smaller elements of O&S costs that we have lumped together into an "other" cost category. For the KC-135R/T fleet, the three elements of other cost that experienced the greatest cost growth over the FY 1996–2012 time period are support equipment replacement, purchased services, and real property maintenance. For the C-130H, the elements of other costs that contributed most to cost growth are contractor logistics support, consumables, and base operating support. Analysis of these costs was limited.

OPPORTUNITIES TO REDUCE OPERATING AND SUPPORT COSTS

Our case study analyses indicate that addressing Air Force O&S costs will not be easy. There are numerous drivers of recent O&S cost growth—we found no silver bullet for mitigating O&S cost growth—and some drivers clearly fall outside the Air Force's control (the striped areas in the figure, i.e., the price of fuel and unit personnel compensation). Air Force leadership will need to understand the risks associated with cost growth that it cannot control and attack O&S costs that it can influence using a portfolio of initiatives that cuts across cost categories. In the remainder of this executive summary, we discuss current initiatives and further opportunities to address cost growth in each of the categories discussed above, as well as several broader potential opportunities to better control O&S costs, for Air Force leadership consideration.

Reducing Fuel Costs

We found the primary root causes of recent fuel spending growth to be increases in fuel prices. The price of fuel is determined by the global market, so Air Force efforts to reduce fuel expenditures must take the form of reductions in fuel consumption. The Air Force is examining a number of options for this. As an example, Air Mobility Command, the largest consumer of fuel in the U.S. Department of Defense (DoD), is considering a portfolio of fuel-efficiency initiatives to reduce its fuel consumption while continuing to meet mobility mission requirements. Recent PAF analysis identified initiatives that are cost-effective at current fuel prices. These could save in total about 50 million gallons of fuel per year, about 5 percent of total mobility air forces fuel usage, or roughly $190 million per year at FY 2013 fuel prices. Six of the initiatives are both cost-effective and relatively easy to implement: engine-out taxiing, flying optimum flight levels and speeds as allowed, further basic weight reductions, further reductions in the use of auxiliary power units, load-balancing improvements, and installing microvanes on the C-130 fleet. Full implementation of these options would save about 16 million gallons of fuel annually, or 1.6 percent of the total annual mobility air forces fuel consumption. Several additional options would further reduce fuel consumption, if implementation challenges can be overcome, and thus deserve further consideration: expanding the use of continuous descent approaches (currently limited by the Federal Aviation Administration), continuing to test the feasibility of vortex surfing (to address safety, airframe stresses, and ride comfort concerns), and conducting a feasibility analysis of ground towing to understand the potential impacts on airfield operations.[9]

In addition, there may be opportunities to reduce flying hours through increased use of simulators. The Air Force is actively exploring approaches for identifying opportunities to substitute simulator hours for aircraft hours where possible.

Reducing Unit Personnel Costs

We found the largest portion of unit personnel cost growth to be driven by compensation rates; however, compensation changes can be quite difficult for any of the military services to influence on their own, as they apply across DoD and must be approved by Congress. Unit manning levels—the other driver of costs in this category—are primarily driven by wartime readiness requirements (using crew ratios for pilots and the Logistics Composite Model [LCOM] for maintainers) and

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major command funding levels.[10] Here, we highlight prior PAF analyses that identified alternative ways of organizing unit-level maintenance that can enable maintenance manpower savings through manpower efficiencies, while not reducing readiness. These ideas do not directly address the root causes of personnel costs identified above, but offer alternative ways of manning that can reduce personnel costs.

One opportunity is to focus unit-level maintenance on activities that are necessary to launch and recover sorties, and to consolidate all other activities within a global network of maintenance facilities. Prior PAF research showed the potential for significant manpower savings through consolidation of selected unit-level maintenance activities. These manpower savings are enabled through economies of scale at centralized facilities. Looking across the KC-135, C-130, and F-16 fleets, providing non-sortie-generation activities from a global network of facilities could reduce requirements for active duty and Air Force Reserve Command maintenance personnel by over 4,000 positions (with an annual savings of more than $200 million), while also increasing the number of aircraft available to units.[11] Further, these savings do not depend on full centralization to a single facility; the Air Force has flexibility in the exact number and location of facilities in the global network. PAF's analysis helped inform the Air Force's Repair Network Integration (RNI) effort, which is reshaping the way unit-level maintenance is organized and has the potential to enable significant maintenance manpower savings over time.

