

NASA AEROSPACE SAFETY ADVISORY PANEL
National Aeronautics and Space Administration
Washington, DC 20546
Dr. Patricia Sanders, Chair

December 9, 2021

Senator Bill Nelson
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Sen. Nelson:

The Aerospace Safety Advisory Panel (ASAP) held a public meeting via conference call on December 6, 2021. This ad-hoc meeting was called to address several recommendations that resulted from our Quarterly meetings and will be included in the ASAP Annual Report for 2021.

Three new ASAP Recommendations, 2021-05-01, 2021-05-02, and 2021-05-03, can be found on page 7 of the attached Minutes. We greatly appreciate the participation and support received from NASA leadership, the subject matter experts, and the support staff.

The Panel submits the enclosed Minutes resulting from the public meeting for your consideration.

Sincerely,



Patricia Sanders
Chair

Enclosure

AEROSPACE SAFETY ADVISORY PANEL

Public Meeting
December 6, 2021
Conference Call

2021 Public Meeting for ASAP Recommendations

Aerospace Safety Advisory Panel (ASAP)

Attendees:

Dr. Patricia Sanders, Chair
Lt Gen (Ret) Susan Helms
Mr. Paul Sean Hill
Dr. Sandra Magnus
Dr. Amy Donahue
Mr. William Bray
Dr. George Nield
Mr. David West
Dr. Richard Williams

Telecon Attendees:

See Attachment 1

ASAP Staff and Support Personnel

Attendees:

Ms. Carol Hamilton, NASA ASAP Executive Director
Ms. Lisa Hackley, NASA ASAP Administrative Officer
Ms. Kerry Leeman, Technical Writer/Editor

Opening Remarks

Ms. Carol Hamilton, ASAP Executive Director, called the meeting to order at 9:30 a.m. ET and welcomed everyone to the ASAP's special public meeting to discuss additional recommendations of 2021. She indicated that no verbal or written statements were received from the public prior to the meeting, but time would be allocated at the end for public comments.

Dr. Patricia Sanders, ASAP Chair, opened the meeting by stating that throughout 2021, in a series of insight and fact-finding discussions and quarterly meetings, the ASAP both explored the status of NASA's ongoing program of work and focused on the longer term, strategic posture of the Agency to address risk management. As a result, the ASAP's 2021 Annual Report will concentrate on the strategic issues as well as their bearing on current development, exploration, and operational matters.

Since its creation on October 1, 1958, Dr. Sanders stated, NASA has been responsible for some truly remarkable accomplishments. As an organization, it is admired around the world, and it regularly wins awards such as "The Best Place to Work in the Federal Government." However, past accomplishments do not guarantee future successes. NASA has also had its share of failures that have come with costly lessons that have not always remained in the institutional memory. For NASA to continue its record of accomplishments in the decades ahead, it will require NASA to

proactively plan for and manage its operations in the presence of numerous challenges and constraints, and deal with the many changes that are taking place within the aerospace community.

As the ASAP discussed in last year's annual report, NASA has been evolving how it conducts its human space flight programs. From its founding, NASA took responsibility for defining, directing, and executing almost all its major programs. Later, NASA made conscious decisions to share responsibility for managing significant portions of certain programs with industry. More recently, several of NASA's key programs have been almost entirely managed by industry. That evolution in responsibility took place in response to several factors, including:

- The belief that it may allow for lower program costs.
- The potential to significantly shorten development schedules.
- A deliberate strategy to turn some activities over to industry to enable NASA to focus its efforts and its budgets on more challenging tasks.

The evolution of roles and responsibilities between NASA and industry has been generally successful, but this trend has changed how NASA executes its mission. Specifically:

- For a significant portion of its program portfolio, NASA is no longer responsible for deciding how systems are designed, developed, and tested.
- Increasingly, NASA is becoming a customer rather than an owner/operator.
- Rather than directing all human spaceflight programs, NASA is more frequently engaging with—and relying on—industry and international partners.

