

Testimony of

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Mr. Chairman and members of the Committee, I am honored and privileged to appear before you today to speak about improving acquisition processes for space systems.

I think space acquisition procedures are the biggest challenge facing our space systems today. We must do things differently. Unless decisive actions are taken, I think we will continue to spend large amounts of money without returning a commensurate capability to our stakeholders.

The U.S. Government manages tens of billions of dollars to build and operate space systems. These systems provide essential capabilities in the following functional areas: position, navigation and timing; missile warning and surveillance; intelligence, surveillance and reconnaissance; environmental sensing; communications; space control; and space science and exploration. Unfortunately, during the last 15 years, a negative trend has developed with respect to the procedures the Government uses to acquire U.S. space systems. In the pursuit of accommodating the needs of various stakeholders, we have developed strict requirements-based processes that are having adverse, unintended consequences. I think we need to transform today's organizational culture and processes used to acquire our space systems. I would like to discuss ten major problems in our management of space systems acquisition today. For each case, I will describe the problem and provide my specific, constructive recommendations on how to solve it.

Problem	Solution
1. Overly detailed requirements from the stakeholders with little flexibility.	Describe only the expected performance attributes, approximate schedules and suggested funding profiles.
2. Proceeding to acquisition before proper technology maturity.	Build the critical technologies to sufficient maturity to prevent technology surprises during the acquisition cycle.
3. Insufficient budget flexibility.	Reduce the number of expenditure centers (EC) and line items, and provide some margin reserve.
4. Requirements creep after program initiation.	Resist stakeholders' desires to increase program capabilities late in the acquisition process.
5. Management experience shortfalls in space acquisition results in too many people in program offices.	Train/hire an elite cadre of government experts and minimize personnel rotation. Hold government managers accountable.
6. Incomplete requirements flow down to subsystems to meet expected performance.	Work with contractors to ensure all implementation requirements have been properly transferred to subsystems.
7. Failure to properly manage subcontractors.	Encourage start of all subcontractors soon after program authority to proceed and ensure proper subcontractor management.
8. Uncertainties in the expected performance and schedule of the new generation of electronic components.	Ensure mature manufacturing processes with validated performance have been developed for all selected components.
9. Tendency to build a new spacecraft for each new set of requirements.	Develop standard interfaces, modular approaches, and plug and play whenever possible.
10. Responsibility for the development of only on-orbit capabilities exclusive of requisite ground services.	Evaluate end-to-end systems and work with our partners to process, exploit and deliver the capabilities.

1. Overly detailed requirements from the stakeholders with little flexibility.

During the first 30 years of the space program, we built capability-driven systems that provided the best that our advanced technologies could offer. That strategy worked well in offering innovative solutions, but it did not always represent the customers' needs. During the last 15 years, however, we have swung the pendulum to the other extreme by collecting overly broad requirements sets that our space systems should meet. This strict requirements-driven process often includes mutually exclusive capabilities that cannot be easily integrated on the same spacecraft. When we attempt to do so, it can drive significant increases in cost and schedule. Our requirements-driven stakeholders often do not understand the cost implications of the various elements of their respective wish lists, and when we proceed to blindly integrate these capabilities, considerable problems develop. This problem is exacerbated when we are asked to hold fixed performance, cost and schedule at the beginning of any space acquisition, thereby inexorably increasing program risk.

Instead, we should develop more discipline to understand the needs of the stakeholders. We must listen to their needs and build systems to connect their basic needs to expected performance attributes for a proposed system, the approximate schedule, and the expected funding profile. If problems develop, I think we should have the flexibility to trade

performance in lieu of cost. If we choose to extend schedule, we have to be willing to increase program cost.

2. Proceeding to acquisition before proper technology maturity.

Enthusiastic stakeholders and space program managers often advocate and start programs to build a spacecraft before the critical technologies have been matured. As a result, we often have to spend years developing the technologies as part of the acquisition with big cost penalties for feeding a large acquisition army when delays occur.

