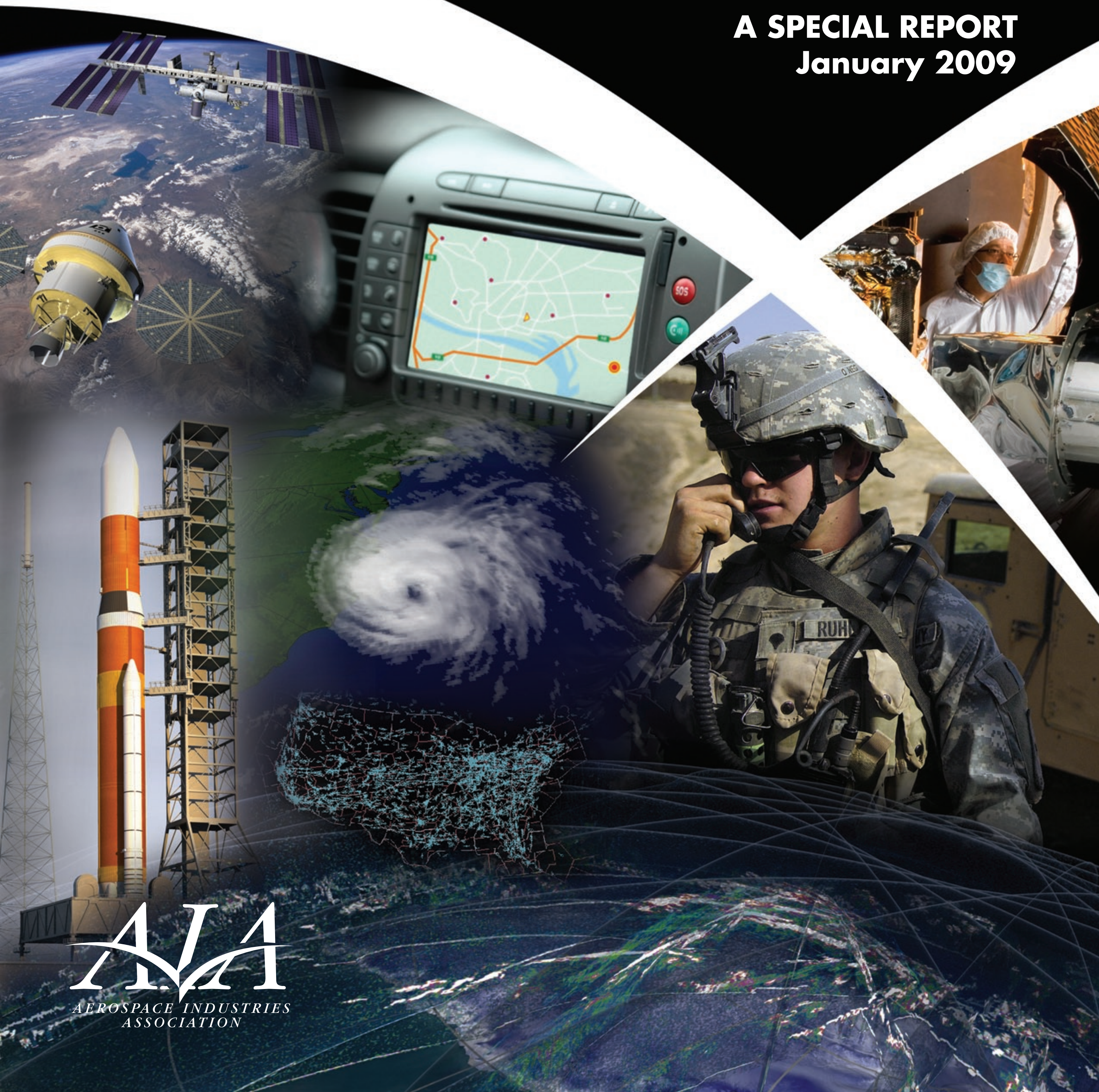
The Role of Space in Addressing America's National Priorities

A SPECIAL REPORT
January 2009



AIA
AEROSPACE INDUSTRIES ASSOCIATION

The Role of Space in Addressing America's National Priorities

A SPECIAL REPORT
January 2009

January 2009

The Role of Space in Addressing America's National Priorities

As a new administration and Congress take office, AIA is working to ensure that our nation's policymakers are aware of the major issues facing our aerospace industry.

This report, *The Role of Space in Addressing America's National Priorities*, focuses on America's space efforts. It indicates how deeply space plays a role in the everyday lives of our citizens and how space has become a vital part of both our economy and national security.

Because this report was prepared with the input of AIA's many aerospace companies, it reflects an industry view that looks beyond individual programs to consider a much wider range of issues.

While the United States still enjoys a leadership position in spaceflight, satellite services and national security space operations, that lead is perishable. Our nation has many areas of international cooperation in space ventures, but we also have credible competitors with the vision and resources to equal or even supplant our dominance — a situation that would adversely affect both our economy and national security.

In a very real sense the "space race" is far from over: We might not be racing, but our global competitors certainly are.

We hope you find this paper both informative and thought-provoking. AIA will be pleased to supply you with further information on these or other issues related to our nation's aerospace industry.

Sincerely,

Marion C. Blakey
President and Chief Executive Officer

Contents

The Role of Space in Addressing America's National Priorities

The Role of Space in Addressing America's National Priorities

EXECUTIVE SUMMARY

Over the past 50 years, space systems and technologies have increasingly become a critical part of our nation's economic, scientific and national security capabilities. Without space systems, U.S. military forces have reduced operational effectiveness, policymakers cannot make informed decisions about the nation's security and economy and civil financial and communications capabilities are degraded or disrupted. Our space capabilities are a source of national pride and an investment in the science and R&D needed to maintain U.S. global competitiveness.

As other nations make rapid advancements in acquiring or exploiting space capabilities, America's leadership in space is no longer guaranteed and the security of its space assets is no longer assured. Given the growing U.S. dependence on these systems, the nation cannot afford to treat its national security, civil and commercial space capabilities as separate "stovepipes" but rather should look at our space capabilities as a singular enterprise consistent with national goals and objectives.

