

The Ares Project: Building an Exploration Culture from the Inside Up

*Stephan A. Cook, Project Manager
Ares Project
Marshall Space Flight Center
Huntsville, AL 35812*

Abstract

NASA is building its first new human-rated space exploration vehicles in nearly 40 years. This marks an important operational and cultural change from the Space Shuttle. In the wake of the *Columbia* disaster, the agency and the nation realized that NASA's goals and culture needed to change. The Ares Project, which is building the launch vehicles that will power human beings to the Moon, Mars, and beyond, is taking a page from the Saturn playbook by having NASA lead both the overall integration and the development of the Ares I upper stage. Ares is also creating a new culture of cooperation, openness, and informed risk taking as we set our sights on other worlds.

Ares has established a team environment where issues can be discussed, information is shared, fun and teamwork are encouraged, and constructive conflict and accountability are expected. Following a "One NASA" philosophy, Ares is taking steps to strengthen cooperation among space centers, contractor partners, engineering and scientific communities, and headquarters personnel. As we learn lessons from things that went wrong with the Space Shuttle, we are also borrowing best practices from what has gone right with that program and others. All of these cultural elements will be necessary as we take the next steps beyond Earth orbit.

Background

On February 1, 2003, NASA employees were shocked and horrified to learn of the second loss of a Space Shuttle. Even while we were still mourning the loss of the crew, many people at NASA began some serious soul-searching. The *Columbia* Accident Investigation Board (CAIB) was formed within two hours after the accident. After a thorough investigation, this independent review board issued the CAIB Report called NASA to task for failures of management and culture. The professionals in the agency took the lessons to heart but had the fortitude and long-term vision to keep going while trying to change "the way NASA did business."

Some critical cultural issues plagued NASA at the time of the *Columbia* accident, especially communication breakdowns within the organization. The CAIB report advised the agency to establish strong engineering technical authority and focus on safety as a core engineering discipline, rather than simply relying on industrial safety policies.

However, the CAIB report also provided NASA with a new opportunity, as it called upon the nation to set a clear and compelling future mission for NASA – something missing over the past three decades. The CAIB report said, "*The loss of Columbia and her crew represents a turning point, calling for a renewed public policy debate and commitment regarding human space exploration. One of our goals has been to set forth the terms of that debate.*" In January 2004, this mandate led to the Vision for Space Exploration, now called the U.S. Space Exploration Policy, which was passed by the U.S. Congress and signed into law by the President in 2005. This policy staged that NASA would retire the Space Shuttle by 2010, complete the International Space Station, and develop a new set of exploration vehicles capable of traveling to the Space Station, the Moon and other more distant destinations.

NASA formed the Constellation Program to develop the vehicles, hardware, and other infrastructure needed to send human beings to the Moon, establish a permanent outpost there, and eventually undertake more ambitious missions to other destinations. The Ares Project, based at Marshall Space Flight Center (MSFC) in Huntsville, Alabama, is responsible for building the new crew and cargo launch vehicles that will take astronauts in the Orion crew exploration vehicle and Altair lunar lander into space and on to other worlds. This constellation of projects has received a mandate from Congress to “go as we pay.” That means achieving these new exploration goals within the existing NASA budget while the Space Operations Mission Directorate completes the International Space Station and retires the Space Shuttle, and other NASA directorates continue their current activities: Earth observations, aeronautics research, and robotic science missions to other planets.

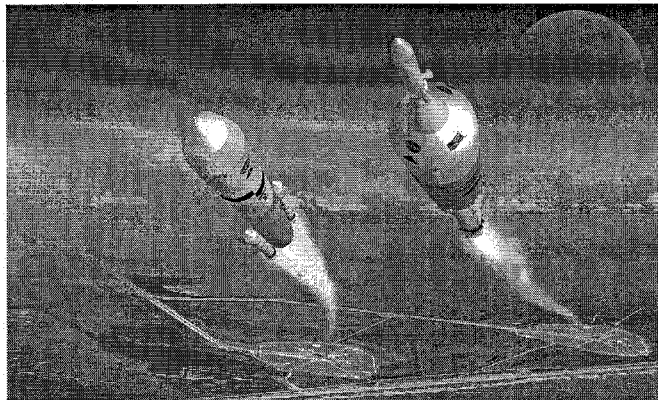


Figure 1. The Ares V cargo launch vehicle (left) and Ares I crew launch vehicle (right) will launch America to the Moon and beyond

Building Organizations from the Ground Up

The Ares Project (originally called the Exploration Launch Projects) and the Constellation Program were started in the late summer of 2005, after an agency-wide team at NASA Headquarters completed the 90-day Exploration Systems Architecture Study (ESAS). The ESAS team analyzed and described all of the possible types of vehicles capable of achieving America’s human exploration goals. At the end of the study, the team selected the best complement of vehicles that could meet complete all the goals outlined in the U.S. Space Policy. These are the vehicles we would need to build. Everything else had to be invented from there—it has proven to be challenging, exciting work.

