Complex Government Technology Development Programs: Meeting the Policy Challenges

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Technology development and systems integration programs such as the Army's Future Combat System (FCS), the Coast Guard's Integrated Deepwater System (IDS) program and the FAA's Next Generation Air Traffic System are far more ambitious than any previously attempted by the U.S. government. They involve the development of groundbreaking technologies to create large, network-centric systems-of-systems with unprecedented capabilities. But such innovations bring unparalleled complexity; in recent testimony before the Senate Armed Services Committee, Secretary of Defense Robert Gates noted the difficulty of developing advanced systems on time and on budget, and numerous reports by the Government Accountability Office, the Congressional Research Service and others point to major cost overruns, schedule slippages and performance shortfalls in these programs.

While the technology and engineering challenges involved are not trivial, the federal government's ability to successfully bring to fruition complex technology programs depends first and foremost on effective policy and governance. Unlike smaller projects, complex programs require that many external elements, such as the bureaucratic politics of coordinating a large number of interlinked organizations, be internalized. Integrating external and internal elements makes complex programs dynamic, non-linear and risk-intensive; it also presents significant policy challenges.

Historically, there has always been a tension between the increasing complexity of new technologies and the policy frameworks that govern them. As Richard Nelson argues in *Technology, Institutions and Economic Growth* (Harvard University Press, 2005) "physical technologies" co-evolve alongside "social technologies" such as new forms of governance and organization. However, not only has it proven harder to advance social technologies than physical technologies, but slow progress in support of social technologies is often a constraint on the societal benefits from innovations in physical technologies (Nelson, R.: "What Enables Rapid Economic Progress: What Are the Needed Institutions?", *Research Policy*, 37:1, 2008).

The recent track record proves that the government's existing tools no longer suffice for large-scale, horizontally integrated 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. Under existing approaches, programs are divided into more manageable smaller components, then integrated into a single platform or system. Yet this approach does not work for complex programs, whose main benefit is derived from integrating many elements into a system of systems whose whole is greater than the sum of its parts. Today, not only is the government customer less savvy in matters of technology, but a typical contractor is a network of firms, often spanning continents and sharing responsibilities for managing costs, schedules and risks. Companies may at the same time be partners and competitors, and sharing information is a sensitive issue at best.

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So the time has come to pioneer new policy and governance models. Yet the nature of complexity is such that it will not be possible to find a one-size-fits-all solution – a single set of rules, standards or regulations – suitable for all possible contingencies. New policies will need to incorporate generous amounts of flexibility and resilience to enable decision makers and program managers to adapt to constantly changing realities.

In 2007-2008, a series of five workshops co-hosted by the Center for Strategic and International Studies and MIT brought together key technology policy, complexity theory, and governance experts from the private sector and academia, as well as government program managers, to discuss the new policies required for managing complex government programs. Five key policy issues emerged from these workshops:

- Improving the government's ability to assess whether the right programs are being initiated and whether they will produce the required capabilities;
- Studying commercial governance models, such as those used to regulate technology development;
- Understanding the effects of complex programs on the industrial base and the government's ability to generate competition and innovation from the industrial base;
- Identifying key attributes for successful governance, as well as the types of organizations that possess them;
- Developing the personnel necessary to lead complex programs.

These issues, as well as others related to the management side of complex programs, were then disseminated to government officials and experts in industry and academia in order to gauge the extent to which they are applicable and can be implemented as policies.

Between January and September 2009, the research will continue in the following manner:

- In-depth evaluation of at least two government agencies (the Defense Department and at least one other agency, e.g. NASA or the Federal Aviation Administration) to establish which of the policy issues raised are being addressed, and how;
- Design specific policy recommendations relating to the five key issues that were raised in the workshops. Possible recommendations include rethinking the process by which complex programs are created (analysis of user requirements, contract preparation, contract management) and defining which elements within that process should be done by the government and which can be outsourced, i.e. to what extent government and industry should be responsible for identifying needs and defining capabilities to meet them. Policy recommendations on developing better in-house government program management will also be discussed.

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 the US to field next-generation capabilities, it will also provide its industrial base with a significant competitive advantage.