The means for implementing this singular enterprise is through a national space strategy that links national policy with needs, programs and resources. This approach will offer greater benefits in cross-community coordination, more efficient use of increasingly scarce government and private sector resources and greater timeliness in addressing dynamic and uncertain future threats.

AIA Recommendations

In recognizing the role of space in addressing our national priorities, the Aerospace Industries Association recommends:

» **Our space capabilities should be coordinated, at the highest level, as a singular enterprise.** Such a coordination body should lead the development and execution of a national space strategy for civil, commercial and national security space.

» **The administration should provide and support a national budget that reflects both robust and stable funding across space functions to prevent**

disruptions to the planned lifecycle of critical, multi-year space programs. With the appropriate organization in place, the administration should provide the budget levels necessary to carry out a new strategy.

Further Recommendations

Section 1. Space Technology: An Investment in our Economy.

» The U.S. government should work to create opportunities for our current workforce, and make science and education a national priority to ensure a strong future workforce.

» The administration and Congress should work to create a more favorable business environment for the U.S. aerospace industry.

Section 2. Space Exploration Keeps America on the Cutting Edge of Education, Discovery and Innovation.

» Both the U.S. Space Exploration Policy and the Constellation Program should be treated as national priorities and given the funding and support needed to keep development on its current schedule and to minimize the impending gap in U.S. human spaceflight.

» The International Space Station should be fully utilized as a national laboratory.

» The NASA science program should receive the funding necessary to provide a wide suite of robotic missions and other research.

Section 3. Observing the Earth's Environment Takes a Global Perspective.

» The U.S. government should immediately address existing and growing gaps in climate measurements and weather satellite coverage.

» The administration should establish, fund and implement a U.S. Earth Observation architecture as a national priority.

Section 4. National Security Space: Protecting Our Nation, Citizens, Allies and Friends through Space Assets.

» The United States should provide balanced and stable funding for current national security space systems, including those supporting ballistic missile defense, while ensuring continued R&D and deployment to counter future threats.

» The United States should support the modernization and upgrading of our aging national security space infrastructure in order to maintain effective systems that can address the increasingly complex demands of the future.

» Space protection and space situational awareness programs should become a funded national priority guided by a comprehensive strategy.

» Budget levels and funding for Operationally Responsive Space should be increased to ensure it becomes a model for fulfilling responsive, affordable, on-demand space support for national security operations.

» The U.S. government should undergo a careful review of critical space technologies to evaluate which technologies should be controlled under the State Department ITAR process and which are truly commercial and could be controlled under the Commerce Department process. This review must be followed with meaningful and careful legislation that would ensure the right technologies are controlled the right way.

The Role of Space in Addressing America's National Priorities

INTRODUCTION

Over the last several decades, innovations from space technologies have increasingly become a part of our daily lives. Today, we have reached a point where no part of the U.S. global economy is untouched by space technologies or applications. From observing the Earth for weather and climate information, to conducting human and robotic exploration of the cosmos, to providing information essential to national security, military operations, commercial interests and foreign policy — all are dependent upon space assets.

Individual day-to-day transactions our citizens take for granted are also critically dependent upon space — from ATM transactions at the bank, to communications via cell phones and the media, to precise location for our emergency responders, airliners and automobiles.

Even as benefits from space appear transparent to users on the ground, many policy decisions are made within narrow agency missions or defined only as a specific task requirement. Given our growing and often unacknowledged dependence on space, it is critical for the next administration to view space as a singular enterprise rather than a collection of separate civil, national security and commercial sectors.

Historically, national space policy goals and objectives have remained consistent across administrations, and the nation has benefited from this overall consistency. It is important that we move past policy statements toward truly implementing policy goals and long-range objectives.

There are many tough issues facing the nation — a slowing economy, the wide-ranging effects of climate and global change and the safety of citizens. Each presents tough challenges for the next administration. Given our reliance on space assets, space capabilities are an essential element for U.S. policymakers to understand and fully utilize as they address domestic and international challenges and opportunities to build from the nation's past achievements in order to guarantee a set of national capabilities from space.

This report summarizes several areas for immediate attention and recommendations for action along four distinctive themes:

- Space Technology: An Investment in Our Economy
- Space Exploration: Keeping America on the Cutting Edge of Education, Discovery and Innovation
- Observing the Earth's Environment Takes A Global Perspective
- National Security Space: Protecting Our Nation, Citizens, Allies and Friends through Space Assets

Recognizing the critical importance of space in supporting many of our top national challenges, the following are recommendations the administration should consider immediately:

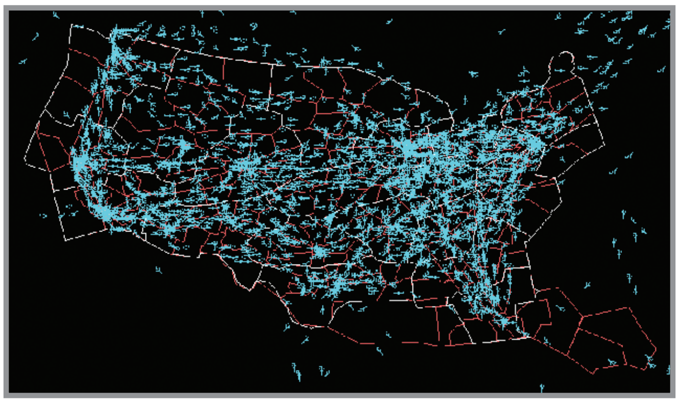
Recommendations

U.S. space capabilities should be coordinated at the highest level as a singular enterprise:

- Make key political appointments early in space-related government departments and agencies to ensure continuity of mission and that the United States remains a world leader in space.
- Establish an interagency national space management and coordination body reporting to the president to encourage improved interagency cooperation on cross-cutting, dual-use programs.
- Develop a cohesive national space strategy to achieve our national goals.
- Consider forming a nonpartisan space advisory board with appointments and tenure not linked to changes in administration in order to provide continuity, counsel and insight into U.S. space interests, needs and capabilities as an independent source of advice to the president. This board should be comprised of distinguished citizens outside of government who are qualified on the basis of achievement and experience.

