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Assessing the Cost-Effectiveness of Modernizing the KC-10 to Meet Global Air Traffic Management Mandates

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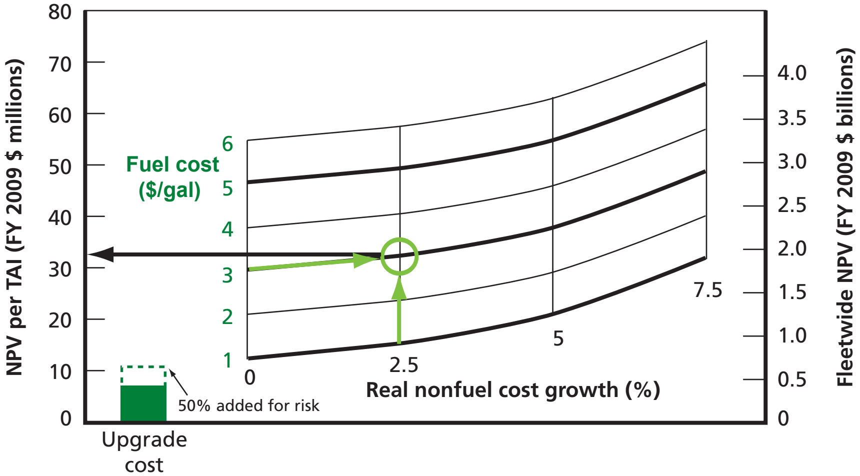
Summary

The KC-10 "Extender" air refueling aircraft is approaching 25 years of service without undergoing significant avionics modernization. Without upgrades, the CNS capabilities of the KC-10 will not allow it to comply with various upcoming air traffic management (ATM) mandates around the world. Noncompliance with these mandates would prevent the KC-10 from flying the most fuel-efficient altitudes and routings in civil air traffic systems and cause delays both on the ground and in the air. (See pp. 5–17.)

A loss of access to optimal airspace and routings would increase operations costs and degrade the wartime effectiveness of the KC-10. For this study, we conducted a cost-effectiveness analysis to determine whether potential avionics modernization options are worthwhile. Our analysis shows that, overall, a KC-10 CNS/ATM upgrade would be cost-effective and result in net cost avoidance. That is, the projected net present value (NPV) of the operations cost avoidance from avionics modernization during the remaining life of the KC-10 fleet exceeds the upgrade cost of the modernization.

Most of the cost avoidance results from fuel savings and thus depends on the price of fuel. Figure S.1 shows the estimated average upgrade cost and future cost avoidance of a CNS/ATM upgrade to the KC-10 on a per-aircraft basis (left axis) and a fleetwide basis (right axis). On the left side of the figure, the green bar represents the estimated upgrade costs per aircraft. The right side of the figure shows the NPV cost avoidance based on the per-gallon cost of fuel and the real rate of cost growth of nonfuel items (primarily contractor logistics

Figure S.1
CNS Upgrade Cost Versus Cost Avoidance Due to CNS Upgrade



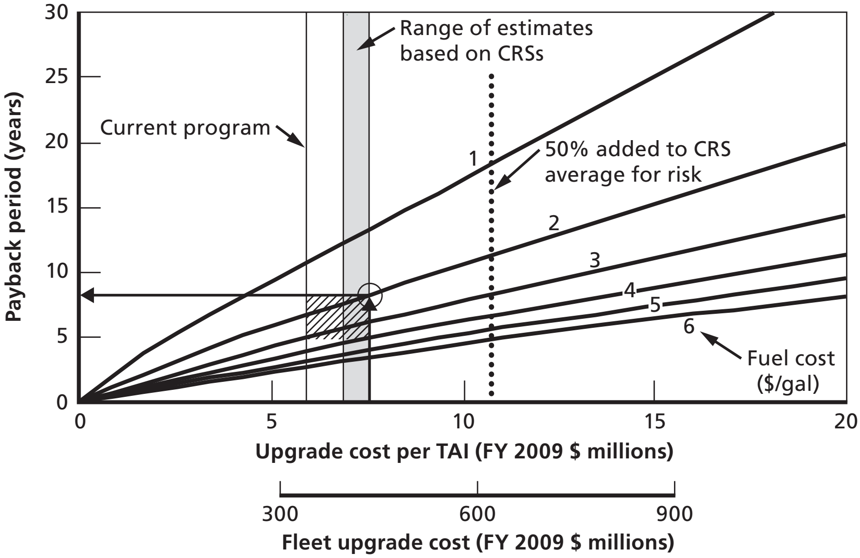
NOTE: TAI = total aircraft inventory.
RAND *MG901-S.1*

support and personnel costs).[1] The cost avoidance from modernization exceeds the upgrade cost over a wide range of assumptions, even in a worst-case scenario of a $1-per-gallon fuel cost and 0-percent real cost growth for nonfuel items. Furthermore, the savings from avoiding altitude restrictions alone (not counting the savings from avoiding delays) are still greater than the upgrade cost. (See pp. 26–32.)

Figure S.2 shows the payback period as a function of the upgrade cost and the cost of fuel per gallon. The payback period can be useful for understanding how soon an investment will be recouped on a nondiscounted basis. In the range of cost estimates for the upgrade, and assuming fuel costs between $2 and $4 per gallon, the payback period ranges from five to eight years. The payback would not begin until 2015, the year in which the first mandates are planned to take effect. (See pp. 32–34.)

[1] In the example in the figure, we assume a constant, real $3-per-gallon fuel cost and real cost growth of 2.5 percent. The intersection of these values (denoted by the green circle) relative to the left vertical axis is the NPV of the savings—$32 million in this example.

Figure S.2
Payback Period from CNS Upgrade



NOTE: CRS = concept refinement study.
RAND *MG901-S.2*

Without modernization, in addition to increased steady-state operations costs, wartime mission effectiveness would be degraded. Not all tanker wartime missions would be affected by the mandates. However, our assessment shows that the KC-10 would be less effective in deployment, air bridge, national reserve, and global strike missions. A noncompliant KC-10's effectiveness ranges from 93 percent to 100 percent of that of a compliant KC-10, depending on the mission. To maintain the existing level of wartime effectiveness (prior to upcoming mandates), the aircraft would have to be modernized or additional tanker aircraft would have to be procured. The costs of either pursuing the upgrade or purchasing additional tankers are comparable. (See pp. 35–44.)

There are additional benefits to modernizing the avionics of the KC-10 fleet that do not necessarily decrease cost or improve wartime effectiveness but nonetheless add to the flexibility of the fleet in meeting mission requirements. These benefits include additional access to airports for landing and continued access to established air refueling tracks. Additional navigation capability (required navigation performance, or RNP, of 0.15–0.3)[2] would allow access to more airports in poor weather. However, most of these airports currently lie in the continental United States (CONUS): Only 26 of the 228 potential newly accessible runways are located outside the CONUS. To best leverage this capability, it must be combined with the means to quickly produce the associated instrument approaches required at more airports. Without modernization, continued access to Hickam Air Force Base (AFB), Hawaii, could be an issue. Furthermore, the KC-10 would be excluded from 70 percent of existing air refueling tracks in the United States. The loss of access to these established refueling locations and altitudes would preclude a majority of military air refueling training. However, we found that, without modernization, complete exclusion of the KC-10 from European airspace would be unlikely. (See pp. 44–48.)

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2 RNP 0.15–0.3 capability allows an aircraft to conduct instrument approaches to landing in poor visibility conditions without the use of ground-based navigational aids.