Mike Griffin, who became NASA Administrator in April 2005, gave the team one clear directive: If Constellation is to be a multi-decade activity, NASA has to maintain the intellectual property on the vehicle rather than be tied to a proprietary/contractor system. This development model was used to build the Saturn launch vehicles for Project Apollo, but it was a new way of doing business for the current NASA team. For the past 30 years, NASA had been using a different business model: deferring development and operational responsibilities to contractors. Clearly to sustain exploration to multiple destinations, over a long time period, and on a very limited budget, it was time for NASA “to get it’s hands dirty,” by taking more control over the process and by accomplishing more of the technical work.

This challenge required serious operational and cultural changes. Griffin’s decision to use and support the Saturn-type organizational model was the single most influential decision to get the Ares Project where it is today. It has allowed NASA to retake control of its own destiny and has been crucial in obtaining employee acceptance of, and participation in, the Constellation Program.

In early August 2005, a meeting was held with a senior MSFC management team of around 80 people at an offsite location, where the team created a common understanding of where Ares was headed. The team discussed its strengths, weaknesses, and concerns, and got input from everyone at the outset, and the entire team was polled to gauge their commitment to this ambitious new effort. While people were excited at the prospect, many were skeptical that we could marshal the resources to do the job. Once we committed the organization, we would not have time to second-guess on our path. The team decided unanimously to move ahead.

We verified that it was not one person's energy driving what the next steps would be, as we knew the Ares Project was about to grow quickly, and we had to tap into the passion of the collective. The Project established team norms at that time, and leadership continues to be a regular topic of discussion within Ares, as managers are challenged on how things are working. The team has reached a point where it knows that these inquiries are not personal, and that everyone wants the best for Ares and NASA.

Senior Marshall and NASA management recommend key project team members. on who should be on the project team. It was my responsibility to name the core team of element and business managers, who in turn would pick people to staff up their teams. Even with the core management assembled, we started out almost 18 months behind schedule. The gap in years was widening between the time planned for Space Shuttle retirement and the time when a replacement launch system would be available. Until the ESAS study, the agency had stalled in deciding what the path forward would be. The Congress and the White House were not happy about the lack of progress. Now that we had the ESAS plan, we had to pull a team together and move out quickly to implement the plan.

Ensuring Quality, Safety, and Teamwork

Ares has two major integration challenges:

- 1) Technical integration of its products
- 2) People integration, which is getting people to focus on how they work together toward increasing efficiency and effectiveness overall.

The CAIB report made it clear that we needed strong engineering and Safety and Mission Assurance (S&MA) leadership on the project from day one. This approach would ensure that we had balanced viewpoints to give us a credible, reliable, and affordable design. From the outset, we needed to do "risk-based design," which is the process of looking for ways to improve system safety through design rather than trying to correct things later. Some specific examples of this approach include:

- Using a single "stick" configuration for the Ares I crew launch vehicle, with the crew riding on top instead of on the side of the launch vehicle, like the Space Shuttle Orbiter, where debris from the launch vehicle can damage the crew vehicle
- Designing in a crew escape system that could get the crew safely away from the stack in case of a failure during launch or ascent.
- Separating crew from cargo wherever practical (hence the separate Ares I and V vehicles).
- Using reliable, proven heritage systems and infrastructure.

Risk-based design is especially important in high-risk areas like propulsion, which resulted in using the Shuttle booster-based first stage and Apollo-derived upper stage engine.

In the area of integrating people, an important cultural decision was made to establish behavioral expectations and norms within the first few months of the Project. This was especially important in light of the CAIB Report's critique of NASA's organizational culture. Ares norms include teamwork, integrity, constant communication, constructive feedback, and accountability.

Accompanying these team norms are meeting norms, including starting and ending on time, having a reasonable agenda, and valuing the impact of all attendees. These behaviors were established to ensure that managers and other teammates use their time effectively and positively. Most importantly, the Ares senior managers have worked to widely communicate and “live” these values. We also have conducted regular surveys of our team members to see how well we are acting on our norms.

