Leveraging Nunn-McCurdy to Ensure Program Success

Dennis K. Van Gemert

Those involved with the acquisition of complex defense systems begin with enthusiasm for the challenging task ahead and confidence that the program and technical goals can and will be met—so why do so many programs fall short of their operational cost goals? For instance, in an environment focused on systems engineering revitalization and

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increasing technical rigor, how does systems engineering fall short of its intended purpose of ensuring cost and capability? How might the Nunn-McCurdy Act adversely affect total taxpayer cost of a system? How might it refocus our design approach? This article addresses those questions.

Life Cycle Costing

Life Cycle Cost = Initial Capital Expenditures + Design and Development Costs + Production Costs + Operations and Maintenance Costs + System Disposal Costs

The system life cycle cost is the total cost of the system from concept through disposal. It is what the system or product will have cost you at its end of life, including the disposal cost and anything offset from salvage value. Salvage value is what the system is worth at end of life, provided that it has any residual value. An example of a system that retains a positive salvage value is an aircraft. At the end of its life, even a 50-year-old air tanker can be sold for scrap metal or stripped for parts that may still be usable on working aircraft or other systems that use the same parts. An example of an item that retains no salvage value at end of life is radioactive waste. Such waste must be disposed of in a strict and costly process.

Systems engineering must be integrated with earned value management and risk management to present the program manager with a comprehensive dashboard view of program information that is essential in making critical program decisions.

Most systems have a disposal cost that is offset by some degree of salvage value, and in some cases, salvage value exceeds the disposal cost. For example, when a car is no longer drivable, a salvage yard will most likely be willing to pay for that vehicle. The salvage yard will intend to gain a profit by selling the individual parts for more than the vehicle itself is worth.

What is the value of a tank at end of life? Can it be stripped for usable parts? Can the metal be recycled? Are there any components that require special disposal requirements? Those are questions that must be discussed during system-concept definition and solved during concept definition and development.

Understanding the relationship between components of life cycle cost is essential to successfully executing the systems engineering process and realizing its true benefit. Disciplined life cycle systems engineering is essential to producing an affordable system that meets its schedule, performance, and cost targets.

Direct Versus Indirect Products

A direct product is that which the program seeks to produce as an end product. Direct products are usually composed of software and hardware. An indirect product is that which contributes to the development of a direct product. Systems engineering produces indirect products, generally in the form of paper (i.e., plans, specifications, operational concepts, architectural diagrams, trade studies, use cases, etc.). Indirect products enhance the quality and performance of the direct products while simultaneously increasing the likelihood of meeting cost and schedule goals. Most of the value of the systems engineering plan is in the document creation itself, more so than in its implementation. Creating the systems engineering plan fosters collaboration, integration, teamwork, and positive working relationships while simultaneously breaking down walls and stovepipes that hinder forward progress. Since direct products have a high degree of visibility, they receive the most attention during a budget challenge. Cutting indirect products may not cause a visible symptom to the program for weeks to years, with the most likely symptoms being higher operational testing, deployment, and operational costs as well as failure to meet some system requirements. The focus on the near-term tangible direct products of machined metal and coded software should not be at the expense of the long-term system life cycle performance parameters.

Saving Dollars Over the Long Run

Congressional budget cuts are commonplace, especially in ACAT [*Acquisition Category*] I programs. History has shown that the Government Accountability Office estimate at completion will exceed the system program office's estimate at completion, and Congress will allocate less than what the system program office requests. That problem is compounded by annual congressional budget cuts and re-allocation of funds. The budget cuts are manageable provided that a comprehensive systems engineering plan is in place that holds true to the systems engineering tenet of managing total system life cycle costs. In the interest of the Nunn-McCurdy Act [*which requires Congress to be informed of programs with cost growth of more than 15 percent and calls for the termination of programs whose total cost grow by more than 25 percent over the original estimate*], program offices often decide that remaining off the congressional radar screen takes precedence over minimizing the total life cycle cost to the taxpayer and the cost burden to the system operator.

Putting yourself in the systems engineering role, you may find that for a modest investment of, say, an additional $10 million in developmental analysis and design costs, you could save more than $100 million in operational, logistics, and maintenance costs during the operational life of the system. This seems like a no-brainer, right? Not really. Let me explain why. Chances are, you will receive resistance from the program office due to budget pressures. After all, keeping the program running is of utmost priority, and violating the budget will most definitely bring unwanted attention to the program. It is often easier to say no than to explain to the chain of command—including Congress—why it is the right thing to do.

Let's not forget that systems engineering is an indirect product, and thus, it will be most likely hit hardest by any proposed or implemented budget reductions. Even if there are no budget cuts, overruns can be taken out of the systems engineering tasks to support the direct products. So don't be surprised when you, the systems engineer, hear that your design enhancement is a great idea; however, there are no funds to support it at this time, and besides, the $100 million won't occur until the system is fielded and will be spread out (amortized) over 20 years of operations.

And thus, one of the key purposes of implementing systems engineering on a program—achieve the best value to the user while ensuring capability thresholds are met—is being violated. If a $10 million design change saves $100 million in operations and maintenance costs, then you have saved the taxpayer $90 million in total life cycle costs. One could argue that a total life cycle of 25 years (5 year development and 20 year operations) amortizes the $90 million savings over 25 years, making it insignificant on a yearly congressional budget basis. On the other hand, the savings results in a $3.6 million savings per year. Now multiply that type of savings over many development programs and then you can address some of the capabilities needed from the unfunded requirements list.