Dr. Sanders emphasized that if these trends continue, which is likely, the Panel believes that it is necessary for NASA to strategically evaluate the path ahead and determine the future shape of the organization. Once the Agency has identified a vision and strategy, it should then make the decisions, and take the necessary actions, that will enable it to accomplish the required transformation. Regardless of the vision that NASA conceives for its future, the Agency will still need to operate as efficiently as possible to manage fixed costs and to maximize the budget available for mission-related work.

As a result of our Panel's discussions, we have identified a series of issues that NASA will need to address with respect to its plans and aspirations for the future; how it intends to interact with both commercial and international partners; its risk management approach; and its changing workforce and infrastructure needs. Dr. Sanders indicated that the Panel is making three specific top-level recommendations that offer improvement opportunities related to NASA's Strategic Vision and Guiding Principles, Agency Governance, and Program Management.

The rapid changes occurring in space technology, investment, and operations—and the growth of a commercial sector interested in pursuits beyond those driven by government requirements—define an inflection point for the space sector. In the past, space activity was primarily sourced directly by government-defined missions. In the future, the government will be only one of many customers, and industry will bring an increasingly broad and technologically sophisticated set of capabilities to realization. Dr. Sanders noted that emerging from this transformational period, it

is hard to predict the array of human space flight activities that might be in motion even 10 years from now, but drivers for the need to transform include:

- Missions to the Moon and Mars are significantly more complex than the objectives of previous years.
- An increase in mission complexity.
- Sustained lunar and Martian missions will involve significantly greater risk than NASA's previous human space flight experiences.
- The pace of technological change will almost certainly continue to increase, requiring designs and systems that are flexible enough to integrate advantageous advancements.
- The aerospace industry is becoming much more diverse and innovative, and companies are willing and able to make major contributions.
- Having benefitted from a positive experience, the international community has made it clear that it would like to work with NASA on future exploration programs.

Dr. Sanders echoed the Panel's shared belief that this all represents a safety issue. Changes in how NASA manages human space flight programs can have a significant impact on the risks associated with those programs. For example, the overall strategy that NASA decides to use for a particular program—whether to “make, manage, or buy”—has major implications for the kind of expertise and experience the Agency's workforce will need to have to successfully execute the program and to manage the associated risks. The Panel believes that NASA's vision for the future, and a clear definition of how it will evaluate and make decisions related to risk (in addition to how it will manage and execute programs), are extremely important factors in ensuring human space flight safety. As a result, the primary focus of the upcoming report will be the urgent need for NASA to strategically define its future role and articulate a vision and a set of guiding principles to direct its efforts.

As NASA continues to evolve and define its future role, Dr. Sanders stated, it is important for the Agency and its stakeholders—Congress, other Executive branch entities, the private sector, and the taxpayers—to understand the context in which NASA has been successfully operating for the past 50 years. By having a clear understanding of what drove, and continues to drive, Agency culture and thinking, NASA and its stakeholder community can work intentionally to chart a meaningful and impactful role for the Agency in the future. Ignoring the external forces and environment in which the Agency must perform will only place NASA in a tenuous position going forward, which in turn will impact how safely and successfully it will be able to carry out U.S. government missions in space.

In looking strategically at the future, Dr. Sanders indicated, the Panel recognizes that NASA faces a number of challenges in its internal and external environment.

First of all, NASA's structure, organizational dynamics, and workforce culture are grounded in the Agency's formation and shaped by the dynamics of its stakeholders. The Agency was established before society had any foundational engineering and operational experience related to sending humans to live and work in space. Consequently, NASA had to invest in and create the workforce and knowledge necessary to engage in human space flight safely and successfully. As the complex undertaking of sending humans to the Moon evolved during the 1960s, various NASA centers emerged with specific technical or operational expertise—a defining feature of the very same

centers that still hold true today. As NASA grew and established new programs, the work split between the different centers ebbed or altered, but it was still fundamentally driven by the original distribution of technical expertise. Dr. Sanders explained that at times, a competitive dynamic has appeared between NASA centers, particularly those that primarily support human space flight and enabled by localized stakeholders. There remains a very strong culture at each NASA center that at times prioritizes its own goals as opposed to those of the overall Agency, creating tension against the implementation of a strategic approach.