In addition, we conducted our own analysis of the CAIB Report to learn what we could do as leaders to shift the culture toward people speaking up. In our analysis, we identified information hoarding as a barrier to integrating across NASA centers and projects. In a follow-on leadership discussion, we raised the issue of “image management” as a key driver of why people might hide bad news or not be fully open about an issue. It looked to the team as if protecting an image was more important than doing the right things in the face of difficulty. We set out to avoid repeating this mistake by serving as leaders who are role models of openness and honesty. This sometimes means being the leader who brings bad news to the table, but it also means that everyone has a voice. We encourage openness, we critique and analyze the process or the problem, not the person.

The results of this have been extremely valuable. In a recent survey, we asked about honesty, and we scored above 90% for people who believed we are honest with them. We feel this also includes Ares team members being honest with each other, as they see it is a way of doing business within Ares and with outside partners as well.

Ares focuses on ensuring everyone feels ownership for making the project a success – starting with the engineers designing the system and continuing through to the Ground Operations team responsible for launching the vehicle. It also means instilling responsibility back into the NASA team, which has been done by making NASA the lead in developing the Ares I. In this way, our NASA engineers have ownership in the success of the system. Our team norms require us to rely on front-line management to guide and cross-check team members’ work at the lowest levels. It also gives anyone on the team direct access to front-line management or to independent technical experts who can argue their points of view.

We have forums (boards) for engineering, S&MA, and project managers that come together to resolve issues/changes in an open environment free from fear of retaliation. The management team uses “lean” processes across the project to remove excess bureaucracy and allow our team to get to the true value-added work.

We are challenging the leadership team to a higher calling of being system leaders who care about the whole—America’s exploration goals—not just Ares. We are part of a larger system that has a mission to complete, and we strive to align what is good for the individual (worker), project (Ares), program (Constellation), and agency – NASA. In doing so, we create incredible momentum that we can sustain over the long term.

Ares focuses on team building at element-level meetings and among the leadership team. We conduct activities to increase the level of teamwork through innovative techniques versus standard “team-building” exercises. Our teams are built by working through issues together and solving problems in the flow of real work. Whenever possible, a team-building activity is designed to educate on key team dynamics while simultaneously moving the Project forward.

Managers are results driven and manage using performance metrics that allow them to assess the current quality level and make mid-course corrections to improve quality overall. We use Lean Six Sigma tools to drive out waste, reduce bureaucracy, and improve quality.

The annual employee survey is a key process/tool that helps us continuously reach new levels of both teamwork and quality. Regarding quality in particular, we focus on building relationships with stakeholders so that all input is considered, but we retain final decision-making accountability. We want partners in the process, not merely providers.

One of the most important motivators for Ares has been our simple, clear, focused mission: “Go build a rocket.” That was the rallying cry the team needed after two decades of projects that never got anywhere due to a lack of focus, commitment, and funding. Instead of many small projects, the team at MSFC became united by NASA’s and America’s mantra: give us the vehicles and tools we need for space exploration.

Ares, Apollo, and Shuttle – Differences and Similarities

Ares draws from 50 years of lessons for developing its team and vehicles. Perhaps the most important lesson we learned from Apollo is to lead the development of the integrated launcher with an in-house staff and build select portions of the hardware in-house—thereby providing inspiration and ownership for our team.

While we are borrowing management lessons from Apollo, operations are more like the early Shuttle development in that NASA has a very constrained budget environment. Ares is unique in the fact that it is operating in the Internet age, when news spreads almost instantly and with less risk tolerance than in previous eras.

Like both Apollo and Shuttle, we are employing a distributed government/industry team across many states and organizations. In all cases, we believe that our team comprises passionate, talented people who want to succeed. Although they are often talented technical experts who could have chosen to use their talents for endeavors that might be more financially rewarding, they chose a space career because they believe exploration of this new frontier will improve life on Earth and lead to a better future. People who work on space systems care deeply about what they do and the difference it makes to humankind.

As we’ve looked back, we also must look forward. Unlike 40 years ago, we are not in a space race – this time we are developing a sustainable approach to exploration. We have more modern communication tools than during the development of Apollo and Shuttle, enabling faster and wider information exchange. The aerospace industry is much smaller now, and it is harder to attract the “best and brightest” to the field; this is compounded by the fact that the U.S. has fallen behind much of the rest of the world in graduating new engineers and scientists. In many cases, we have to rebuild our capabilities to develop such systems. The Shuttle was being executed by the “A team” that just got humans to the moon – they had lots of experience. In many ways, it is not just NASA, but America itself must start the journey all over again.

