For DoD weapon systems and infrastructure, the cost of corrosion increases year after year and exceeds $21 billion yearly Department wide as of July 2010. Corrosion affects military readiness by taking critical weapon systems out of action, and has also affected safety, resulting in fatal accidents due to the degradation of equipment. Corrosion is unintended material degradation due to interaction with the environment. Unfortunately, as the warfighters demand more from their systems, corrosion prevention and control is frequently traded during the acquisition cycle for weapon system performance. As a result, the DoD remains entrenched in a *find-and-fix* corrosion management philosophy which is expensive and unsustainable. The proposed research and development corrosion program focuses on developing fundamental understanding, new test methods, material performance data, prediction methodology, and technology transition to the warfighter. The particular emphasis of this work centers on the impact of corrosion and environmental interaction on structural integrity; a focus unique within the broad DoD Technical Corrosion Collaboration (TCC) program. The effort has seven tasks integrally supported by undergraduate and graduate students at the United States Air Force Academy and University of Virginia. Collaboration with the Universities of Akron, Hawaii, Southern Mississippi, and Ohio State under the auspices of the TCC ensures all aspects of material degradation of high performance DoD alloys and coatings are addressed.

Task 1 yields a standardized fatigue test method for determining how corrosion damage (pit) to fatigue crack transition changes with the presence of corrosion inhibitor, material substitution alloys, environment or other aircraft relevant situations. This test method can be the basis for subsequent TCC testing as appropriate. Task 2 provides quantitative data showing how the moist operational environment diminishes fatigue performance of all structural alloys and how novel inhibitors can mitigate the deleterious effect. Development of a fracture mechanics based life prediction algorithm, consistent with current DoD methodology, for variable environments is the focus of Task 3. Task 4 is the most challenging of all tasks, the study of the effect of the interaction of atmospheric conditions and aircraft spectrum loading on fatigue crack growth behavior. Recent developments from the TCC and a leveraged NavAir STTR (Phase II) program in crack growth modeling methods and mechanistic insights into crack progression modeling are transitioned in Task 5. DoD weapon systems frequently use ultra-high strength stainless steel (e.g. Custom 465) components to eliminate reliance on coatings. The aim of Task 6 is to develop the scientific understanding necessary to expand the experimental database and inform/improve prognosis modeling of environmental fatigue of stainless steel structure. Task 7 expands on the successes of Task 6 to improve the DoD capability to manage damaging environmental effects, both stress corrosion cracking and corrosion-fatigue, of modern stainless ultra-high strength steels for airframe applications.