APRIL 2018

National DEFENSE

THE BUSINESS AND TECHNOLOGY MAGAZINE OF NDIA

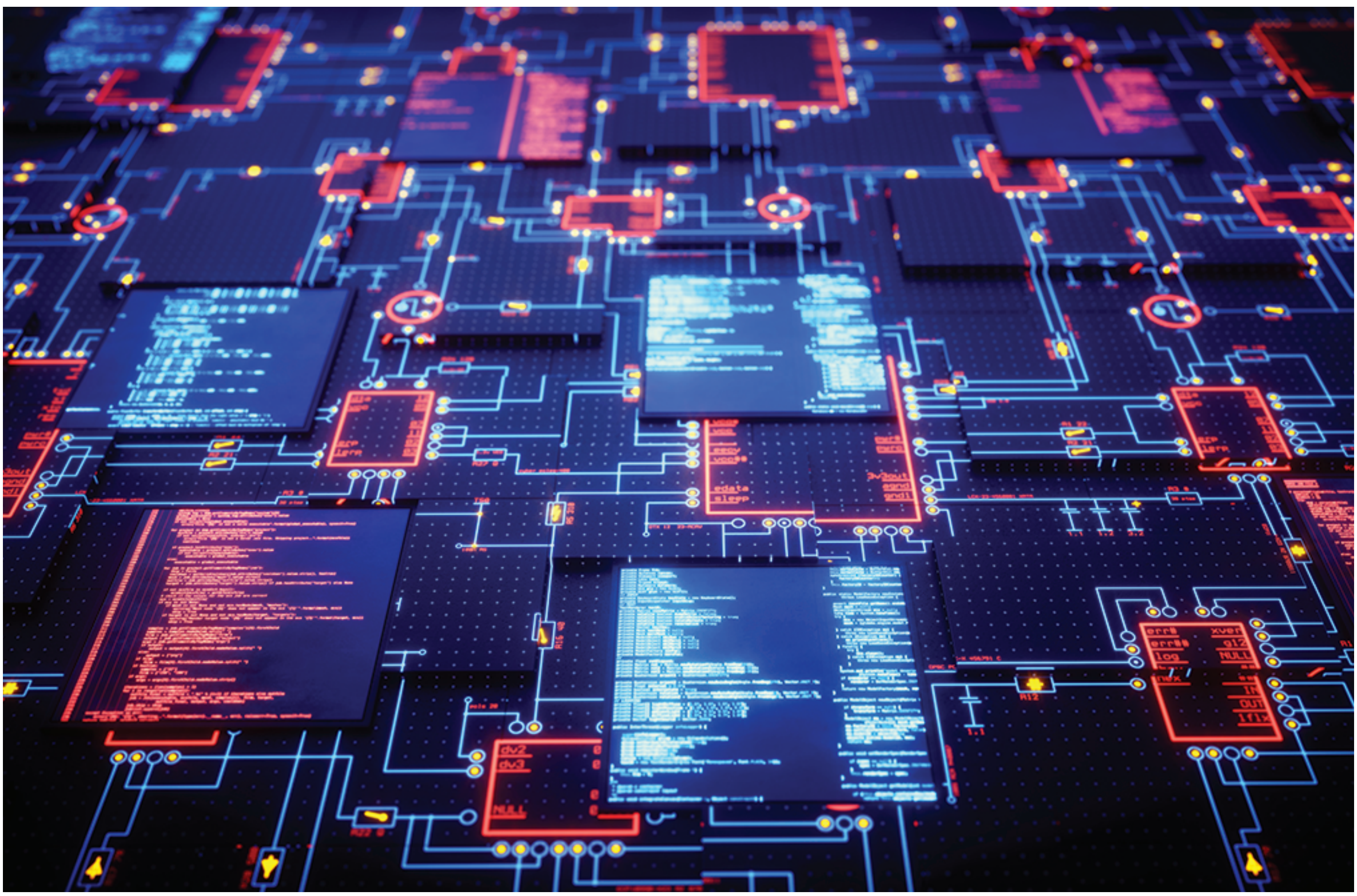
Viewpoint BY STEVE CARLSON AND JAMES S.B. CHEW

Preventing Expensive Electronic Hardware Mistakes

"Management reserve" is a common term for all Defense Department and defense industrial base program managers. As a program execution management system is constructed, experienced subject matter experts are consulted to assess risk. This risk assessment is based on experience from previous programs. As a rule, the higher the risk, the higher the management reserve.