The Greatest Challenges

Given the challenges NASA has faced and continues to face in this environment, convincing the team that the effort was “real” was perhaps the largest hurdle to overcome. This was crucial after two decades of starts and stops trying to develop a Shuttle replacement: some team members felt very jaded. Having a clear national mandate, a more hands-on role for the agency, and our need to overcome a human spaceflight gap helped us focus our efforts.

MSFC team members needed to rid themselves of any sense of entitlement or arrogance based on past history. This sense of humility was instilled by constantly communicating and *practicing* the norm of “confident humility,” correcting individuals who did not act in this way, and then giving them challenging

assignments. It is okay to use your past experience to inform decisions; it is not okay to arrogantly assume that past success means you are always right.

It was absolutely necessary to ensure ownership and accountability within the Project. This was done by restructuring organizations to be product-focused, holding line managers accountable for performance, using experienced engineering managers to check and guide the efforts of young engineers, and setting up streamlined processes for team members to bring forward issues and ideas.

The Ares Project must continue to manage the team's workload effectively, as we have a lot on our plates. In addition, other initiatives continue to affect our workforce, including skill development, continuous improvement, culture shifts, and knowledge management. These items are important, and Ares leadership discussions concentrate on figuring out how to support all of these while maintaining momentum for building the products we need. We examine schedules for overlapping efforts, redirect workforce to assist other groups during heavy workload times, and evaluate other possibilities on an ongoing basis. We use Lean Six Sigma to recapture time that is identified as waste in the system. In doing so, we alleviate some of the burden by eliminating activities that do not add high value. We encourage stand-down periods so that employees can have a balanced work and personal life.

Working across organizational boundaries is not a cultural norm within the agency, and integration is a word that is widely used but not clearly defined. Therefore, we have begun defining what integration means within groups working in or for Ares. For example, the Ground Operations and Vehicle Integration teams recently met to create a working definition between themselves. These activities ensure people understand each other, get to know each other in person—not just through electronic communication—and identify specific ways to work together, or integrate. Eventually this type of effort will spread throughout the Project, and we envision a better understanding of what integration means.

Lastly, the Ares team strives to communicate goals, plans, and issues up, down, and laterally within the organization—in person—as often as possible. The senior managers understand that one-way emails alone are not effective communication. That is why we engage in “Ares walk-about,” small communications forums, weekly status newsletters, and all-hands gatherings to convey and receive information. Behaviorally, this means managers must also be approachable by team members, and have the expectation that this attitude filters down throughout the organization.

Lessons for Moving Forward

Rebuilding an “oversight” culture into a “doing” culture is just as hard as—or harder than—building a new rocket for the first time in three decades. However, placing clear responsibility and accountability in the hands of the lowest levels of the organization will continue to be a major key to Ares success. Also, it is important to have team members who know they are fully trusted to execute their roles. The experience of building the Ares team and rockets has strengthened my faith in NASA's ability to survive tough issues, decisions, and public scrutiny. This survival is made easier by having a clear, easy-to-understand goal and key stakeholders who are willing to establish, live by, and be evaluated against a set of norms.

The Ares Project must continue to translate the lessons from the past into actionable strategies that can be used today. For example, the CAIB Report's findings can be daunting. However, if core drivers can be identified and worked on, such speaking up rather than protecting an image, fundamental changes can shift the culture incrementally in positive ways. However, this process will require patience because changing organizational culture takes time.

The Ares Project will build the Ares I and Ares V launch vehicles needed to explore the Moon and beyond. Those efforts are most successful when people feel pride and accountability for the work they produce, and the organization delivers on its promises.

We are working to establish a culture where flexibility and change form the basis of our operations. Getting the workforce to be in that mindset will allow the Project to be nimble and adapt as we go. We cannot let old habits return, where people want to work on their own pet projects at the cost of a concerted team effort.

Building the rockets, like building the team, will be an ongoing process and journey. Like the edge of space itself, we will never truly "get there." However, as we progress, remaining hungry and humble enough to accept the next challenge, we will build a world-class, affordable, safe, reliable system and an organization capable of bringing innovative solutions to the nation.

