Written Statement of

Mr. Daniel L. Dumbacher
Executive Director
American Institute of Aeronautics and Astronautics

Subcommittee on Space
Committee on Science, Space, and Technology
United States House of Representatives

"NASA's Cost and Schedule Overruns: Acquisitions and Program Management Challenges"

June 14, 2018

Chairman Babin, Ranking Member Bera, and distinguished members of the Subcommittee, I want to thank you for the opportunity to address you today as you consider recommendations to help minimize challenges that lead to increased costs and schedule on NASA programs. I sit before you as a former NASA program manager, a former educator, and as the current executive director of the world's largest aerospace professional society, the American Institute of Aeronautics and Astronautics. Over the span of my career I have led several of these major NASA programs and I have helped educate and prepare our nation's future aerospace workforce.

Let me first say that the work NASA employees and its industry partners do is challenging. The NASA/Industry team should be commended for their accomplishments under tight constraints.

The programs are complex, and a great deal of planning and commitment are necessary to execute a successful mission. Every program has its unique challenges and setbacks, but NASA works hard to address these issues, develop solutions, and incrementally make progress toward achieving the respective missions. No matter how much planning takes place, or how well thought out the plan, it is difficult to estimate the costs and schedules of these complex projects. This is especially the case for the larger projects such as the Space Launch System (SLS), the Orion spacecraft, and the James Webb Space Telescope. For these programs, even when using the soundest estimating tools based on applicable past experience, it is extremely challenging, in part because each first-time development is unique.

All federal government departments and agencies are operating in a time of heightened fiscal responsibility and accountability. Accordingly, NASA has updated policies and guidance to focus on (1) program formulation and implementation with robust cost estimating, including cost estimates and the approach, (2) well-defined baselines, designs, and risk postures at key decision points, and (3) authoritative requirements and guidance with emphasis on formal (decision) documentation. Especially during the implementation phases of its projects, NASA has processes to ensure that rigorous cost assessment is performed and program progress is well understood by enhancing the periodic performance review process and by providing support to projects when cost, schedule, and/or technical performance is in question. NASA has shifted its operational paradigm to better balance technical requirements with the establishment of adequate cost, schedule, and technical baselines, and during execution by addressing poor performance to avoid collateral impact to other missions. Since NASA instituted its Joint Cost and Schedule Confidence Level, or JCL, policy nearly a decade ago to understand and assess program risks impacting cost and schedule, NASA's cost and schedule performance has improved… *significantly*. NASA should be lauded for moving cost growth against established baselines from 45 percent on average, pre-JCL, to less than 2 percent since instituting the JCL process.

From my perspective, the issues experienced in the NASA projects can be assessed in basically two categories. These categories are (1) the need for stable and consistent funding, and (2) workforce development. I will address these below.

Stable and Consistent Funding

In a simplified perspective, project management has three basic "knobs"—content, schedule, and cost. A change in any one of these variables directly affects the other two variables. Cost and schedule issues do arise when there are unanticipated changes to a program or when development challenges arise, particularly during first-time production and when technical capability is being pushed. Disruptions to the budget process and funding stream, along with major policy and priority shifts, affect schedules and contracts and ultimately lead to additional costs. This is especially problematic for large projects that require long-term investments and long-term life cycles. It is also quite difficult for NASA to plan and implement programs without sufficient resources or reserves. While the agency receives approximately 5/10ths of a penny for every tax dollar, the number, breadth, and complexity of programs continues to increase. NASA also operates within the confines of administration policy shifts and the economic market conditions. Overall, aerospace, and increasingly commercial supply chains, are affected by external policy and economic conditions.

A key issue is how certain projects are developed under a flat-line budget that does not account for the needed project life-cycle growth for detailed design and test. Perhaps even more important, a flat-line budget does not provide program managers with the ability to address design and operational changes required both before and after testing and also with system integration. In fact, a flat-line budget requires project managers to realign the work as they go to stay under the budget cap, resulting in hard priority decisions and inefficiencies that explicitly break the linkages across schedules and budget allocations within a program. These circumstances can, and do, add to program costs and move schedules to the right.

We learned this lesson with the International Space Station (ISS) and yet, now we are repeating it with the SLS and Orion. Moreover, at various points these fiscal limitations have also led to contractor layoffs, which negatively impact the base of knowledge and experience available to draw from in future programs.

The current budgeting process, including the regular use of continuing resolutions, late year appropriations, and threats of government shutdowns, results in endless, multiple planning scenarios. Such irregularities lead to inefficiencies in planning and technical execution. It is extremely challenging for NASA and its industry partners to resolve complex technical issues, hold schedules, and predict accurate flight dates when the budget is constantly in flux. Although budget increases in recent years have helped to increase margin in the programs, additional funding, outside of the normal planning cycle, can create inefficient spending profiles because there is little time to integrate a changed funding profile – even when the change is a

positive one – into program planning. As I stated in my October 2015 testimony before this subcommittee, the need to constantly have backup plans for each potential appropriations outcome, different budget planning levels, along with flexible workforce blueprints, all but invites confusion and miscommunication. In a program such as SLS these inefficiencies can and do result in significant cost to the taxpayer that occurs simply because of disruptions to the planning process caused by external factors such as the ones I have described.

A related issue is the inability of NASA to include appropriate budget and schedule margins in its program planning because of externally imposed constraints. Like the imposed flat- line budgets, planned margin is difficult to include because it becomes the first target for budget reduction in the Executive Branch budget and congressional appropriations processes. The May 2018 Government Accountability Office (GAO) report discusses the Goddard Space Flight Center margin requirements. This is done for the small missions; however, in the large-scale, higher visibility programs, planned margin becomes the victim of the budget negotiation process. I must point out that even the smaller missions have difficulty in protecting the schedule and cost margins in the budget process.