Despite all this careful planning, expensive hardware mistakes are common. The reasons are simple. First, all defense acquisition programs are incorporating new technologies that have not been fully vetted. Second, the "lessons learned" from the past acquisition programs are forgotten the moment the platform meets initial operating capability.

There is almost a quiet resignation within the Defense Department on the inevitability of acquisition program cost and schedule overruns. And the "guardians of the status quo"



DEFENSE DEPT., FORD

are all too glad to initiate a "blame game," focusing on the narrative that a science-and-technology program has "failed."

They ignore the fact that firm, fixed-price commercial product development is common. Even when the benchmarks of today's commercial products are pointed out to these guardians, they wrongfully state that these practices cannot be adopted to "sophisticated" defense platforms.

Fortunately, the department and Congress agree that adopting the commercial best practices that lead to first-pass success are totally reasonable expectations to have in defense systems as well. Steps are being taken to implement these practices, rightfully under the management of the newly formed undersecretary of defense for research and engineering.

The good news is that techniques exist today to address the technology that is the root cause of the majority of defense electronic program acquisition delays. Studying and adopting the commercial electronics best practices of "emulate before you fabricate" will not only result in first-pass success, but also "future-proofed" — in other words, sustainable and modernizable — electronic systems that are verified with real metrics.

The commercial electronics industry has developed a methodology that directly addresses the drawbacks of historical approaches. The Cadence system prototyping methodology introduces an emulation and analysis step, as well as an explicit go/no-go step prior to committing an idea to a physical prototyping step.

By using the system prototyping methodology and metric-driven verification, the Defense Department can transition capability faster to the warfighter.

Incorporating these two new steps significantly addresses the shortcomings of the "automatic fast path to prototype" approach.

It allows first-pass success of physical prototypes with regards to function, the confidence to use advanced process technology rather than a field programmable gate array for prototypes, and short-circuits the physical prototyping of function and size, weight and power infeasible solution paths. It also gives the ability to explore size, weight and power in multiple technologies without re-design.

Emulation is a vital technology for system prototyping because it provides the combination of capacity, run-time performance, accuracy, linkages to physical analysis such as performance, power and thermal — and the visibility necessary to make accurate go/no-go decisions. Its performance is great enough to enable running application software on hardware designs resident in the emulator. Companies such as NVIDIA use the industry's leading emulation system for system prototyping flows.

The interoperability requirement laid out in the 2018 National Defense Strategy is inclusive down to the component level.

It states that "combined forces able to act together coherently and effectively to achieve military objectives require interoperability. Interoperability is a priority for operational concepts, modular force elements, communications, information sharing and equipment."

Emulation technology, coupled with the system prototyping methodology, provides insurance that new device designs can interoperate with existing components, subsystems and systems. The in-circuit-emulation use model can be used to

emulate the new design physically coupled to existing devices and boards.

The stated strategy for dealing with the very real problem of parts obsolescence is to instill the rigor of an iterative, evolving system process that can renew and refine fielded systems. The system prototyping methodology has been successfully applied to address the parts obsolescence problem.

The Defense Department's scope needs to change. Part-for-part replacement is often not a good choice for systems that have been in the field for some time. Rather, looking ahead for the likely next candidates for obsolescence and grouping them together with the present can yield significant savings and improvements.

Further, by taking a broader architectural view, opportunities for system optimization and mission expansion can be applied to choose the scope of the upgrade to be undertaken.

Getting proficient at this methodology is the ultimate way to future-proof systems, thus meeting this tenet of the 2018 National Defense Strategy: "The department will realign the incentive and reporting structure to increase speed of delivery, enable design tradeoffs in the requirements process, expand the role of warfighters and intelligence analysts throughout the acquisitions process, and utilize nontraditional suppliers.

"Prototyping and experimentation should be used prior to defining requirements and commercial off-the-shelf systems. Platform electronics and software must be designed for routine replacement instead of static configurations that last more than a decade." **ND**

James S.B. Chew is chair of NDIA's Science and Engineering Technology Division and group director of aerospace and defense at Cadence Design Systems Inc. Steve Carlson is director and solutions architect for aerospace and defense at Cadence.

This article was reprinted from the April 2018 issue of *National Defense*