National Aeronautics and Space Administration



Stephen A. Cook
Ares Project Manager

**The Ares Project:
Building an Exploration Culture from
the Inside Up**



A Look Ahead

- ◆ **Ares Background**
- ◆ **Building the Organization**
- ◆ **Ensuring Quality, Safety, and Teamwork**
- ◆ **Ares, Apollo, and Shuttle – Differences and Similarities**
- ◆ **Biggest Challenges Ahead**
- ◆ **Lessons for Moving Forward**



Ares Background

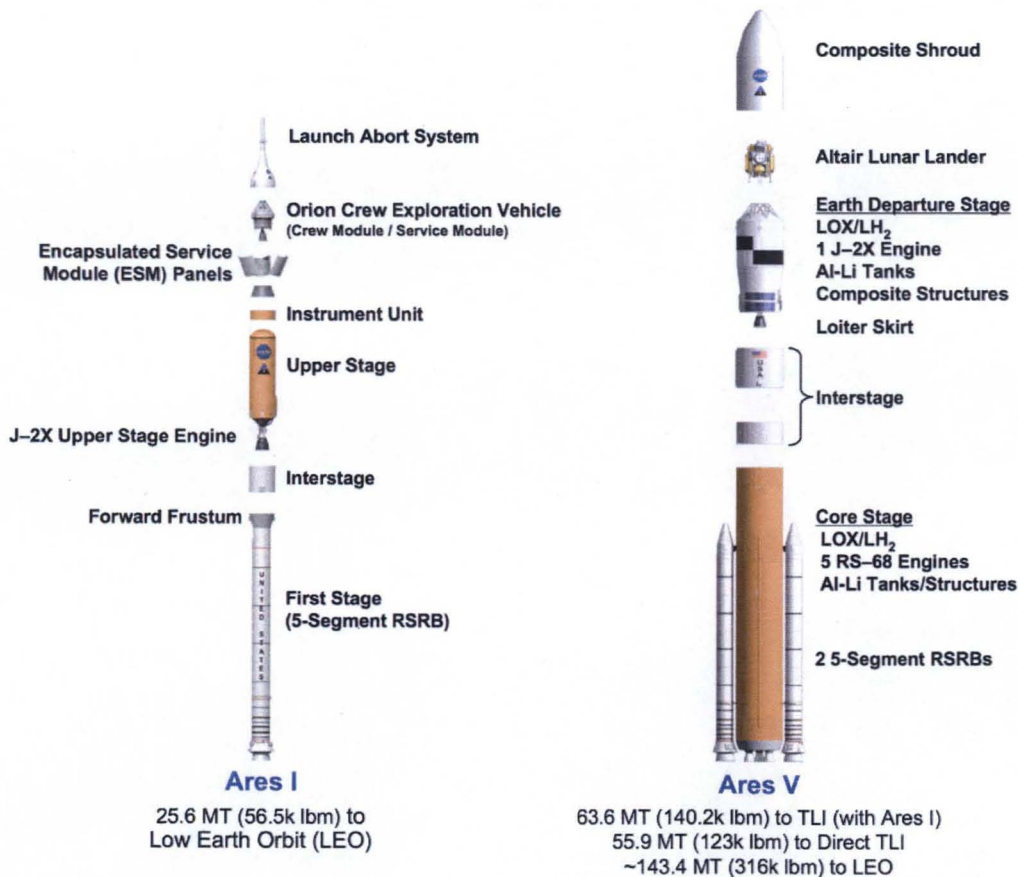


- ◆ **Columbia Accident Investigation Board (CAIB) Report (2003)**
 - Called NASA to task for management and culture failures
 - Advised agency to establish strong engineering technical authority
 - Focused on safety as a core engineering discipline
 - Also provided NASA with a new opportunity – to set a clear and compelling future mission

- ◆ **Vision for Space Exploration announced (2004)**
 - Finish the International Space Station
 - Retire the Shuttle
 - Build an outpost on the Moon
 - Go beyond