Secondly, as NASA internally tackles the changes that must happen for it to be successful in the changing external environment, the expectations of its external stakeholder communities—specifically Congress and the Executive Branch—must also change, Dr. Sanders stressed. For example, the Panel has continued to stress the importance of constancy of purpose and its role in the ability of the Agency to manage risk intelligently and proactively. Not only do consistency and clarity of objectives help the Agency plan more efficiently, but they also send a clear message to the workforce about the Agency's direction, providing focus and background for decision-making at all levels. Constant and abrupt changes in direction create inefficiencies in planning and execution that create confusion and uncertainty in the workforce and dilute the focus in decision-making, all of which increase risk and cost. Thankfully, for the past two Administrations, the Moon has remained the primary mission, but earlier transitions were not so smooth.

Dr. Sanders stated that disruptive changes in direction not only decrease the ability of the Agency to operate efficiently, but they also shape internal NASA culture. For example, as the Space Shuttle program was ending, the Agency was given a clear mandate to return to the Moon. When the Constellation program was cancelled, after an administration-level review of its program performance, the Agency focus was redirected to an asteroid landing mission, an objective that made less technical sense for a long-term development of interplanetary capability. When the asteroid objective lost traction within a few years, it created a ripple of uncertainty and loss of strong mission focus in the workforce that still echoes today. The abrupt changes and confusing communication in direction for NASA's primary touchstone program caught the whole community—but especially the NASA workforce—by surprise.

The subsequent dynamics and behavioral patterns that emerged due to that disconnect now appear to be normalized into the organizational culture, Dr. Sanders observed. NASA leadership, unable to discuss a comprehensive lunar program for many years, with a historical resemblance to the Apollo program, became focused on creating tools and capabilities outside of the traditional program context the Agency. And, consequently, the Exploration Ground Systems, Orion, and the Space Launch System were set up as three individual programs, each with their own processes, structures, and management approaches, rather than what previously would have been an integrated single program. These three individual programs were then distributed across the three major NASA human space flight centers to make the resource allocation equitable and to satisfy stakeholder requirements.

Unfortunately, Dr. Sanders noted, this approach resulted in a critical gap in the system-of-systems integration process that is usually filled by having a single overarching program umbrella with requisite program authorities and integration responsibilities. In the absence of a formal program umbrella, NASA Headquarters established a bottoms-up integration effort, which required the individual programs to negotiate among themselves; a difficult proposition when discussing

design and operational changes that allocate risks to different elements, which then impacts individual program cost and schedule.

Rather than assessing the negative impacts to cohesive integrated risk management, NASA has adapted this disassociated program structure with the view that it is a manageable alternative to the familiar and effective program framework that served them well for the Apollo, Space Transportation System, and International Space Station programs.

Thirdly, NASA, because of the numerous stakeholders across the Executive and Legislative branches of government, has other dynamics that impact its ability to execute. Stakeholders, from the Office of Management and Budget, to separate Congressional delegations and offices, mean numerous agendas, creating occasionally contradicting directives for the Agency. Each stakeholder's priorities drive tasks and workflows that are not optimized at the Agency level. This restricts NASA's ability to manage its own internal costs, especially regarding infrastructure and labor.