A second opportunity is to increase the size of operational squadrons. Recent PAF analysis of the Air Force's F-35 fleet showed that, for combat-coded aircraft, the required maintenance manpower per primary assigned aircraft (PAA) decreases

as the number of PAA per squadron increases. As an example, a squadron of 36 PAA could be supported by 26 percent fewer maintenance positions per PAA than could a single squadron of 18 PAA. Furthermore, assigning multiple squadrons to a single wing can generate additional savings, e.g., a wing of three 36-PAA squadrons requires 6 percent fewer maintenance positions per PAA than a single squadron of 36 PAA.[12] While this analysis, which was based on prior Integrated Security Construct (ISC) scenarios, suggests that beddown scenarios that consist of larger squadrons will generally continue to satisfy surge and rotational requirements, larger squadrons could make dispersed operations more difficult to pursue even as dispersal is being integrated into DoD strategy.[13]

Reducing Weapon System Sustainment Costs

We found the major root causes of WSS spending growth in this time frame for these fleets to be war-related usage and aging effects, and therefore difficult to mitigate directly. Costs attributed to war-related usage are likely to diminish in the longer term with a shift to peacetime operations. Aging aircraft issues, on the other hand, are likely to continue to drive up WSS costs for legacy fleets, regardless of changes to the operating environment or usage. Because root causes of cost growth in these areas are largely beyond the control of the Air Force, this leads us to examine options to control and reduce WSS costs within the Air Force's control. These include opportunities highlighted in recent PAF work as well as ongoing Office of the Secretary of Defense and Air Force initiatives.[14] Below, we discuss the potential benefits of increased senior leadership engagement in understanding and managing O&S costs, development of an enterprise sustainment strategy for weapon systems, and expansion of business case analyses to revisit sustainment strategies over time.

Increased Senior Leader Attention to Understanding and Managing Costs

Our WSS cost analysis required access to data from a number of logistics and sustainment cost databases, as well as information from many subject-matter experts, including item managers and other supply specialists, product support managers and functional specialists on their staffs, and financial managers at all levels from the Air Logistics Complexes to the Pentagon. In the course of this analysis, we encountered many difficulties in accessing and utilizing these data for analysis.[15] Cost information tracked by the financial management community can differ from the information used by the functional staff, which can generate confusion. For example, aircraft programmed depot maintenance costs are tracked monetarily by some staff, but in terms of planned or actual work hours by other staff. Program managers responsible for large and costly sustainment programs often had little insight into the costs or cost drivers of the activities they are trying to manage. These challenges are not unique to WSS costs; they also exist at the unit level, as personnel sometimes do not have access to information that could help them make more cost-effective decisions.

Our analysis leads us to recommend the following steps to promote a more cost-conscious culture among Air Force sustainment professionals. First, cost metrics for O&S activities should be formally established and consistently tracked within both organically performed and contracted activities, and periodically reviewed by Air Force leadership in conjunction with corresponding mission performance measures. This establishes a firm set of corporate standards against which costs can be monitored and assessed. Second, O&S cost metrics and their underlying data should be shared throughout the Air Force and DoD to provide greater visibility and facilitate better cost management. This would include distributing the metrics and data beyond maintenance organizations to field-level users and corporate Air Force leadership. Third, program offices, product support managers, and providers of government and commercial sustainment services should be held accountable for explaining changes in both cost and performance metrics. Over time, concentrated senior leadership attention will force the development of more valuable metrics and higher-quality information and instill an urgency to better manage these costs.

These recommendations are consistent with the November 2012 Secretary of the Air Force memo outlining a number of tasks for reducing costs and improving decisionmaking for

Cost metrics for O&S activities should be formally established and consistently tracked.

WSS activities.[16] Task One of that memo states the need for a governance structure, metrics, and data to support better management of O&S costs. The recommendations are also consistent with the application of "should cost" principles to sustainment activities affecting weapon systems. Should cost is a management initiative introduced by the Under Secretary of Defense (Acquisition, Technology, and Logistics) to scrutinize contractor and government costs and achieve savings.[17]

It is important to note that these recommendations do not depend on procuring new data systems. While existing data systems could be improved, there are already a wealth of cost data that could be used more consistently, made more widely accessible, and be more clearly understood and explained both within and outside the depots performing WSS activities.