Ares I and Ares V



◆ Ares I Crew Launch Vehicle

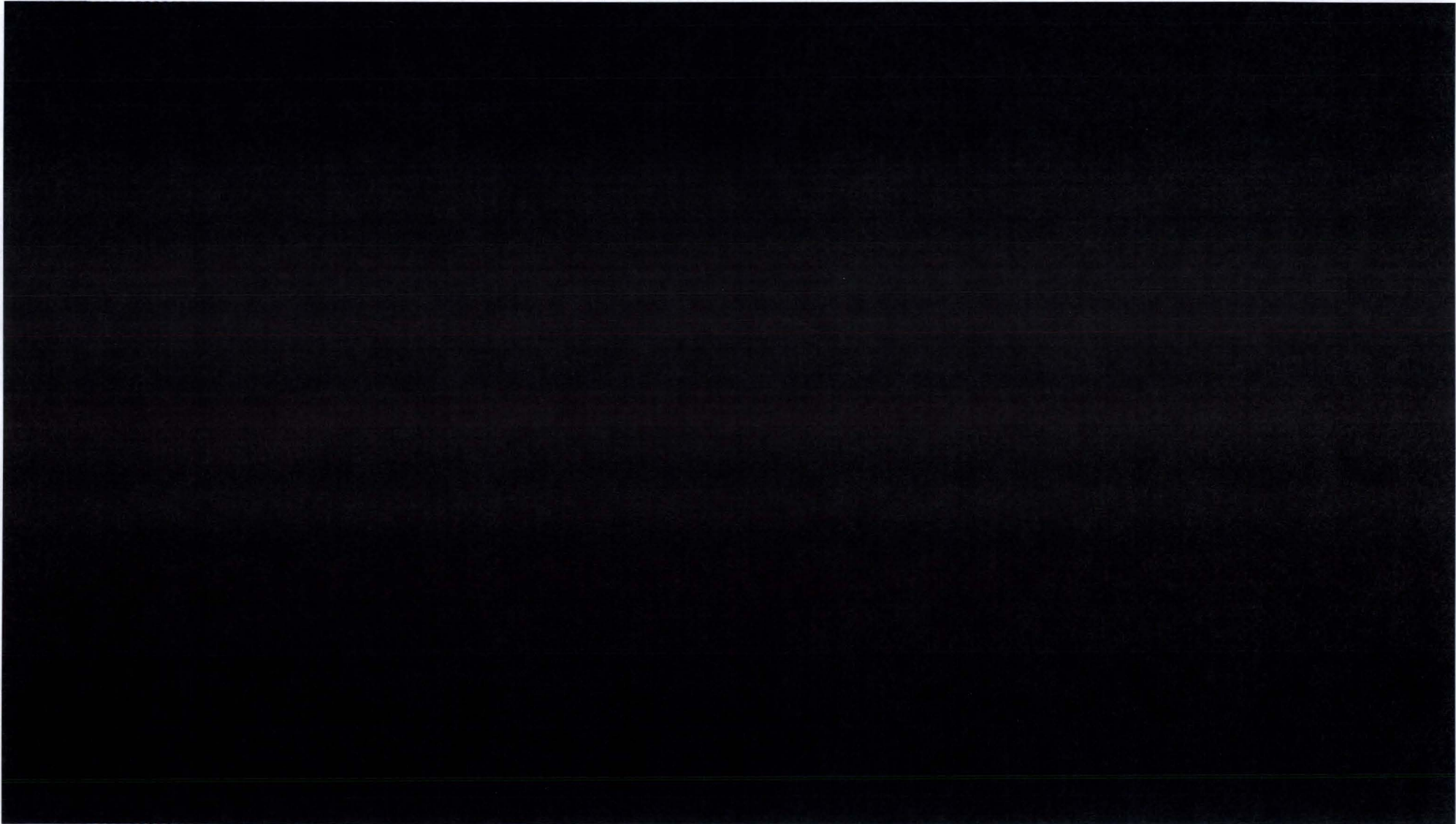
- First new human-rated launch vehicle design to fly in over 30 years
- Launches crew to low Earth orbit
- Uses Saturn and Shuttle heritage propulsion designs
- First flight: Ares I-X April 2009
- First crewed flight: Orion 1 2013
- First mission to International Space Station 2015

◆ Ares V Cargo Launch Vehicle

- Largest rocket ever designed
- Solid rocket boosters and liquid core stage lift Earth departure stage and Altair lunar lander to Earth orbit
- Earth departure stage propels Altair and Orion crew exploration vehicle to Moon
- 30% more capacity than Saturn V
- First flight ~2019
- First mission to the Moon 2020



The Power to Explore





Building the Ares Project Organization



- ◆ **Agency-wide team completed the Exploration Systems Architecture Study (ESAS)**
- ◆ **NASA Administrator Mike Griffin, gave the team one clear directive:**
 - NASA to maintain the intellectual property on the vehicle
 - Allowed NASA to retake control of its own destiny and obtain employee acceptance and participation
- ◆ **Established Ares team August 2005**
- ◆ **People excited, but some skeptical**
- ◆ **Established team norms**
- ◆ **Senior leaders chosen to form their teams**
- ◆ **Team had to pull together and move out quickly to implement the plan**



Ensuring Quality, Safety, and Teamwork

Ares Projects Office Team Norms

HAVE FUN

Once in a career opportunity!