The administration should provide and support a national budget that reflects both robust and stable funding across space functions to prevent disruptions to the planned lifecycle of critical, multiyear space programs.

Failure to plan and execute stable programs resourcefully has contributed to inefficiencies, cost overruns and schedule delays on a disproportionate number of critical programs. Our nation's complex space infrastructure will benefit from a more coordinated approach to establishing the national architecture, plans and budgets for meeting the ongoing domestic and international demands on our nation's space capabilities.



The remainder of this document discusses critical areas our country must address to guarantee continued leadership in space. It discusses how integral our space infrastructure is toward supporting economic activity, fostering future innovation, addressing climate and global change and protecting our citizens.

SECTION I

Space Technology: An Investment in Our Economy

What do farmers, banks and the fire department have in common? They all rely on an invisible infrastructure in orbit above the Earth.

Our nation's economy is tied directly to our space infrastructure. Everyday activities that are taken for granted by the man in the street are supported or even driven by space systems. These systems are transparent to us and are noticed only when services are interrupted. Once seen primarily as an American enterprise, space systems now face stiff global competition.

Communications drive today's commerce, and space systems are a chief conduit of our nation's communications systems. The Internet, e-mail, cell phones and PDAs (personal digital assistants) have become the standard for businesses and recreation. Our direct-to-home television and satellite radio have become normal in many American homes and automobiles. These all depend on our satellite communications systems. Similarly, the global positioning systems (GPS), originally designed for military use, are now relied upon for banking transactions, ATMs, improved agriculture, air traffic and ground transportation systems and by emergency responders.

The importance of all these systems is clear to the world. More than 30 nations have purchased their own communications satellites. Other nations have seen the importance of GPS, and several are developing their own positioning, navigation and timing systems (PNTs). Additionally, many nations now have commercial launch capability, and since 1986 our nation has been facing an increasingly competitive launch market.

The aerospace industry plays a vital role in driving the U.S. economy. In 2008 aerospace industry sales were at $204 billion dollars: space systems represented more than $33 billion of this total. (See 2008 Aerospace Industry Sales on facing page.) These systems support other important aspects of the economy that are based on business communications, GPS, remote sensing and media delivery.

Virtually every American in many aspects of daily life relies upon the space-based services and space technologies described above. The space systems that provide these services, however, need to be routinely updated and replaced. It is not currently feasible to perform maintenance upon these systems or even refuel them — a capability we take for granted with automobiles and other systems we use daily.

Space systems have limited life spans, and at today's pace of technology, they quickly become obsolete. It is imperative that we plan and budget for their routine replacement, modernization and supporting Earth-based infrastructure so that the services we depend upon on a daily basis are there when needed. In addition, we also need to develop an executable contingency plan to mitigate the impacts of an unexpected catastrophic space systems failure.

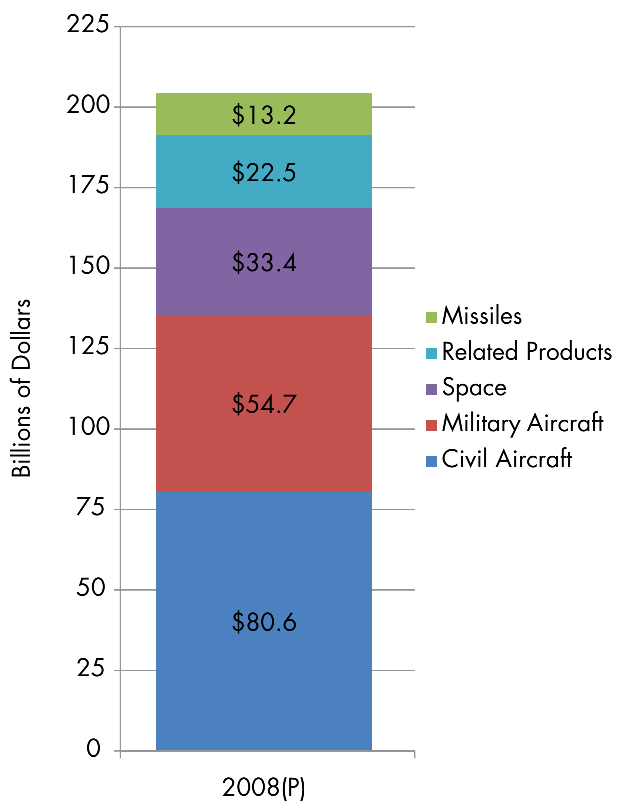
To guarantee that American citizens can continue to enjoy and take advantage of the vast economic benefits that are gained from our space assets, the administration needs to take actions that will ensure a robust and highly qualified space workforce of today and tomorrow and to maintain a favorable business environment for the United States.

Robust and Highly Qualified Space Workforce Essential

Numerous reports from business and government organizations warn that our nation's competitive edge is eroding due in part to a decline in workforce science, technology, engineering and mathematics (STEM) skills.

In a recent survey of more than 270,000 college freshmen, only 7.5 percent said they intended to major in engineering — the lowest level since the 1970s. At the same time, other nations, such as China and India, emphasize the education of scientists and engineers and could become the world leaders in technology. Efforts to sustain a strong U.S. scientific and technical workforce are not only critical to the space workforce but also to our economy and national security.

Preliminary 2008 Aerospace Industry Sales



TOTAL: $204.4 Billion

Today, the space workforce faces near- and long-term concerns. In the civil space sector a core challenge for the near term will be reorienting the workforce from space shuttle operations to development of other programs. In the long term, all space sectors face retirements as well as challenges in recruiting and retaining both new and experienced scientists, engineers and technical specialists in an industry that has cyclical fluctuations. To illustrate, about 60 percent of the aerospace industry is age 45 or older; 75 percent of NASA's workforce is at least 40 years old.

