ACQUISITION INNOVATION RESEARCH CENTER

Setting Reliability Requirements for Subsystems

INCUBATOR EXECUTIVE SUMMARY

MAY 2024

PRINCIPAL INVESTIGATOR
Dr. Azad Madni, *University of Southern California*

CO-PRINCIPAL INVESTIGATOR
Dr. Dan Erwin, *University of Southern California*

SENIOR RESEARCHER
Dr. Michael Sievers, *University of Southern California*

PROJECT MANAGER
Dr. Ayesha Madni, *University of Southern California*

USC

SPONSOR
Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S))

EXECUTIVE SUMMARY

Critical defense systems are required to be always available for use. The means for achieving availability goals, meeting needs, and identifying key availability parameters vary across organizations and platforms, making identifying opportunities and areas for efficiency improvements challenging. Although data related to system downtime are captured, they are seldom well-organized and in a form suitable for performing trade studies to identify promising candidate efficiency enhancements.

During this seedling effort, we contacted U.S. Department of Defense (DoD) personnel responsible for system maintenance to discuss their current approach to providing and documenting availability-related issues. Our key finding is that although systems can be significantly different, the means employed and availability concerns are strikingly similar:

- Systems fail more often than expected.
- Systems take longer to restore service than expected.
- Parts needed for repair may not be available and are sometimes borrowed from other systems.
- Some systems get deployed with degraded capability.
- Some systems have internal spares that enable continued use until repairs are possible, but most systems tend to be “single-string.”
- Systems occasionally tend to undergo additional repairs found during preventive maintenance cycles.
- Predictive maintenance remains a desired but elusive goal.

Our study examined the potential for using semi-supervised machine learning methods that look for patterns in vast amounts of data. Using synthetic data, we identified and used such patterns to discern availability trends suitable for performing trade studies and evaluating key factors such as costs, risks, maintenance depot efficiencies, and redundancies.

We also created concepts for a trade study dashboard that defines and analyzes availability scenarios. Exemplar scenarios included:

- Depot maintenance time vs. inherent reliability
- Maintenance time outliers
- System usage vs time-to-maintenance
- Redundancy vs time-to-maintenance

DISCLAIMER

The Acquisition Innovation Research Center (AIRC) is a multi-university partnership led and managed by the Stevens Institute of Technology and sponsored by the U.S. Department of Defense (DoD) through the Systems Engineering Research Center (SERC)—a DoD University-Affiliated Research Center (UARC).

This material is based upon work supported, in whole or in part, by the U.S. Department of Defense through the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S)) and the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) under Contract HQ0034-19-D-0003, TO#0285.

The views, findings, conclusions, and recommendations expressed in this material are solely those of the authors and do not necessarily reflect the views or positions of the United States Government (including the Department of Defense (DoD) and any government personnel), the Stevens Institute of Technology, or the University of Southern California.

No Warranty.

This Material is furnished on an "as-is" basis. The Stevens Institute of Technology and University of Southern California make no warranties of any kind—either expressed or implied—as to any matter, including (but not limited to) warranty of fitness for purpose or merchantability, exclusivity, or results obtained from use of the material.

The Stevens Institute of Technology and University of Southern California do not make any warranty of any kind with respect to freedom from patent, trademark, or copyright infringement.

SYSTEMS ENGINEERING RESEARCH CENTER

AIRC ACQUISITION INNOVATION RESEARCH CENTER

STEVENS INSTITUTE OF TECHNOLOGY 1870