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REPORT

Methodology for Constructing a Modernization Roadmap for Air Force Automatic Test Systems

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Summary

Virtually all the electronics in an Air Force weapon system are tested using automatic test equipment, much of which is unique to that weapon system. However, the Air Force's ATSs are currently beset by increasing hardware and software obsolescence, which is compounded by the number and variety of legacy ATS types. In response to an overall Department of Defense policy, the Air Force is planning to modernize its component repair capabilities, rehosting them on a much smaller number of modern common testing systems. This report focuses on the economic aspect of the rehosting decision, i.e., which component repairs should be rehosted to use resources most efficiently while maintaining repair capabilities.[1]

Our approach was to formulate rehosting decisions for each legacy ATS for each associated unit under test (UUT).[2] These decisions needed to take into account three sets of information: the projected UUT workload for old and new ATSs; the cost to operate, maintain, and sustain the new and legacy systems; and the nonrecurring cost of rehosting the UUTs on a new ATS. To select an optimal rehosting strategy given the costs and constraints, we formulated a mixed integer linear program. As a test case, we selected a set of six avionics ATS types that collectively repair a selected set of 470 UUTs from the B-1B, focusing on a single weapon system with a small number of operating locations to facilitate data collection.

Our analysis showed that the major driver of rehosting cost is that of rewriting the software programs to run on the new ATS to test each UUT (currently estimated at $300,000 to $1 million, depending on the unit's complexity). This implies that good candidates for rehosting should have

1. very high and increasing maintenance costs and obsolescence issues
2. a relatively small number of UUTs repaired.

An example in our analysis is the contrast between the Radar Electronic Warfare (REW) test station and the Depot Automated Test System for Avionics (DATSA). Both have very high sustainment costs (more than $2 million per year), but the DATSA repairs 350 UUTs, while the REW repairs 22.[3] Total estimated rehosting costs would be $22 million for the REW but $111 million for the DATSA. The REW is therefore close to the point at which it

[1] Modern common test stations offer other advantages, such as a more flexible workforce and the ability to share workload across depots, which we did not include in our analysis.

[2] The UUT is the electronic system component an ATS tests.

[3] Note that the B-1B avionics suite includes more UUTs than we examined and that the ATSs for some of these, notably the DATSA, repair more UUTs than those in our study.

would be cost-effective to rehost its entire workload over a ten-year period. On the other hand, sustainment costs for the DATSA would have to increase substantially to warrant complete rehosting of its workload.

In some situations, an incremental rehosting strategy may be justified:

- Rehosting a small number of UUTs may substantially reduce the total annual workload for a particular ATS type (the idled systems may be used as spares or a source of compatible components).
- The need for significant software modifications to support sustainment engineering for a legacy ATS may provide an opportunity for transition. In such cases, the software costs are essentially sunk, and rehosting the UUTs on a modern ATS may well be life-cycle cost-effective.

In some cases, numbers of a particular ATS type may be very limited, and those may not be sustainable (catastrophic failure). Rehosting the entire workload may be the only option (although doing so may take some time because of manpower and other constraints).

If the Air Force is to manage ATSs centrally, it needs ongoing access to much better data. For example, there is substantial uncertainty about the costs for legacy ATSs and other data required to use our approach. This is particularly true of software translation costs, for which more detailed information on actual translation costs might help make estimates more accurate.

The long-term benefits of modernized and common testing equipment make a strong case for making common families be the foundation of ATS acquisition on future platforms. The methodology can also be used to calculate a roadmap for rehosting the workloads for current platforms that will be phased out or reduced in the near term (10–20 years).