Recommendation

The U.S. government should work to create opportunities for our current workforce and make science and education a national priority to ensure a strong future workforce:

» Continue to support and fund the education and outreach offices of NASA, NOAA, DoD and other STEM-related agencies.

Favorable Business Environment Needed

The traditional space industry has been a solid provider of U.S. space systems for more than 50 years. Attention should also be given to a new generation of entrepreneurial firms that are emerging and pursuing new, nontraditional space markets for smaller and less expensive spacecraft and launch vehicles. These companies and projects offer a wellspring of innovation, growth and competitiveness for the U.S. economy and are attracting the attention of national security and civilian space agencies for their potential to address new governmental requirements.

Many regulatory and economic barriers exist, however, making it difficult for U.S. businesses to provide much-needed services to the government as well as to continue their tradition of innovation. Federal agencies have long-established processes, such as detailed oversight and analysis and cost-plus contracting, for dealing with traditional industry. These often conflict, however, with how entrepreneurs and small businesses not only prefer but also need to do business with the government, for example, using rapid prototyping development approaches and commercial contracting terms.

Commercial space launch indemnification — U.S. government payment of claims resulting from licensed commercial launch activities — is also critical to continued U.S. participation in the increasingly competitive international launch market.

In 1984 Congress enacted the Commercial Space Launch Act to license and regulate commercial launches conducted in the United States or by U.S. entities. The act was amended in 1988, adding a risk allocation regime to address exposure of companies providing FAA-licensed commercial launch services to potentially catastrophic third-party liability resulting from launch-related activities. This provision, which has a five-year sunset clause and has been extended four times since 1988, is due to expire on December 31, 2009.

Without commercial launch indemnification, U.S. launch providers would be at a distinct disadvantage in the international launch market where our share has declined to only 12 percent. Because our nation's commercial providers also launch military and civil spacecraft, their economic viability and competitiveness are significant factors in assuring access to space for critical national security and civil missions.

Finally, the unpredictability of long-term research — in combination with shorter product cycle times and increasing global competition — is leading U.S. companies to sharply reduce their research programs to focus on near-term product development and short market horizons.[1] Extending the R&D tax credit would help ensure that the aerospace industry will continue to contribute to national economic goals; without it, the United States ranks last among industrialized nations in R&D incentives.[2]

Recommendation

The administration and Congress should work to create a more favorable business environment for the U.S. aerospace industry:

- Encourage Congress to enact amendments to the Commercial Space Launch Act that would delete the sunset provision and lift the current government cap on provisions for payment of claims in excess of required insurance well in advance of the December 31, 2009 expiration.
- Streamline regulatory burdens associated with doing business with the federal government.
- Pursue appropriate policies, such as extending the R&D tax credit.
- Use commercial services when they are available and meet user needs, including launch services, commercial buys of satellite data and services and on-orbit services to the International Space Station.
- Raise the importance of the role of the commercial space industry 1) by dedicating offices in federal government agencies that would identify opportunities for regulatory, tax and other incentives to promote the rapid growth of the industry and 2) by monitoring agency progress in embracing the opportunities offered by the growing commercial space industry.

SECTION 2

Space Exploration Keeps America on the Cutting Edge of Education, Discovery and Innovation

U.S. investments in space exploration have been an impetus for global technological and economic advances by focusing our science and industry on new problems and new solutions. Apollo, for example, helped fuel our economy for many years and sharpened our technologies. We must continue our commitment as the world leader in space exploration to help maintain our cutting edge in discovery and innovation.

NASA has led some of the nation's most exciting and innovative projects: American astronauts have been aboard the International Space Station continuously since 2000; our probes are enroute to or have reached all the planets of the solar system and have explored the surfaces of some; our telescopes are looking deep into the cosmos; satellites also look toward the Earth in study. We now are preparing for the logical steps forward to once again take humans beyond low-Earth orbit to the moon, Mars and beyond.

To maintain and benefit from our leadership in space exploration, the federal government needs to ensure support for the U. S. Space Exploration Policy and Constellation Program, provide for maximum utilization of the International Space Station and support NASA's science programs.

U.S. Space Exploration Policy and Constellation Program

Following the *Columbia* accident in February 2003, a re-evaluation of America's human spaceflight program was undertaken. In January 2004 the U.S. Space Exploration Policy was unveiled, challenging NASA to pursue human space exploration beyond low-Earth orbit. The policy's stated goals include:

- » Retire the space shuttle at the end of the decade, after completing the International Space Station.
- » Develop a new, human-rated spacecraft to enable returning to the moon by 2020.
- » Encourage partnerships with the emerging commercial space sector.
- » Continue robotic exploration of the solar system with the longer range objectives of humans exploring Mars and beyond.

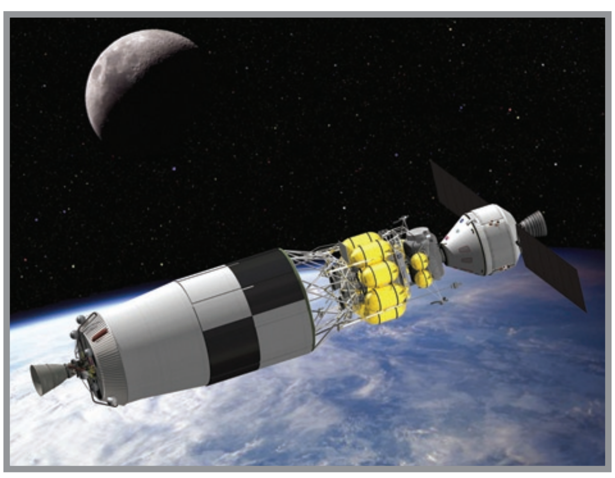
The Constellation Program was developed after an extensive NASA exploration systems architecture study that engaged industry, academia and other government agencies in rigorous assessments and reviews of technologies, systems and infrastructure. The resulting architecture takes advantage of existing technologies and proven engineering concepts while allowing for insertion of new technology advancements over the course of the program. This approach minimizes cost and schedule risk and places crew safety at the highest priority.