Instead, I think we should build critical payload subsystems first under cost-plus contracts prior to major procurements in order to mitigate technology risk. Once the payload critical technologies, subsystems, and systems have been built and properly tested, the more conventional spacecraft integration and test of those systems can often be performed, and the systems built, using accelerated schedules in an advantageous combination of firm fixed price for basic functions and cost plus overlay to ensure increased testing and complete mission assurance.

3. Insufficient budget flexibility.

It is difficult to manage our space acquisition programs today without having the budget flexibility to solve problems as soon as they develop. I think program managers are trapped by very specific budget constraints when their programs are partitioned in proliferate ECs and line items, and they are overly limited in the money that can be transferred

between programs. Since the contractors feel pressured to provide optimistic budget proposals to win programs, this lack of budget flexibility prevents us from solving problems as soon as we observe early symptoms. Fewer ECs and line items would give greater flexibility to move money among them so that we can be more effective managers. I recommend execution year reserves for space acquisition programs. I am not suggesting these reserves be implemented with no oversight. These reserves should be used judiciously by program managers to solve problems during program execution with the program manager's supervisor providing the proper accountability for execution of those funds.

4. Requirements creep after program initiation.

Since there are many users impacted by the capabilities and operations of our space systems today, there is an inclination by many of these stakeholders to request increased capabilities for the various specific programs being pursued during the acquisition cycle. These stakeholders are driven by the need to address a dynamic target set and/or the appeal of new technology perceived to increase capabilities. Even though these motives are laudable, they do have negative impacts on program system acquisition.

Program managers should resist stakeholders' desires to increase program capabilities late in the acquisition cycle.

5. Management experience shortfalls in space acquisition results in too many people without the requisite experience in program offices.

To manage complex programs, we need a highly trained workforce with the correct skill set. It has become difficult to find the requisite trained expertise in government to run major programs. I think we tend to compensate by significantly increasing the workforce numbers to obtain the expertise through collective thinking and prescribed processes involving many government and support personnel. The unintended consequences are that contractors are compelled to match one-for-one the size of their respective government program office, resulting in value reduction on both sides.

I think we should also pay more attention to the technical training of our workforce and hire greater expertise in government, while minimizing personnel rotations. Consequently, we could better empower program managers to make decisions in their programs and hold the managers accountable for their actions. We should carefully select trained program managers to ensure the correct balance of knowledge and experience.

6. Incomplete requirements flow down to subsystems to meet expected performance.

In many cases, I have observed that prime contractors fail to perform a detailed system engineering analysis during the first few months of program execution, and some requirements are inadvertently not communicated to some tiers of subcontractors.

When these problems are not found until several years after the beginning of the program, they result in major cost impacts to the project.

I think we should work with contractors to ensure that all implementation requirements to meet the contracted capabilities have been properly flowed down to the subcontractors. The flow down should include both the system level and the environmental requirements.

7. Failure to properly manage subcontractors.

Encourage the quick start and proper management of subcontractors. It takes many months and often years for a prime contractor to finalize the specifications for subcontractors and put those subcontractors to work for the prime. This slow pace at the beginning of the program has a detrimental impact on total program cost and schedule. Once under contract, prime contractors often do not fully integrate subcontractors' program management plans and management schedules into the prime's integrated master plans and integrated master schedules. As a result, there are frequent surprises in program execution with adverse cost and schedule impacts. I have also noted that different aerospace companies exhibit different management styles when dealing with the subcontractors. Those companies that consider subcontracting program management a valuable step in career progression and position their best talented technical individuals in those

jobs, do significantly better than those companies that consider subcontracting management a business support function.

I think we should work with industry to ensure there is sufficient maturity in the description of the work being proposed by subcontractors at the time of proposal submission so the prime can finalize subcontractor tasks during the first few months after contract award. Then, the prime contractor should manage the subcontractors with authority by imposing strict discipline in the work that has to be done to ensure proper compliance to performance, cost, and schedule. All subsystem deliverables essential for program execution should be integrated in the master plan and master schedule.