We are running a marathon, not a sprint – not in 24/7 emergency mode all the time.

RESPECT OUR FAMILIES AND OURSELVES – HEALTHY BALANCE BETWEEN WORK AND FAMILY IS ESSENTIAL

INTEGRITY IS EXPECTED

"Look each other straight in the eye, tell the truth, full disclosure"

TEAMWORK IS ESSENTIAL

"Our" instead of "my", "We" instead of "I", "Us" rather than "me" ... "we're all important"

INTEGRATION AMONG THE PROJECT AND WITH PARTNER ORGANIZATIONS (E.G., ENGINEERING, S&MA, OTHER CENTERS, PROGRAM/PROJECTS) IS ESSENTIAL

Communicate, communicate, communicate with each other

Don't wait on someone else to initiate

BELIEVE THE BEST ABOUT EACH OTHER (ASSUME NO MALICIOUS INTENT)

CONSTRUCTIVE CONFLICT LEADING TO DECISIONS (CLOSURE) AND ONCE MADE DON'T CARRY IT PERSONALLY IF IT DID NOT GO YOUR WAY

WE WILL HOLD EACH OTHER ACCOUNTABLE AND MEET OUR COMMITMENTS

Our ultimate commitment is a safe, reliable, affordable delivery of Orion to orbit

FAILURE IS ACCEPTABLE DURING DEVELOPMENT

We are willing to take calculated risks to further our knowledge

EARLY IDENTIFICATION AND HIGHLIGHT OF ISSUES.



◆ Ares has two major integration challenges:

- Technical integration of its products
- People integration

◆ Technical integration through risk-based design

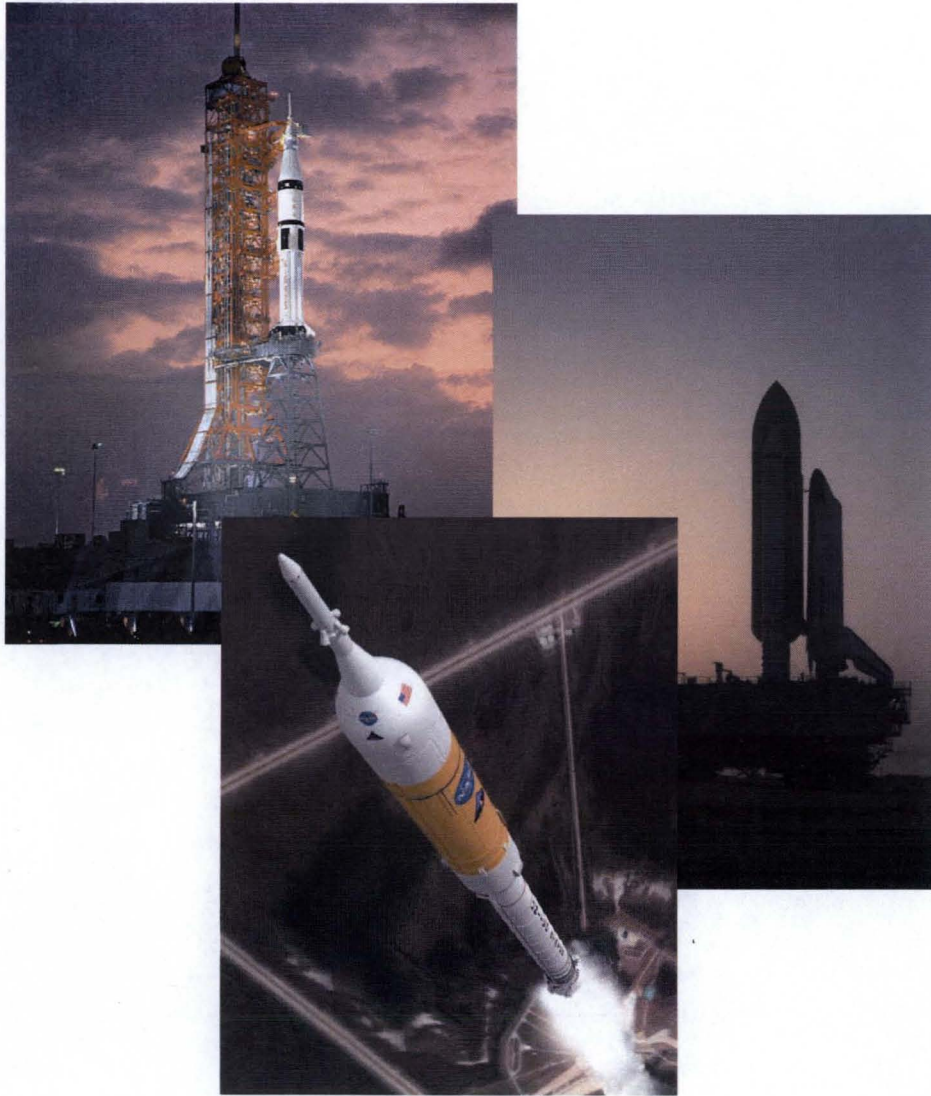
- Using a single "stick" configuration
- Designing in a crew escape system
- Separating crew from cargo
- Using reliable, proven heritage systems and infrastructure