NASA and the agency's industry partners are making excellent progress in developing and constructing the systems specified for Constellation. It is critical that

NASA and the nation stay the course and adhere to the plans and architecture that have been implemented over the last five years. The architecture for continued U.S. leadership in space exploration is well-defined and has been rigorously examined. It places the United States on a course of reliable and affordable human and robotic exploration systems for the upcoming decades.

Key Constellation systems include the *Orion* spacecraft for our astronauts, the *Ares I* Launch Vehicle to carry *Orion* to orbit, the *Ares V* Heavy Lift Launch Vehicle to transport large cargo elements, such as the *Altair* Lunar Lander, to orbit and to the moon and the supporting infrastructure.

Two images of systems in NASA's Constellation program: (top) the *Orion* spacecraft orbiting the moon and (bottom) the *Ares V* Cargo Launch Vehicle joined with the *Altair* Lunar Lander.



Recommendation

Both the U.S. Space Exploration Policy and the Constellation Program should be treated as national priorities and given the funding and support needed to keep development on its current schedule and to minimize the impending gap in U.S. human spaceflight.

Maximum Utilization of International Space Station

Led by the United States, the International Space Station program draws upon the scientific and technological resources of 16 nations, including Canada, Japan, Russia and members of the European Space Agency.

Designated by Congress as a National Laboratory, the space station will provide a unique and very valuable environment for scientific research. The possibilities of microgravity research have long been desired by the scientific communities. Breakthroughs, including pharmaceuticals and biomedicine, are within reach.

Other U.S. government agencies are eager to utilize the space station's potential. NASA has signed agreements with the National Institutes of Health and the Agriculture Department and has signed Space Act Agreements with private firms with the prospective to open unique U.S. markets.

In addition, the space station will play a critical support role in the Constellation Program by aligning scientific research to back up exploration objectives, including medical countermeasures for long-term human space travel and the development of enabling technologies. The space station demonstrates the value of human involvement in space exploration and the ability to accurately assess and properly address unforeseen events in order to maintain overall mission objectives.

With the assembly of the International Space Station scheduled for completion by year-end 2010, U.S. commitments to our international partners will be fulfilled and the space station will shift from its construction phase to its utilization phase.

Recommendation

The International Space Station should be fully utilized as a national laboratory:

» Continue support by providing adequate funding to successfully operate and supply the orbiting laboratory as it enters into the utilization phase.

» Encourage and enable all U.S. government agencies to utilize the space station's capabilities in order to increase the return on our investment.

» Continue to provide funding and support for the Commercial Orbital Transportation System (COTS) designed to provide commercial resupply and, eventually, crew delivery to the space station.

NASA's Science Programs

NASA's science program represents an array of technological achievements and discoveries that complement the human spaceflight program. Because science is at the foundation of space exploration, it is important that NASA continue its intertwined paths of human and robotic exploration of space.

NASA executes its program of science and technology in four disciplines:

» **Planetary:** Probes, including MESSENGER to Mercury, Cassini orbiting Saturn and New Horizons to Pluto, are joined by NASA's successful Mars Exploration Program. The twin Mars Rovers cross the Martian terrain, the Mars Phoenix Lander has landed at the Martian pole and the Mars Odyssey and Mars Reconnaissance Orbiter provide scientific imagery from overhead.

» **Heliophysics (the study of the sun):** Missions include STEREO's study of solar storms as they blast into space and toward Earth, the TIMED mission studying the influences of the sun on Earth's atmosphere and RHESSI studying solar flares.

» **Astronomy and Astrophysics:** NASA's observatories, such as the Hubble Space Telescope, the Chandra X-Ray Observatory and the Spitzer Infrared Telescope are discovering the origins of the universe.

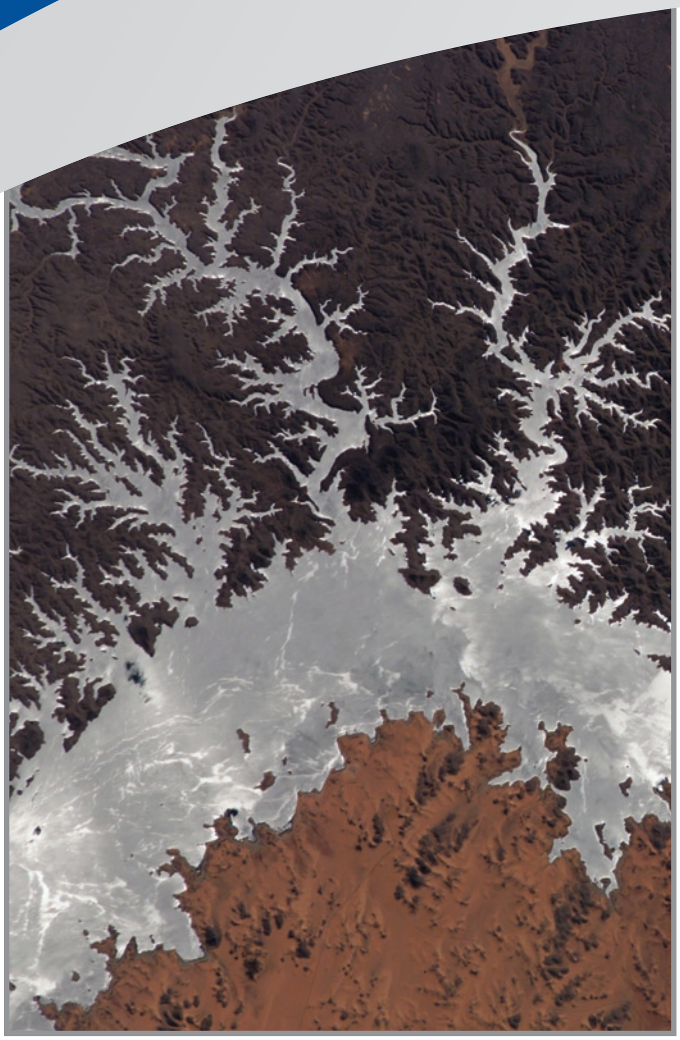
» **Earth Science:** Earth observation system missions are helping us in the critically important task of understanding our changing climate.