8. Uncertainties in the expected performance and schedule of the new generation of electronic components.

With the tremendous advances in the semiconductor and microchip industries during the last 15 years, great numbers of traditionally separate components are now integrated into more complex single parts. Since these components are evolving quickly, the companies involved as primes, contractors, and subcontractors tend to go out independently to obtain their electronic components from the industrial base without important compliance checks. Problems of flawed manufacturing or immature processes in some of the electronic vendors, found only late in system testing, have significantly impacted program costs and schedules.

I think we should work with industry and the Aerospace Corporation to ensure mature manufacturing processes are used and there is no overdependence on any one vendor. Redundant procurements must be used at the beginning of programs if there is a sufficiently high risk of time delays by depending on a single parts contractor. Finally, to achieve mission assurance, I think the Government must take an active role managing the parts and materials approval process.

9. Tendency to build a new spacecraft for each new set of requirements.

In spite of the great demand for the use of satellites to meet defense, intelligence, and commercial applications, I think spacecraft manufacturers have a propensity to build a different spacecraft for each specific application. Even though all spacecraft use the same basic bus support functions such as power, structure, attitude control, thermal, propulsion, and communication, and some of the components and many of the subsystems are the same, there is still a paucity of commonality. It often seems every spacecraft is designed using a clean a sheet of paper.

I think we should work with industry to encourage the development of standard interfaces, modular approaches and plug and play configurations whenever possible. If a spacecraft constellation using identical systems is being implemented, we should build them using the same framework implemented in the aircraft industry using production assembly lines. Emphasizing

distributed constellations and production assembly lines, we should reap increased capabilities by providing multiple redundancies while reducing overall cost.

10. Responsibility for the development of only on-orbit capabilities exclusive of requisite ground services.

I think it is essential that we do not isolate the responsibilities of the space system acquisition agency (such as the National Reconnaissance Office) from the responsibility of the organizations responsible for exploitation and dissemination of the product (such as the National Security Agency or the National Geospatial-Intelligence Agency). We should carefully analyze the questions we are trying to answer, determine if space is the best medium to obtain that information, and proceed to perform an end-to-end analysis of all the elements required to convert the collected data into information for decision-making. The ground infrastructure required to command and control the spacecraft and process, exploit, and distribute the resulting information, is just as demanding as the space systems. When we fail to work in perfect alignment with the various other players, delays occur because not all the elements of the complex system are ready when needed. I think the space system producers should share end-to-end responsibility for system performance.

I think we should evaluate the end-to-end system and work with our partners to process, exploit, and deliver our capabilities.

In conclusion, I have described what I believe the processes, culture, and technology challenges are besetting the Department of Defense and the Intelligence Community (IC) space systems organizations today and provided specific recommendations on corrective actions. We must be resolute pursuing effective solutions to today's problems. I think it is critical to move away from the requirements-driven procedures in place today so we can have the flexibility to describe the expected performance attributes of proposed systems, their approximate schedule and the proposed funding profile. We must not fix all three fundamental contract parameters (performance, schedule, and cost) in any space acquisition in order to avoid expanding program risk exponentially. I think there should be a common approach for the acquisition of both small and large spacecraft. If we follow these recommendations, we can develop effective business models that apply to the entire industry.

I remain deeply concerned that the culture and processes that we have come to accept as the *de facto* standard operating procedure do not represent the best framework for the enhanced capabilities that we need to provide to the military and the IC. We must transform the ways we do business, become much more proactive and effective in satellite acquisition program management. Our challenge is to return more to the nation for resources invested. To rise to this challenge and continue to be the leading space faring nation, I think we must modify, streamline, or eliminate some of the processes and

change the culture to which we have become accustomed during the last 15 years. We must learn from our mistakes, galvanize our efforts, and move forward to transform our space acquisition processes now.