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Investigating Optimal Replacement of Aging Air Force Systems

Edward G. Keating, Matthew Dixon

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Summary

This report examines a common problem: Whether to continue to repair an aging system or to invest in a new replacement. In particular, we look at this issue from the perspective of the United States Air Force.

Modeling the Decision to Repair or Replace an Aging Aircraft

We consider a type of aircraft (e.g., a tanker) that the Air Force envisions having in its inventory, in some form, into the foreseeable future. We then consider the decision to operate an existing aircraft for one more year or to replace it with a new version right now.

Operating an existing aircraft for one more year results in some aircraft availability level at the cost of the requisite maintenance, fuel, and labor. In contrast, purchasing a new aircraft results in a stream of both costs and aircraft availability.

We find that the Air Force should repair, rather than replace, an aging system if and only if the availability-adjusted marginal cost of the existing aircraft is less than the replacement's average cost per available year.

The C-21A Repair Versus Replacement Decision

We applied our methodology to the C-21A, the Air Force's version of the Learjet 35 passenger aircraft.

According to data provided to RAND by the C-21A program office, the aircraft has had variable, but generally increasing, maintenance and modification costs over time. Of particular concern to the C-21A program office is a major renovation of the aircraft set forth in its system and component replacement schedule for the 2012 timeframe.

We find, with our current parameter estimates, that it probably would be appropriate to undertake the replacement schedule's 2012 renovation, but that the C-21A should be retired sometime around 2020. (See pp. 11– 12.)

Estimating Model Parameters for the KC-135

We next applied our model to the KC-135 tanker.

The Air Force's KC-135 fleet is, on average, over 40 years old. The fleet has had considerable problems in recent years, including degraded availability and increased installation-level on- and off-equipment maintenance costs. The KC-135's programmed depot maintenance package has also grown.

We obtained KC-135 operating and support cost estimates from RAND colleague Michael Kennedy. Those cost estimates, in conjunction with our maintenance cost growth-rate estimates, were used to populate our model.

It is uncertain what would replace the KC-135, but for illustrative purposes we assumed a Boeing 767 replacement. We then made a series of assumptions about how 767 tanker maintenance costs and availability would evolve as the aircraft aged.

With the parameters we used, we find it will be optimal to replace the KC-135 before the end of the decade. This finding is broadly in accord with Kennedy et al.'s unpublished RAND research. We caution, however, that our parameter estimates are speculative; we urge more in-depth analysis of this issue. (See pp. 30–32.)