NASA's robotic missions will also be joined by new missions, including the James Webb Space Telescope, the Juno Jupiter polar-orbiter, the Solar Dynamics Observatory, the Lunar Reconnaissance Orbiter and earth science missions for the study of climate and global change.

Adequate funding and attention is necessary to provide robotic precursor missions for human space missions, to explore areas of space currently beyond human reach and for critical missions looking toward the Earth in this time of climate and global change.

Recommendation

The NASA science program should receive the funding necessary to provide a wide suite of robotic missions and other research.



SECTION 3

Observing the Earth's Environment Takes a Global Perspective

Without space capability we would not be able to monitor from a global view what is happening now on our planet, nor would we be able to forecast what is to come in terms of weather, climate or other natural events. Given the dramatic changes in population, demographics and availability of natural resources over the last several decades — and with these trends expected to increase in the future — the United States needs heightened monitoring of the Earth to improve models, forecasts and dissemination of information to shape policy, risk assessment, national security and management decisions.

A range of target applications across economic sectors benefits from information about the Earth, including energy, aviation, agriculture, disaster and risk management, public health, insurance and emerging markets addressing climate and global change. There is a need for improving and maintaining a robust, civil, space-based monitoring system.

The effects of global change can be disastrous if we are not prepared for them. We hear almost daily about the devastating and deadly impacts of floods, droughts, forest fires, tornadoes, hurricanes, tsunamis, earthquakes or volcanoes somewhere in the world. In the aftermath of these natural disasters, there are renewed calls for better prediction, preparation, response and recovery on the part of governments.

The one constant throughout these natural disasters is the need for better and timelier information about the natural and man-made environment. Many studies have shown that past investments in improving our knowledge about the environment, our predictive capabilities and our decision support systems have earned valuable returns in saving lives and preserving property. Rather than reacting to each natural disaster after the fact with a patchwork of new systems and processes, what is needed is a consistent, systematic investment in Earth observations, data management and communications, Earth-system modeling and decision support systems targeted at understanding, predicting, preparing for and responding to the impacts of global change.

Earth observation also plays a role in national security. Climate and global change emerge as having serious impacts on our country's economic security and on the health and well-being of the population. Recent testimony to the Senate Committee on Foreign Relations attributed climate change as a key factor in the conflicts in Darfur and Somalia,[3] and credible studies show that the economies of both developed and developing nations are at risk.

In addition, international migration caused by climate change threatens border stability and poses potential health hazards as well. Drought, flooding and even minor sea rise to low-lying nations or populated river deltas could increase refugee migration over international borders, including those of the United States. Even events occurring on the far side of the world can threaten critical resources necessary to the United States and global markets.

What Is Global Change?

Where *climate change* refers specifically to the changes that are occurring to our climate, *global change* encompasses the interaction between the natural and man-made environment, such as demographics, climate change, severe weather and natural events, urban development, changes in availability of natural resources, crop infestation and disease vectors and other environmental impacts to society.

Space provides a unique platform for providing a global view to predict and respond to climate and global change events.

To ensure we are able to continue efficient monitoring of the environment, the U.S. government must modernize our aging constellation of weather and climate satellite systems and establish a national global monitoring strategy and architectural framework.

Aging Weather and Climate Satellite Systems

Our current constellation of Earth observation satellites, both those monitoring climate variables and those monitoring the weather, were launched in the 1990s, and many are now moving past their planned lifespan. With an average span of 15 years between initiation of Earth observation satellite programs and launch, long-term planning and commitment is required to avoid gaps of coverage for day-to-day weather forecasts and the data collection needed for research and modeling.

The historic pattern of U.S. planning, budgeting and deployment of space systems for Earth monitoring has involved a constant progression of improvements and advanced systems. But that pattern is changing. At the same time that demand for better information and understanding of weather and climate is growing, the U.S. capability is shrinking.

NASA's research and development capabilities have experienced dwindling budgets, and a set of state-of-the-art satellites for handoff to the National Oceanic and Atmospheric Administration is rapidly declining in number. Projections for replacing the research and development satellites still fall short of what is needed with short-term increases often followed by cuts.

Acquisitions for NOAA's fleet of operational Earth-monitoring spacecraft for forecasting weather and climate trends are severely constrained by limited funding and resources. This rising trend does not allow planners to field the state-of-the-art satellites that NASA has tested and proven for use in day-to-day hurricane and weather forecasting and climate monitoring.

In 2007 the National Academy of Sciences published "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond." It reported that our nation faces gaps in its capability to provide essential environmental data and lists target observables for weather (55), climate (26) and hazards (7) that are not completely met today. It also provides a list of critical measurements needed to gather this data.

There are two systems in development and acquisition today that could be great steps forward in meeting these needs — the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and the Geostationary Operational Environmental Satellite (GOES) series. Both have the capacity to be further optimized by leveraging investments already made and taking advantage of R&D that NASA has already accomplished. Without overcoming the constraints of funding and the lack of a long-range strategy, the United States will not benefit fully from these systems that could improve the accuracy of projections for climate change and forecasts of hurricanes, tornadoes and floods.

Recommendation

The U.S. government should immediately address existing and growing gaps in climate measurements and weather satellite coverage:

» Provide the level of funding required to sustain robust, operational monitoring systems and investing in next-generation, R&D Earth observation systems.

» Call for private sector capabilities and capacities to the maximum extent possible to enable improved delivery of observations, model outputs, decision support tools and product generation.

» Enact NASA and NOAA Earth science and operational environmental monitoring missions, such as those recommended by the National Academy of Sciences. These missions should be treated as a national priority in order to properly model and address climate and global change.