While the former Air Logistics Centers operated independently, with little sharing of information across or outside of these organizations, the new Air Force Sustainment Center, which includes the renamed Air Logistics Complexes, can help enable such a sweeping cultural shift as we recommend. As an example, the first Air Force Sustainment Center commander directed and advocated for a focus on cost-effectiveness by articulating a management philosophy, leadership model, and data-informed approaches to problem solving and continuous improvement, which essentially amounts to a cultural shift to better target cost-effectiveness. In addition, new requirements for collection of data on contractor logistics support contract costs similar to Air Force data on organic support costs should enable better scrutiny and improvements in the cost-effectiveness of contract support over time.

While there are no easy solutions to the Air Force's O&S cost challenges, understanding and tracking costs are necessary steps to help Air Force leadership achieve the cost-conscious culture it seeks and bolster cost-reduction initiatives.

Development of an Air Force Enterprise Sustainment Strategy

The Air Force currently develops sustainment strategies for each new weapon system. Such decisions are often made for the specific weapon system, within narrow organizational boundaries, determined later in the acquisition process, and do not always consider the implications of individual decisions for the broader Air Force sustainment enterprise. As such, it may be difficult to identify best-value sources for sustainment activities from an Air Force enterprise perspective. Because of the delays in development of such strategies, interim contractor logistics support arrangements are often required to provide initial support for new systems, and it can be difficult to transition the workload to organic facilities later if desired, as investments may be needed to create organic capabilities.[18]

Recent PAF research highlights the benefits of developing an Air Force enterprise sustainment strategy that defines preferred strategies for supporting weapon systems at the technology and subsystems level.[19] Such an enterprise strategy would identify best-value sources for a wide range of sustainment activities, which would then allow support system design decisions to be made very early in the acquisition process for all aspects of new systems that have characteristics in common with legacy fleets. The only new sourcing decisions required would be those associated with brand new technologies. An enterprise sustainment strategy can also inform where the Air Force should focus its efforts to gain access to data rights, thus creating the potential for competition to reduce O&S costs in the future.

The creation of the Air Force Life Cycle Management Center, which includes Air Force Materiel Command's (AFMC's) program executive officer (PEO) organizations and program offices, and the implementation of true cradle-to-grave responsibility for product support within PEOs and system program managers significantly enhance the Air Force's ability to effectively develop and implement enterprise sustainment strategies.[20] This management structure should facilitate development of high-level Air Force guidance governing development

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of sustainment strategies for individual fleets and implementation of those strategies at the PEO and program level.

Sustainment Business Case Analyses for Legacy Fleets

Once the Air Force has selected sources to perform sustainment activities for a weapon system, it can be difficult to instill a sense of urgency to reduce O&S costs over time. However, recent legislation, Section 805 of the 2010 National Defense Authorization Act (Pub. L. 111-84), requires weapon system programs to revalidate the product support strategy through business case analyses (BCAs) a minimum of every five years. The Secretary of the Air Force WSS memo also highlights the role sustainment BCAs can play in reducing O&S costs. Such BCAs can be used to develop in-depth assessments of the costs of organic versus contract provision of a range of sustainment activities. As such, they can create competitive pressures to find ways to maintain weapon system availability at a lower cost for both organic and contract capabilities, as each would wish to be viewed as the best value source for sustainment.

AFMC's Air Force Life Cycle Management Center and Air Force Sustainment Center can help implement such initiatives, as they have the ability to identify best practices and standardize processes across AFMC's PEO portfolios and program offices (in the case of the Life Cycle Management Center) and organic depots (in the case of the Sustainment Center). Indeed, the Product Support Enterprise Vision put forth by AFMC embodies many of these same goals and objectives.[21]

ONGOING AIR FORCE INITIATIVES TO UNDERSTAND AND CONTROL OPERATING AND SUPPORT COSTS

Since late 2012, the Air Force has embarked on two separate but related efforts to understand and contain logistics costs. The Cost of Logistics effort (led by the Deputy Chief of Staff Logistics, Installations & Mission Support) seeks to understand the cost of logistics, relate it to readiness, and identify efficiencies and reduce waste within logistics activities and processes. One accomplishment is the development of a Logistics Cost Reference Document that provides a common reference point for logistics cost categories and definitions, to inform the Planning, Programing, Budget, and Execution (PPBE) process and logistics cost analyses. Another is to develop and refine a logistics cost model that provides a cost data substructure for logistics in order to provide insights into logistics activities and costs. These efforts can help provide a lexicon for, a framework for, and baseline of logistics costs to inform analysis and decisionmaking.