And fourth, another external factor that influences NASA's ability to operate more efficiently, and that directly impacts risk and safety, Dr. Sanders stated, is the national budget formulation process. NASA receives its budget allocation annually. For the last decade, even that process has been routinely delayed, requiring the Agency to work in a constant environment of budget uncertainty. Although it is well understood that the budget profile for a complex engineering system requires significantly more up-front investment during the design and development phase, NASA must manage its programs with essentially flat-line spending profiles from year-to-year. In an uncertain and constrained budget environment, engineering decisions are driven by short-term cost considerations that have long-term consequences for operations, including and especially, safety and risk posture.

While NASA must evaluate its structure, organizational dynamics, and culture to align to the new environment it finds itself operating in, to be successful, it needs strong support and awareness from the stakeholder communities who must recognize their impact on the ability of the Agency to safely execute the nation's space mission.

So, what does success look like? Dr. Sanders mentioned that in the ASAP Annual Report for 2020, the Panel initiated a discussion of some strategic issues facing NASA in a rapidly evolving environment, which the Panel believes have significant impact on the safety and risk management of human space flight. In particular, the Panel posed the following questions for the Agency:

- What role NASA intends to perform going forward and why?
- How will the Agency interact with both commercial and international partners?
- How will the Agency address shared risks?
- What management practices will be employed?
- How the expectations will be communicated to their partners and to their workforce?
- How effective Systems Engineering and Integration (SE&I) will be accomplished?
- What the NASA workforce of the future should look like and how it will be achieved?

As NASA begins to craft answers to the critical strategic questions and create the vision and guiding principles for the Agency over the next several decades, the Panel offers the following recommendations to help guide their efforts:

Recommendation 2021-05-01

NASA should develop a strategic vision for the future of space exploration and operations that encompasses at least the next twenty years, including potential alternative scenarios, which is driven by how the Agency is going to understand and manage risk in the more complex environment in which it will be operating.

- ***The vision should describe the role that NASA intends to play during that period and how it plans to engage with both commercial and international partners.***
- ***NASA should assess the workforce, including the number, types, skills, experience, and responsibilities that will be required, and the infrastructure facility requirements, with a plan for managing changes needed to meet those requirements.***
- ***NASA should also propose general criteria for evaluating “make, manage, or buy” decisions on future programs or projects.***
- ***All aspects of the strategic vision and its implementation should be clearly and unambiguously communicated throughout the workforce of the Agency.***

Recommendation 2021-05-02

As a part of an overall risk management approach and in order to develop and execute its strategic vision for the future of space exploration, NASA should establish and provide leadership through a “board of directors” that includes the Center Directors and other key officials, with the emphasis on providing benefit to the Agency’s mission as a cohesive whole, and not to the individual components of the Agency. The Board should act to identify the strategic risks and obstacles that NASA may encounter in executing its mission, evaluate Agency-level mitigation approaches, and align the efforts of all Centers to ensure desired outcomes.

Recommendation 2021-05-03

NASA should manage Artemis as an integrated program with top-down alignment, and designate a Program Manager endowed with authority, responsibility, and accountability, along with a robust bottoms-up, collaborative feedback process for both Systems Engineering and Integration (SE&I) and risk management.

Dr. Sanders indicated that the recommendations will be discussed more fully in the ASAP’s 2021 Annual Report. The Panel is presenting them now for the public. Dr. Sanders then invited Panel members to add any comments to the discussion. No comments were made. Before she concluded the ASAP’s 2021 Recommendations public meeting, Dr. Sanders opened up the discussion for public comments. No comments were received.

Dr. Sanders thanked all the participants and adjourned the meeting at 9:53 a.m. ET.

ATTACHMENT 1

Note: The names and affiliations are as given by the attendees, and/or as recorded by the telecon operator.

PARTICIPANTS

Alexandra Coultrut	Nanoraks LLC
Dani Lentz	NASA Space Flight
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David Millmen	N/A
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Jamie Donahugh	NASA
Jared Stout	MBI PLLC
Jeff Foust	Space News
Joey Roulette	The New York Times
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Linda Karanian	Karanian Aerospace Consulting
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