National Global Monitoring Strategy and Architectural Framework

While Earth observations are implemented through many agencies across the government, there is no overarching policy or national strategy to serve as a guideline for setting priorities and plans for investing in research, development, applications and operational systems.

A national long-range strategy and "enterprise architecture" are needed to guide plans that cross federal agency missions and leverage the contributions of academia and industry for effectively collecting and managing important Earth information. This architecture or blueprint would enable coordination of a commonly recognized target vision for federal Earth observation activities based on assessments of essential measurements, monitoring capabilities and decision support tools for applications of national priority. The architecture would include data handling, processing, computing and visualization facilities and data interoperability standards and protocols to optimize benefits of the resulting information for society.

The transition of technology from experimental Earth science missions to the next generation of operational (proven or nonexperimental) Earth monitoring systems has been challenging. Therefore the architectural blueprint should take a long view with horizons out for at least three decades as well as provide guidance in transitioning new technology experimental sensors and systems into the next generation of operational observing systems.

As part of a global monitoring blueprint, there should be a national advisory board on Earth observations that would develop, iterate, evolve and optimize the strategy and architecture for U.S. Global Earth Observation System of Systems toward realizing a target vision. Members of this board should include academia, industry, nonprofit representatives and the private sector and should draw upon member expertise to conduct periodic assessments of essential measurement and monitoring capabilities needed to provide information to Earth system models and decision support tools.

Recommendation

The administration should establish, fund and implement a U.S. Earth observation architecture as a national priority:

» As part of this architecture, develop an overall plan to include both research and development of new Earth observation systems and a process to carry these experimental satellites into the next generation of operational satellites.

» Implement and evolve the U.S. Global Earth Observation policy recently drafted by the Office of Science and Technology Policy.

» Establish a national advisory board on Earth observations that will develop and optimize the architecture for U.S. Earth observation systems. Members of this board should include academia, industry, nonprofit representatives and other members of the private sector.

SECTION 4

National Security Space: Protecting Our Nation, Citizens, Allies and Friends through Space Assets

U.S. dependence on national security space (NSS) assets is undeniable, yet many fail to recognize or appreciate the importance of these systems or how easily their capabilities could be impaired or even destroyed. Space systems have been integrated into virtually all aspects of U.S. military and intelligence operations, including communications, command and control and intelligence gathering. The dependence we have on NSS systems, however, makes them a natural target of our adversaries.

Space systems provide global capability to transmit communications, intelligence and positioning navigation and timing into the hands of our warfighters — giving the Army, Navy, Air Force and Marine Corps the tools needed to win in battle. Without NSS systems, our warfighters are essentially blinded on the battlefield and many critical DoD systems cease to operate. For both the military and intelligence communities, without NSS, intelligence, surveillance and reconnaissance (ISR) capabilities against America's most dangerous enemies are degraded.

Because NSS systems and their capabilities are relied upon for U.S. security and economic vitality, they represent a critical infrastructure that must be maintained and modernized. Threats to our NSS systems continue to emerge as seen by the successful Chinese direct-ascent anti-satellite weapon test in 2007.

Protecting and securing our space assets should be a top national security priority. It is imperative that the United States redoubles its efforts to maintain our technological edge in space to guarantee that our leaders, warfighters and other users are provided with the most secure, effective and affordable space-based assets available.

To enable NSS assets to keep meeting a variety of our current and future national security demands, Congress and the administration should provide balanced and stable funding for national security space; modernize and maintain our aging national security space infrastructure; ensure space protection and situational awareness; develop a more responsive space infrastructure; and modernize export controls for our national security space industrial base.

Balanced and Stable Funding

Balanced and stable funding for NSS technologies, systems and capabilities ensures our warfighters benefits from resources that help save lives on the battlefield and win engagements. Funding for current and future NSS also strengthens a critical infrastructure that enables ISR, provides for a strong national defense and assists our nation's leaders in decisionmaking. Conversely, unstable funding profiles can impede program performance and system development, weaken an already fragile industrial base, lead to programmatic cost overruns and, ultimately, have an impact on U.S. national security.

To highlight the importance of adequate funding for NSS, consider the various national security systems and capabilities that depend on space. For example, armored combat vehicles, unmanned aerial vehicles, naval cruisers, guided weapons and missile defense platforms all rely on NSS assets to operate. The intelligence community depends on NSS for the ISR that keeps our nation's leaders informed on key national security issues.

In essence, virtually all military operations rely on NSS. The services require NSS for warfare planning, environmental monitoring, missile warning, situational awareness, secure communications, disaster relief and humanitarian assistance. The military is also working to integrate NSS even further with net-centric operations and the Army's Future Combat Systems program.

In order to keep our edge in national and homeland defense through a strong space infrastructure, balanced and stable funding for NSS is critical.

Systems where space assets provide key capabilities:

- Armored Combat Vehicles
- Missile Defense Platforms
- Guided Weapons
- Naval Cruisers
- Unmanned Aerial Vehicles
- Command and Control
- Situational Awareness
- Missile Warning
- Intelligence
- Global Communications
- Future Combat Systems

Balanced and stable funding will be especially important in the area of current and future missions for ballistic missile defense (BMD). We live in a hostile world where rogue nations are pursuing the development of increasingly sophisticated ballistic missiles. Space systems and a multilayered and integrated ballistic missile defense system that is comprised of space-based, airborne and ground-based sensors, shooters and command and control are critical to our national security

Approaches to future threats include a network of space-based sensors to provide detection and "birth-to-death" tracking and land- and sea-based mobile interceptors capable of being deployed worldwide on a variety of platforms. Ensuring a truly layered approach to the BMD system will provide a more robust defensive system and expand the range of response options available to the president and senior U.S. military leaders.

Recommendation

The United States should provide balanced and stable funding for current national security space systems, including those supporting ballistic missile defense, while ensuring continued R&D and deployment to counter future threats.

