# No. 16: Wrestling with Complexity in Defense Programs (11/03/09)

In recent years, defense programs are more ambitious than any previously attempted. They promise unprecedented capability through integrating groundbreaking technologies into network-centric systems-of-systems, such as the Army's Future Combat System (FCS) and the Coast Guard's Integrated Deepwater System (IDS). Yet such programs involve unparalleled complexity – not only of the underlying technology, but of the organizations that propose, build and use them – which in turn affects the ability to deliver them on time and on budget. New policies and governance models are called for, as well as changes in the organizations that manage such programs.

**Complexity in Defense Programs Today**

An analysis of more than 90 Major Defense Acquisition Programs (MDAPs) in fiscal year 2008 showed approximately $372 billion in aggregated cost overruns. On average these MDAPs are expected to cost 40 percent more than projected (53 percent more when weighted by program size).[1] In addition, the Government Accountability Office found that, on average, MDAPs experienced a 22-month delay in reaching initial operational capability.[2]

This track record indicates that existing governance and management tools no longer suffice for today's complex programs. Current approaches were developed years ago, in an environment where the government customer was technically astute and worked closely with a single vertically integrated contractor per program. Such approaches divide programs into more manageable smaller components, then integrate them into a single platform or system.

Yet these processes do not work for complex programs. Complex programs are inherently dynamic, non-linear, and risk-intensive. They require that many external elements, such as the politics of coordinating a large number of linked organizations, be internalized. Their main benefit is derived from the very act of integrating many elements into a system-of-systems whose whole is greater than the sum of its parts. As such, to divide the program into pieces at the outset, develop each piece and then attempt re-integration risks the loss of the desired unique capability. Furthermore, the government today is less savvy in matters of technology and typically interacts not with a single contractor but with a systems integrator that represents a broad network of firms.

**The Technology – Governance Gap**

The phenomenon of swift technological progress outpacing governance and management is by no means new. Absent a clear and immediate crisis, public organizations have little incentive to innovate or take risks. As a result, new approaches evolve infrequently. Yet the reality is that few radically innovative defense programs could have succeeded without parallel successes in developing new governance models and management tools. The ships of World War I could not have been developed without the invention of the Gantt chart, and the most important step in launching the Polaris ballistic missile program was the establishment of a new governance structure in the form of the Special Projects Office.

[1] Department of Defense (2008) *Selected Acquisition Report (SAR) Summary Tables*; CSIS analysis.
[2] Government Accountability Office (2009) *Defense Acquisitions: Assessments of Selected Weapon Programs*, p.2.

Nevertheless, governance in the acquisition of complex defense systems often takes a back seat to the engineering aspects of these programs, under the assumption that that good technology development and program management will suffice. In parallel, the tempo of outsourcing key governance elements to the private sector, from writing requirements to program management and oversight, has increased. The resulting imbalance often leads to mismanaged expectations, poor investments and unhappy outcomes.[3]

We make two recommendations for dealing with complexity in the context of defense programs: develop new governance models, and infuse organizations with the ability to withstand the frequent changes and constant uncertainty that complex programs entail.

**New Governance Models Needed**

First, there is a need to generate new policies and governance models that take into account the specific challenges posed by complex programs. Because of the complex nature of new defense programs, there can be no "one size fits all" policy or model. A research and development program seeking radical breakthroughs demands a different model from upgrade or production programs. It may also be prudent to differentiate between hardware and service provision programs.

Developing new governance models requires a better understanding of program attributes, i.e. what the program needs in order to succeed, and of the elements of governance that different organizations possess. On the program side, additional research is needed on how funding stability, schedule stability, technology maturity, stability of requirements, estimated vs. contracted cost, and management stability affect performance. On the organizational side, attributes such as technical awareness, project management skill, customer understanding, organizational longevity, manufacturing expertise, and organizational independence require more attention.

**Flexibility and Resilience as Keys to Success**

Second, having selected a governance model and the organization to implement it, we should insure against a future need to change that model, either because an inappropriate model was initially chosen or because circumstances changed. The organizations that govern and manage complex programs therefore need to mirror the nature of complexity by incorporating the ability to learn, adjust behavior, and if necessary, self-reorganize.

To build more fault-tolerant organizations, we propose focusing on the concepts of flexibility and resilience. Flexibility is the organization's ability to adapt and respond to anticipated, but unpredictable changes. Resilience is the ability to withstand the effect of changes while adapting and responding to them. The emerging research areas of resilience engineering, strategic ambidexterity and prediction markets will be of use here.

Revolutionary breakthroughs in technology mean that complex systems-of-systems are attemptable; whether they are achievable will depend on our ability to develop the appropriate policy and governance models they demand. Meeting the complexity challenge will not only enable militaries to field next-generation defense capabilities, it will also provide the companies that developed these capabilities with a significant competitive advantage the production of new, complex, high-value products and services.

— Guy Ben-Ari & Matthew Zlatnik



[3] Michael Schrage (2009) "Making Governance Matter More: Oversight, Insight and Foresight in Complex Systems Procurements", in: Guy Ben-Ari and Pierre Chao (eds.) *Organizing for a Complex World: Developing Tomorrow's Defense and Net-Centric Systems*.