The Department of Defense’s acquisitions and sustainment of weapons systems, and ancillary support systems are being squeezed from multiple angles: performance demands are increasing, mission needs are evolving rapidly, competition for funding is increasing, and environmental and occupational regulations continue to change. This setting is challenging for Program Managers who are responsible for developing, buying, fielding, and sustaining the systems that must meet mission requirements. Program Managers must anticipate and navigate these challenges to thrive in this new landscape.

Simply meeting today’s performance goals and procurement cost constraints is no longer adequate. These two objectives do not ensure lower total ownership costs, which is driven by the sustainment phase, nor resilient long-term mission performance. Total ownership cost includes the elements of a program’s life-cycle cost such as development, design, manufacturing, sustainment and disposal, as well as other related infrastructure or business process costs not necessarily attributed to the program.

Typically, 85% of the total ownership cost is locked by the time that procurement starts. “Hidden” costs associated with environmental and occupational exposures are locked in during system development. In addition, future liabilities associated with environmental and occupational exposure that occur during manufacturing, maintenance and disposal are fully determined before a single platform is deployed. Future regulations both in the U.S. and abroad can limit the availability of key materials. Future liabilities can impact political support, total ownership costs, and system availability threatening readiness. Previous costing approaches have traditionally only considered present costs within a program.

There is a need to allow PMs and system designers to look at design choices and their implications for both sustainment costs as well as longer-term worker health and external societal costs, which may be significant. The ability to analyze choices and identify future costs driven by a program or system was not available until now. Today, program managers need to show that their systems meet cost goals and performance needs while also enhancing mission readiness across the entire life cycle, while considering future impact to warfighters, service men and woman responsible for maintenance, the populations adjacent to our installations and ranges, and society at large.

Given that traditional life cycle costing approaches are incomplete, what tools are available to project managers for this type of thorough, forward-looking analysis? Data is abundant and represents the raw material of the digital age. Engineers, operators, and the service men and woman working at our depots generate vast amounts of system data during development,
testing, and operations. However, how can project managers effectively consolidate and derive value or insight from that data?

**Systems Analysis Transforms Data to Insight**

Noblis, working with DoD has developed the guidance and tools to conduct systems analyses of all types of cost know as a “Sustainability Analysis”. A Sustainability Analysis combines a life cycle cost (LCC) estimate for total ownership costs and a life cycle assessment (LCA) for broader impacts to the population and environment. LCA quantifies resource requirements, environmental releases, and waste through each life cycle stage of a system and estimates the associated impacts to: 1) Resource Availability, 2) Human Health, and 3) Ecosystem Quality. Together LCC estimating and LCA (a sustainability analysis) provide an estimate for:

- **Total Ownership Costs (TOC),** which assess costs to DoD that are incurred during the full life cycle. It identifies and quantifies the “hidden costs” to DoD due to health and environmental impacts both today and in future. These costs are typically not considered during acquisitions.

- **Life Cycle Assessment (LCA),** which assesses impacts to the broader population and the environment. Traditionally, these impacts have occurred because of emissions to the outdoors (e.g., particulate matter from a jet engine). These impacts can be assessed at a direct level (e.g., years of life affected) or as costs.

- **Contingency Costs that occur in the future (e.g., site remediation, hospitalization, disability, or unavailability of resources).** These costs directly impact readiness and re necessary to factor in to ensure a resilient system.

The Defense Department has been actively pushing for more thorough systems approaches with accurate projections of costs and impacts in order to make effective tradeoffs as early as possible in the acquisition process.

To operationalize the analysis, Noblis developed a database (known as the Defense Input-Output database, or DIO) that allows analysts to more completely assess system costs and impacts. The DIO links known data (purchase of materials, use of energy, etc.) to environmental and worker health impacts. Taken together, traditional cost information and the Noblis database create a sophisticated way to generate insight, rather than data.

**Case Study— How Can Systems Analysis Make Tangible Impact?**

The Defense Department has been concerned with the Environmental, Safety, and Occupational Health (ESOH) impacts of cadmium for many years and through work with the Strategic Environmental Research and Development Program (SERDP) has developed new technologies that are ready for deployment at depots department-wide. Currently, Cadmium brush plating is one of the largest usages of cadmium in industrial processes at DoD maintenance depots. Zinc-nickel (ZnNi) brush plating was developed as an alternative technology to reduce the use of cadmium plating in DoD maintenance depots and Original Equipment Manufacturers.

In an effort to address Defense Department concerns, the Air Force Life Cycle Management Center partnered with Noblis to conduct a more comprehensive systems analysis to understand impacts and costs using a life-cycle perspective. Challenges of implementation included the up-front costs and impacts to performance that this new alternative technology may pose. The results of the analysis indicated a slight increase in internal costs to the Air Force in transitioning from cadmium brush plating to ZnNi in addition to several benefits including reductions worker exposure to cadmium and solid waste streams from brush plating. This systems approach allowed AFLCMC to better quantify their achievement of DoD’s strategy of eliminating Cd in brush plating repair operations in
industrial operations at maintenance depots. This approach resulted in achievement both of DoD’s strategy along with AFLCMC’s mission to increase mission readiness, while reducing ESOH impacts.

Summary
A Sustainability Analysis can uncover previously hidden human health and environmental impacts and their associated life cycle costs. Such an analysis can help inform both design decisions when making choices among alternatives and also inform long-term supportability requirements once a design has been chosen. The application of Sustainability Analyses across DoD is expected to result in (1) Lower Total Ownership Costs for systems and (2) Sustainable systems – those that use fewer and safer resources and have reduced human health and environmental impacts and ensure future availability and readiness.

Noblis has developed a web-based tool, AcquLCA, that provides cost-effective sustainability analysis that meets DoD requirements. This new web-based tool, performs the scalable life cycle cost and impact assessments crucial for creating well-researched, well-planned, and sustainable systems. Noblis’ expert judgment helps with focusing on data sources with the highest priority and most meaning for the analysis.

To learn more about Noblis’ energy, environment, and life cycle assessment work and research, contact:

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