More recently, the Air Force also embarked on an effort called Cost Effective Readiness (CER). Broadly, CER aims to increase integration in the operations and logistics communities and shift from a budget-driven to cost-driven environment in order to reduce O&S costs. CER consists of both a broad effort on the part of leadership to increase coordination and collaboration in planning and execution processes, and specific analytic questions and initiatives to pursue. The Air Force Sustainment Center has spearheaded a number of CER initiatives. It points to a decline in the composite sales rate for maintenance in the Air Force Working Capital Fund as a measure of success. The budgeted rate in FY 2017 marks a decline in nominal terms from the rate in FY 2011.

One question examined in 2014 is to what degree significant departure from planned activity (i.e., planning versus execution) in both operational and logistics activity (e.g., flying hours, spares requirements, and depot repairs, such as engine overhauls and aircraft depot maintenance) drives inefficiencies—and thus cost—in supply chain planning and support. Ongoing PAF analysis supports this effort by seeking to quantify the connections between such root causes and downstream costs, while taking into account planning processes and slack capacity that might mitigate such effects.

Another effort examines opportunities to reduce recurring O&S costs through reducing peacetime aircraft availability (AA) levels, with the ability to surge readiness when needed for wartime. Currently, the Air Force is investigating how AA standards are developed, whether peacetime activities can be sustained at lower AA levels, and whether AA can be surged in needed time frames. PAF has been asked to support this effort by examining the potential for cost savings associated with reduced peacetime AA.

An FY 2013 PAF analysis in support of the Air Force's Cost of Logistics effort assessed this issue from a different direction. Instead of assessing the potential cost savings from fundamental changes to operations or logistics activities, this project assessed the impacts to both peacetime and wartime readiness from reducing funding to specific logistics cost categories. The analysis found that sustained cuts to different logistics cost categories have not only different impacts on readiness over time, but also different recovery costs and timelines.

The extent of these readiness impacts is not intuitively obvious, the relationships among categories changes over time, and some logistics cuts generate a long-term cost rather than savings. This suggests that careful, integrated analysis is necessary to understand the implications of cuts to logistics resources.

Only through an understanding of the interactions between readiness requirements and the costs they drive can Air Force leaders effectively make tradeoffs to maximize capability within available resources.

SUMMARY AND RECOMMENDATIONS

To summarize, the Air Force has experienced significant O&S cost growth for a number of reasons, many of which are not under the Air Force's direct control. The initiatives summarized here focus on areas of O&S costs within the control of the Air Force. The Air Force already has rigorous analysis in-hand that offers options to reduce field-level O&S costs, and there are a range of initiatives and ideas on the table to reduce O&S costs more broadly. The combination of these offers a wide range of opportunities.

Based on the analyses discussed above, we offer several recommendations to help the Air Force better manage and reduce O&S costs. First, where quantitative analysis exists, move to implement policies that maintain current readiness levels at lower O&S cost. For field-level activities (i.e., unit personnel and fuel):

- Continue to implement the RNI initiative to reduce maintenance manpower requirements.
- Consider larger squadrons to reduce maintenance manpower requirements, while also considering implications for more dispersed deployment constructs.
- Continue to implement fuel-efficiency initiatives to reduce fuel consumption.
- Continue to examine opportunities to reduce flying hours through greater use of simulator training.

For WSS, raise the profile of cost in decisions throughout the weapon system life cycle and develop a cost-conscious culture throughout the Air Force:

- Place greater senior leadership attention on O&S costs to increase visibility of these costs and their drivers and improve management of these costs.
- Develop an enterprise sustainment strategy to determine the best value sources of sustainment activities from an Air Force enterprise perspective. Target efforts to access data rights on those activities where organic provision is, or may be in the future, most cost-effective.
- Pursue sustainment BCAs across the fleets to create incentives for both organic and contract providers to reduce their costs over time.

Finally, for the range of ideas and initiatives that seek to reduce readiness-related resources and objectives:

- Continue conducting rigorous analysis, carefully linking resources to readiness so that senior leaders understand the potential risks in capabilities that are being contemplated.
- In such analyses, consider a range of potential readiness impacts, potential near-term and long-term savings, recovery timelines, and recovery cost.

Aircraft O&S costs have declined since FY 2011, due in large part to reductions in fuel and aircraft modification costs. Weapon system maintenance costs, however, have remained fairly constant despite reductions in the Air Force aircraft inventory and flying hours. The cost of maintaining aging fleets is likely to continue to drive O&S costs, and the Air Force will need to keep seeking and executing strategies to reduce costs. It is critical to pursue a portfolio of cost-reduction initiatives to address the complex set of drivers of O&S costs and to enable more informed decisionmaking as Air Force leaders seek to balance readiness requirements and costs over time.