The Department of Defense should be focused on total life cycle cost of a system, not the cost on a year-by-year basis. That requires long-term strategic thinking and planning—something that could only benefit our greatest military in the world! Involving engineering, logistics, and maintenance technicians during the early design concept phase of the avionics bays may be more costly upfront, but it will save a great deal of money in the long haul. The difference between a few hours and several days of downtime to perform routine inspection and servicing of critical components is not just budget burden but also an asset-availability concern.

From Good Intention to Implementation

Implementing system life cycle costing is all about educating congressional members and their staffs on the value of a disciplined life cycle costing approach to defense systems acquisition. DoD and its contractors have an important role in ensuring that Congress is informed during the budget process of possible short-term budget challenges and their impact to the total cost of system procurements. Congress has the power to specify that cuts may not be made to systems engineering products and processes (e.g., life cycle costing, planning, requirements management, disposal analysis, human factors engineering, etc.) The defense acquisition community must educate its decision makers and change its propensity to focus on short-term budget issues at the expense of the long-term financial health and affordability of defense, homeland security, or intelligence systems. While software and hardware show tangible progress towards an end goal, they may be misleading indicators if schedule and budget baselines are compromised in the process. Re-work is very expensive, and deploying a system that is not optimized to reduce operations cost is even more costly. Maintainability and availability of a system must be designed in at the system level and flowed down to the component level. It is a unique opportunity for collaborative learning between DoD, its contractors, and Congress. Working groups harnessing the knowledge of Congress and industry experts could inject a new level of affordability into national security procurements, allowing the taxpayer to get more bang for the buck.

Reducing the Long-Term Life Cycle Costs

Next time you are sitting through that long design review, don't be too shy to ask, "How will you get at that frequently replaced component without having to perform major disassembly of the vehicle?" After all, would it make sense to have to remove the engine block from your car to change the oil or a headlamp? This example may seem a bit overzealous, but it is presents a strong parallel to real-world occurrences. Many engineers are not taught early in their careers to design for maintainability. One exception to this case is the design of the International Space Station, in which all engineers were required to participate in training courses geared towards teaching how to design for safety and maintainability. Training involved using simulators to demonstrate an astronaut's limitations during on-orbit servicing of the station. They were taught to understand the difficulties of operating tools while floating in a vacuum and from within a pressurized space suit.

A design team can often significantly reduce the total life cycle cost of a system by reaching across disciplines to execute a rigorous systems engineering approach. Often by increasing the design, development, and test budgets,

DEPARTURE OF MAGAZINE ART DIRECTOR

Defense AT&L magazine wishes Paula L. Croisetiere a fond farewell as she moves on to a new position as a courseware production/process manager for DAU's e-Learning and Technology Center.

Croisetiere has served as the magazine's art director for 18 years, beginning when the magazine was known as *Program Manager. It* was later renamed *PM*, and in 2004, it became *Defense AT&L* magazine. She oversaw the redesign of the magazine's masthead with each name change. In addition, under Croisetiere's oversight, the magazine underwent multiple redesigns, continually improving over the years as it transformed from a single-color newsletter format to its current full-color, magazine format. Numerous readers have commented on the high quality of the magazine's design, and Croisetiere's efforts were a significant contributing factor in the magazine's recent recognition with a 2009 APEX award for publication excellence from Communications Concepts.

In addition to serving as art director for the magazine, Croisetiere served as the senior graphic designer and prepress production manager for DAU's Visual Arts and Press division. She worked on numerous DAU Press publications, among them the university's catalogs, strategic plans, brochures, and displays; and was heavily involved in the development and maintenance of the university's branding program.

Croisetiere, who has 25 years of graphic design experience, began her career as a commercial art instructional aide for the Arlington Career Center, then served multiple positions in private industry before becoming a visual information specialist at the Defense Mapping School. She joined the Defense Systems Management College in 1991 as a visual information specialist.

Croisetiere has an associate's degree in commercial art with a specialization in graphic design from Northern Virginia Community College and a bachelor's degree in computer graphics from George Mason University. She is currently pursuing a master's degree in instructional design from George Mason University.

combined with cross-discipline systems engineering, one can reduce the operations, maintenance, and disposal costs of a system; and that significantly reduces the total life cycle cost of a critical system. To accomplish that requires a change of mindsets and a strong investment in training and education. We graduate the best engineers from our universities, but there is no substitute for practical experience and understanding. It is easy to overlook maintenance and logistics considerations during design, permitted the designers are not familiar with those considerations. Designers need to keep their eye on the big picture and realize that almost every decision involves trades—staying off the congressional radar versus the total tax payer burden, for example.

Nunn-McCurdy is beneficial to our nation, but as most things in life, it comes with unintended consequences that must be managed by those ultimately responsible and accountable for the program cost, schedule, and performance—and on down to the lowest-level employee. Nunn-McCurdy is a beneficial element of our systems of checks and balances, protecting the taxpayer from runaway costs and forcing program managers to focus on cost and schedule performance in balance with technical performance. A Nunn-McCurdy review should include, as an essential element, the integration of systems engineering throughout a program and all of its interfaces. There must also be a documented connection elaborating on the interdependencies between cost performance, schedule performance, technical performance, and systems engineering implementation.

Proper and disciplined implementation of the systems engineering process and methodology is the most effective tool in a program manager's toolset for controlling the cost and schedule baselines as well as managing the technical baseline. Improper requirements management is a leading cause of scope creep. As a program progresses, the cost to change or add requirements becomes significantly more. It is important to remember that each change or addition must be analyzed to determine its impact on other requirements, system performance, cost, and schedule. For that reason, systems engineering must be integrated with earned value management and risk management to present the program manager with a comprehensive dashboard view of program information that is essential in making critical program decisions.

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