◆ People integration

- Establishing team and meeting norms early
- Walking the talk – managers modeling/living values
- Encouraging openness
- ***Communicate, communicate, communicate!***
- Measuring management performance
- Motivation through a simple, straightforward mission: go build a rocket



Ares, Apollo, and Shuttle – Differences and Similarities



◆ Similarities

- **Apollo:** NASA-led development team
- **Shuttle:** Constrained budget
- **Both:** Employing distributed government/industry team across many states and organizations

◆ Differences

- Not in a space race
- More modern communication tools
- Faster and wider information exchange
- Aerospace industry much smaller
- Harder to attract the “best and brightest”
- U.S. not graduating as many scientists and engineers
- It is not just NASA – America itself must start the journey all over again



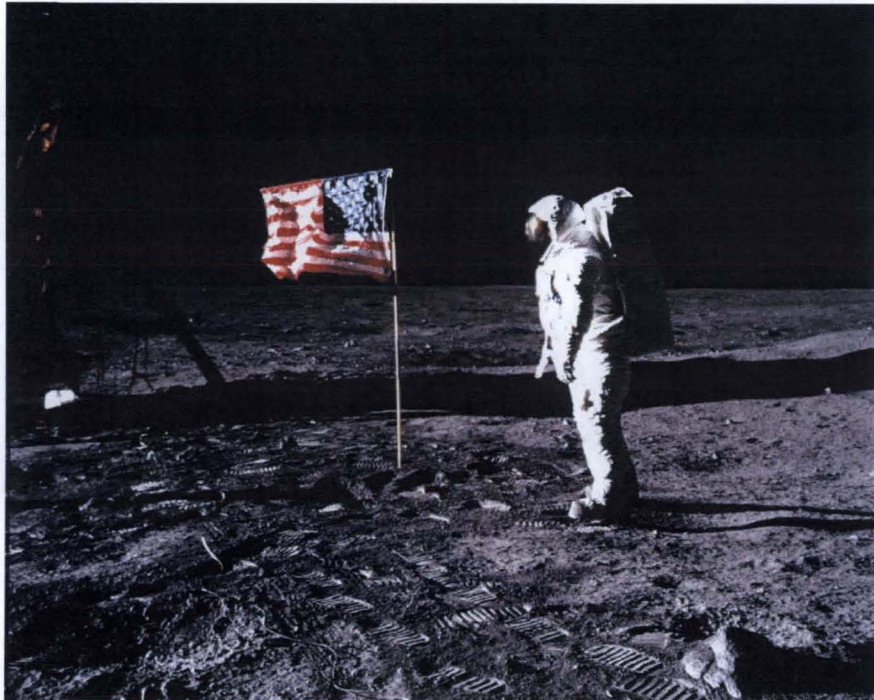
Biggest Challenges Ahead



- ◆ **Convincing the team that the effort is “real”**
- ◆ **Ensuring a sense of humility**
- ◆ **Ownership and accountability**
- ◆ **Managing workload**
- ◆ **Integration among Ares elements and other Constellation projects**
- ◆ **Communication**



Lessons for Moving Forward



- ◆ Rebuilding an “oversight” culture into a “doing” culture is just as hard as building a new rocket
- ◆ Translating lessons learned in the past into actionable strategies for the present and future
- ◆ Ensuring that the Ares organization as a whole delivers on its promises
- ◆ Establishing a culture of flexibility and change
- ◆ Remaining humble yet hungry for the next challenge



Questions?

www.nasa.gov/ares