Notes

[1] Calculated based on growth in fixed-wing, non–special operations forces (SOF) aircraft O&S costs measured in nominal dollars between FYs 1996 and 2011. Unless stated otherwise, costs in this report are in nominal or then-year dollars; that is, they are not adjusted for inflation.

[2] We also performed a case study analysis of the F-22 fleet. However, we were unable to develop an equivalent level of detail for costs associated with F-22 contractor logistics support. Therefore, we focus on the two organic case studies here.

[3] Between FY 2011 and the end of FY 2015, overseas operations and total Air Force flying hours diminished, and the price of crude oil dropped. These factors contributed to an 8 percent drop in aircraft O&S cost over five years in then-year dollars.

[4] We calculated these costs from fuel costs and gallons consumed reported in Air Force Total Ownership Cost for the case study fleets.

[5] For the KC-135R/T fleet, personnel end strength associated with the guard and reserve grew significantly, while active duty end strength fell. The C-130H saw a proportionally larger increase in active duty personnel and a proportionally smaller increase in guard and reserve end strength.

[6] Additional comparisons of military to U.S. civilian compensation, and reasons for the increases in military compensation, are found in James Hosek, Beth J. Asch, and Michael G. Mattock, S*hould the Increase in Military Pay Be Slowed?* Santa Monica, Calif.: RAND Corporation, TR-1185, 2012. As of April 23, 2015: http://www.rand.org/t/TR1185

[7] T56 depot-level maintenance costs were exceptionally low in the late 1990s, in part due to a discount on material costs with the engine manufacturer. Costs grew rapidly thereafter, due to loss of the discount and equitable price adjustments tied to a unique producer price index allowed under the terms of the contract.

[8] We observe that DLR costs per flying hour on most weapon systems increased sharply between FYs 2001 and 2005, which coincides with a period of significant growth in the Air Force's Working Capital Fund rates.

[9] See Christopher A. Mouton, James D. Powers, Dan Romano, Christopher Guo, Sean Bednarz, and Caolionn O'Connell, *Fuel Reduction for the Mobility Air Forces*, Santa Monica, Calif.: RAND Corporation, RR-757-AF, 2015. As of April 23, 2015: http://www.rand.org/t/RR757

[10] In practice, manpower requirements derived from LCOM and other tools are not generally fully funded, causing authorized personnel levels to fall short of stated manpower requirements. Furthermore, there can be differences between authorized and actual assigned manpower levels due to retention and recruiting fluctuations. These factors all contribute to realized end strength levels.

[11] See Robert S. Tripp, Ronald G. McGarvey, Ben D. Van Roo, James M. Masters, and Jerry M. Sollinger, *A Repair Network Concept for Air Force Maintenance: Conclusions from Analysis of C-130, F-16, and KC-135 Fleets*, Santa Monica, Calif.: RAND Corporation, MG-919-AF, 2010. As of April 23, 2015: http://www.rand.org/t/MG919

If Air National Guard units are considered, additional maintenance manpower savings can be achieved.

[12] See Ronald G. McGarvey, James H. Bigelow, Gary Briggs, Peter Buryk, Raymond E. Conley, John G. Drew, Perry Shameem Firoz, Julie Kim, Lance Menthe, S. Craig Moore, William W. Taylor, and William A. Williams, *Assessment of Beddown Alternatives for the F-35: Executive Summary*, Santa Monica, Calif.: RAND Corporation, RR-124/1-AF, 2013. As of April 23, 2015: http://www.rand.org/t/RR124z1

[13] Current DoD policy calls for capabilities that enable dispersed operations. See, for example, Secretary of Defense, *2014 Quadrennial Defense Review*, Washington, D.C., March 4, 2014.

[14] See Ashton Carter, Office of the Under Secretary of Defense, *Memorandum: Better Buying Power—Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending*, September 14, 2010, and Frank Kendall, Office of the Under Secretary of Defense, *Memorandum: Implementing Directive for Better Buying Power 2.0—Achieving Greater Efficiency and Productivity in Defense Spending*, April 24, 2013. The initiative contains nearly three-dozen individual ideas to control costs. Some of the ideas pertain solely or primarily to weapon system acquisition, but some pertain to both acquisition and sustainment, such as increasing the use of competition or changes in contracting techniques to reduce costs. See also Michael Donley, Secretary of the Air Force, *Memorandum: Improving the Linkage Between Resources and Readiness for AF Weapon Systems*, November 28, 2012.