Workforce Development

A separate, but related, issue that must be addressed is the workforce challenges impacting not only NASA but the aerospace community as a whole. There remains a nationwide shortage of workers for jobs requiring skills in science, technology, engineering, arts, and mathematics (STEAM). These workers form the backbone of an aerospace and defense (A&D) industrial base that the United States and its allies count on to ensure and sustain innovation, economic growth, global competitiveness, and security. According to Aviation Week & Space Technology's 2017 Aerospace & Defense Workforce Study, nearly 30 percent of the nation's A&D workforce is over the age of 55, and 22 percent are younger than 35. The percentages of ethnic minorities and women working in A&D, at less than 25 percent, have not changed significantly in four decades despite a major shift in the demographics of the United States. Additionally, only 16 percent of 12th graders are proficient in math and have expressed interest in a STEAM-related career.

More specific to NASA, the GAO cites that 56 percent of NASA's workforce is 50 years of age or older. More experienced employees have retired, passed away, or moved on to other endeavors. Others have stayed several years past their initial retirement eligibility date. Unfortunately, there is a shortage of highly trained technical graduates to fill the skills gap, and many young professionals are inadequately prepared in cross-functional skills. More concerning, they lack development program experience. The vast majority of the NASA human

spaceflight workforce has been hired and trained after Space Shuttle development. ISS development has provided on-orbit expertise; however, launch system development experience is minimal. NASA expertise that developed the Space Shuttle has retired or passed away.

Many young professionals are also electing to leave NASA or the sector altogether for other high-tech jobs. This is sometimes the result of program layoffs, but, according to Aviation Week, it really comes down to job satisfaction, which includes challenging work; access to tools, learning, and technology; and being part of an organization that encourages innovation in technology, processes, and business.

For the United States to continue its long-held space exploration leadership in the world, significant investments need to be made in addressing the workforce development via hands-on real hardware programs and research. Key technical challenges for the future of space exploration such as nuclear propulsion, on-orbit assembly, human survival in microgravity, and propellant depots need to be addressed. Such investments would meet key research and engineering needs while providing valuable experience for the future workforce.

NASA should proactively, with administration and congressional support, establish key metrics for doing in-house work and assess use of its capabilities as space privatization continues to grow. The Goddard Space Flight Center model of 10 percent in-house effort is a prime example. Use of the unique NASA test facilities and workforce expertise for common testing and assessment of commercial space systems and products will ensure standard program performance, safety and reliability, and, if done right, will save private industry from the large investments.

Workforce diversity is absolutely essential as well. The future complex problems demand the inclusion of all perspectives for innovative AND relevant solutions. Moreover, we must continue to welcome highly skilled, non-U.S. citizens who wish to be educated and trained at our top institutions and retain those talented individuals who want to work alongside U.S.-born colleagues to contribute to the advancement of our sector. Collectively this workforce drives economic growth, innovation, and the entrepreneurial spirit that has continually pushed the aerospace community to accomplish the seemingly impossible. A well-developed “leadership bench” is also necessary for a program or mission’s success. This ensures the availability of appropriate expertise to assess and balance risk and priorities—all in a timely manner. Developing the workforce through hands-on real hardware programs will provide the needed bench strength.

The tightly constrained and constantly changing fiscal environment also leaves little maneuvering room or forgiveness for the ability to predict outcomes during a development process. Since the Challenger accident in 1986, and particularly following the Columbia accident, NASA's program and project managers have become increasingly conservative, sometimes losing sight of opportunities that present themselves by pushing the envelope of design, technology, and testing.

I must be crystal clear on this point: Safety remains the utmost priority in space exploration. This nation must always protect the safety of the astronauts, their families, and the workforce. I am suggesting that there is a better balance in terms of accepting risk. NASA must be allowed, like in the Apollo era, to recognize the opportunities, be bold in pursuing them, assess the risks, and consciously and continuously manage the risk for these challenging endeavors – without facing punitive outcomes. By its very nature, exploration requires the ability to understand the situation and make intelligent judgments to move forward.

Conclusion

The keys to a well-executed program are stable and adequate funding and a sufficiently experienced workforce. Plain and simple. I commend NASA for doing such a great job operating under the current unpredictable budget environment and funding constraints. The agency is working to integrate the latest technologies to reduce costs while maintaining or improving performance and safety. The programs in development are advancing steadily, and they will continue to encounter technical, management, and operational challenges. Keeping programs on schedule is essential to maintain our global leadership in space and minimize the overall program costs. A return to a regular appropriations process coupled with a long-term perspective will help address these issues and will help accomplish the administration's goal of returning to the moon and furthering the human neighborhood to Mars and beyond.

At the same time, Congress must continue to pass legislation that enhances the pipeline of STEAM-competent workers into the U.S. economy; this includes initiatives aimed at underrepresented demographics. Congress should also craft legislation that will bolster economic competitiveness and job opportunities in the sector and encourage education and training programs required for both the existing workforce and new entrants. Federal incentives and/or grants need to be readily available to support industry, government, and academic partnerships that tailor training for high-level skills and that provide professional education opportunities and research-focused collaborations. And Congress should pass visa legislation that encourages the retention of foreign professional workers in U.S. industry.

Again, thank you for the opportunity to address this body and thank you for your continued support of our nation's space program. I look forward to answering any questions you may have for me in this regard.