

**Life Cycle Resilience Depends on Maintainability**  
**GSAW 2018 Tutorial Abstract**  
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The DoD Systems Engineering Research Center has developed an ontology for reasoning about system quality factors and their interactions. It identifies three primary sources of system resilience: Robustness (being unaffected by a disturbance); Adaptability (being able to diagnose a disturbance and adapt itself to be unaffected by the disturbance); and Maintainability (being organized to enable rapid and often improved abilities to be unaffected by a disturbance).. Maintainability includes both Modifiability (ease and speed of modification) and Repairability (ease and speed of fixing defects or vulnerabilities).

For tightly-budgeted software system acquisitions, the major incentive is to keep within the acquisition budget, often missing opportunities to develop more maintainable systems and reduce total ownership costs. The DoD Systems Engineering Research Center research project on System Qualities Ontology, Tradespace and Affordability (SQOTA) has identified and developed three sources of Maintainability-enhancement tools to enable systems to be not only more Affordable in terms of total ownership costs, but also more Changeable and Dependable. Maintainability supports Changeability in terms of rapid adaptability to new opportunities and threats, and also supports Dependability in terms of Availability, in that reducing Mean Time to Repair (MTTR) for a system with a given Reliability in terms of Mean Time Between Failures (MTBF) improves Availability via the equation  $Availability = MTBF / (MTBF + MTTR)$ .

The three sources of improved Maintainability tools include two Opportunity Trees for identifying strategies for improving a system's Modifiability for enhancing the system's capabilities, and strategies for improving the system's Repairability for cost-effectively repairing its defects. Another source for software is a set of data analytics tools for identifying shortfalls in the software's Maintainability and sources of software technical debt that projects can use during development to deliver more maintainable systems.

A third, more management-oriented tool is a Systems/Software Maintenance Readiness Framework (SMRF) for evaluating and improving a project's Maintainability planning, staffing, and preparation of technology for cost-effective maintenance. The presentation will summarize the nature, usage, and effects of these tools, including automated and human procedures for evaluating a software system's Maintainability and technical debt.