[15] The Weapon System Cost Retrieval System (WSCRS) had fairly detailed costs for organic depot maintenance by weapon system. After the completion of this research, WSCRS lost funding and can no longer be queried by users. The Depot Cost And Schedule Tool (DCAST) is used at each Air Logistics Complex, has detailed depot maintenance costs and quantities, and is a rich source of engine and aircraft overhaul data.

[16] See Michael Donley, Secretary of the Air Force, *Memorandum: Improving the Linkage Between Resources and Readiness for AF Weapon Systems*, November 28, 2012.

[17] See Ashton B. Carter, Under Secretary of Defense (Acquisition, Technology, and Logistics), *Memorandum for Acquisition and Logistics Professionals: Implementation of Should-Cost and Will-Cost Management*, April 22, 2011.

[18] Engine repair provides an example of these types of decisions. The Oklahoma City Air Logistics Complex is the Air Force's technical repair center for propulsion. There have been cases where the Air Force implemented contract support for new engines and then later transitioned hands-on work to the depot while paying the original equipment manufacturer a management fee. If there had been a determination up front about organic repair for particular types of engines, the initial contracts and subsequent pass-through fees could have been avoided.

[19] See John G. Drew, Ronald M. McGarvey, and Peter Buryk, *Enabling Early Sustainment Decisions: Application to F-35 Depot-Level Maintenance*, Santa Monica, Calif.: RAND Corporation, RR-397-AF, 2013. As of April 23, 2015: http://www.rand.org/t/RR397

[20] For a detailed discussion of recent changes to how the Air Force manages product support for its weapon systems, see Robert S. Tripp, Kristin F. Lynch, Daniel M. Romano, William Shelton, John A. Ausink, Chelsea Kaihoi Duran, Robert G. DeFeo, David W. George, Raymond E. Conley, Bernard Fox, and Jerry M. Sollinger, *Air Force Materiel Command Reorganization Analysis: Final Report*, Santa Monica, Calif.: RAND Corporation, MG-1219-AF, 2012. As of April 23, 2015: http://www.rand.org/t/MG1219

[21] See U.S. Air Force, *Air Force Product Support Enterprise Vision*, July 2013.

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About This Report

Air Force expenditures on operating and support (O&S) costs have grown at above-inflation rates in recent years, despite reductions in the overall size of the Air Force fleet. To better understand why, in FY 2012 RAND Project AIR FORCE (PAF) utilized Air Force Total Ownership Cost data to perform a statistical analysis of O&S cost trends for fixed-wing, non–special operations forces Air Force aircraft, with the objective of understanding the primary drivers of O&S costs. In FY 2013, PAF supplemented this statistical analysis with detailed case study analyses of O&S costs for three aircraft platforms to better illuminate the root causes of the largest categories of cost growth experienced over the past decade and a half. (The platforms selected for case study analysis were the KC-135R/T, C-130H, and F-22 fleets. This report reviews the findings for the KC-135R/T and C-130H fleets.) This executive summary describes key findings from the FY 2012–2013 analyses, discusses current Air Force efforts to mitigate, and hopefully reduce, the largest categories of O&S costs, and recommends additional actions for Air Force leadership consideration.

The FY 2012 project was commissioned by General Philip M. Breedlove, then Vice Chief of Staff (AF/CV); Maj Gen John Cooper, then Director of Logistics, Deputy Chief of Staff for Logistics, Installations and Mission Support (AF/A4L); James Brooks, then Deputy Director, Strategic Planning, Deputy Chief of Staff for Strategic Plans and Programs (AF/A8X); and Ranae Woods, Air Force Cost Analysis Agency. The FY 2013 project was commissioned by Lt Gen Bruce Litchfield, then Commander of the Air Force Sustainment Center, and Lt Gen C.D. Moore, then Commander of the Air Force Life Cycle Management Center, and was co-sponsored by Ranae Woods. An FY 2014 project commissioned by Lt Gen Bruce Litchfield; Lt Gen Judy Fedder, then Deputy Chief of Staff, Logistics, Installations & Mission Support (AF/A4/7); and Lt Gen C.D. Moore is supporting the Air Force's Cost Effective Readiness initiatives. The work was conducted within the Resource Management Program of RAND Project AIR FORCE.

This report should interest Air Force leaders and analysts seeking to better understand aircraft O&S cost growth trends and primary drivers, as well as the most effective options for addressing them.

RAND Project AIR FORCE

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