Modernizing-Maintaining NSS Infrastructure

As noted earlier, space-based assets provide position, navigation and timing; ISR; environmental monitoring; and satellite communications (MILSATCOM) that represent the bedrock of U.S. military operations.

Critical national security space satellites, including GPS satellites, are aging past their designed life span. Programs to replace and enhance these capabilities and protect them from potential attack have been delayed and could result in gaps in coverage. To continue to provide the services and capabilities our national security community needs, U.S. satellites and their associated ground infrastructure need to be upgraded.

Specifically, the aging GPS system depends on contact between satellites and fixed monitoring stations from the ground — all infrastructure that requires upgrading. The next-generation GPS ground control segment, scheduled to become operational in 2013, will enable net-centric capabilities that maximize the increased capabilities of the new generation of GPS satellites.

Our nation's environmental monitoring satellites are also significantly overburdened. Six Defense Meteorological Support Program (DMSP) satellites, designed for a life span of four years, are at the average age of 7½, and the replacement NPOESS is still in development.

In MILSATCOM, the first replacement to the Defense Satellite Communications System is coming on line with the current constellation past its planned lifespan. This Wideband Global SATCOM (WGS) system is providing a 12-fold increase in bandwidth to our nation's warfighter. Other new systems, including the

Our Global Positioning System is aging:

- 50 percent of GPS satellites have been on station for nearly 14 years, despite an original design life of 7½ years.
- Other GPS satellites are more than halfway through their planned 10-year life span.
- While our GPS systems are aging, the European Union is developing its own PNT systems and other nations, including Russia and China, are upgrading or developing their satellite infrastructure.
- Aging satellites can be more susceptible to attack or sudden failure and could mean U.S. loss of leadership in global PNT, which would harm our industrial base and economy.

Transformational Satellite Communications System (TSAT) and the Advanced Extremely High-Frequency System (AEHF), will provide enhanced, protected communications to reduce dependence upon vulnerable, unprotected systems.

Space-based systems also provide important missile warning capabilities to protect the United States and its allies. Like GPS, these systems are aging and must be sustained through the fielding of new systems. New systems, such as the Space-Based Infrared System (SBIRS), will provide enhanced monitoring capabilities for effective missile warning and will protect against other threats to U.S. national security.

As U.S. satellite systems continue to age, our demand for national security space systems is also increasing. In the coming decade, DoD expects the demand for MILSATCOM capacity alone to jump by an order of magnitude — from 13.6 gigabytes per second in 2006 to 160 gigabytes in 2015. This does not even begin to take into account the various other space services on which the national security community depends.

Recommendation

The United States should support the modernization and upgrading of our aging national security space infrastructure in order to maintain effective systems that can address the increasingly complex demands of the future.

Space Protection and Situational Awareness

Increased age is not the only challenge facing our NSS assets.

During much of the Cold War and the period immediately afterward, the United States could count on its preeminence in NSS. Today this is no longer assured as more and more nations are becoming, or seek to become, space competitors. As the space environment becomes more crowded and contested, the United States will need to make certain that its important NSS assets are protected from unintended or intentional interference or damage and be prepared to face and respond to threats to space capabilities.

There have already been warning signs. Nearly 10 years ago the Commission to Assess U.S. National Security Space Management and Organization highlighted the growing vulnerability of our space assets and sounded the alarm about the threat of a "space Pearl Harbor." The commission's members wrote that our increasing dependence on space tempts potential adversaries to employ operations that are "intended to deceive, disrupt, deny, degrade or destroy U.S. space systems."[4] More recently, a 2004 report by the National Security Telecommunications Advisory Committee Satellite Task Force — a presidential advisory group — indicated that our satellite assets are already vulnerable to a variety of threats and that the government "does not fully optimize or protect the satellite infrastructure."[5]

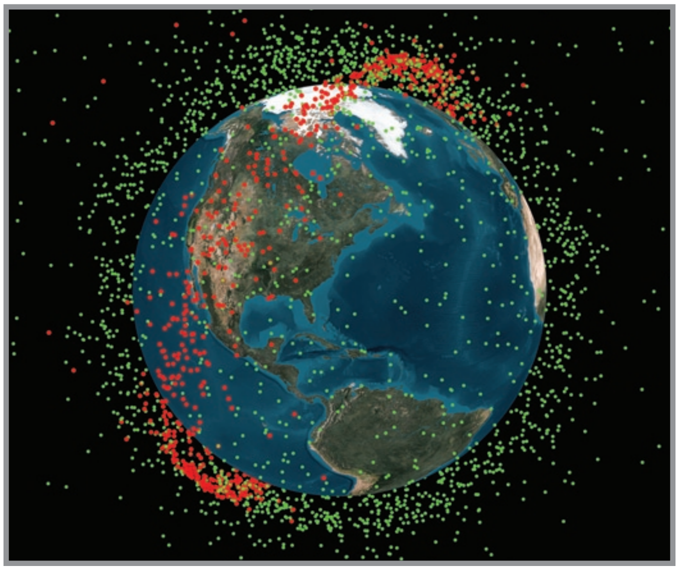
Threats from rogue nations and strategic competitors have grown over the years. In 2007 the Chinese military demonstrated its capability to destroy space assets when it successfully tested an anti-satellite weapon that subsequently unleashed a massive debris cloud that has put the world's space assets at risk well into the future. Potential adversaries are also developing systems to disable and jam U.S. and allied space systems some of which are widely available and can be purchased on the Internet. In addition to these overt threats, debris and the increased amount of objects in space represent serious mission and operational threats to national security space systems.

The loss or significant degradation of any of several U.S. satellite systems would have widespread implications for our military and our economy.

As discussed earlier, NSS systems are a critical infrastructure that enable today's 21st century military. Significant disruption of our GPS system, for example, would undermine our warfighting capabilities while simultaneously disrupting the U.S. economic engine. Degradation in our satellite communications systems could paralyze our warfighting efforts, substantially reducing our troops' ability to succeed on the battlefield or to provide humanitarian relief and peacekeeping support.

NSS assets are critical to the success of the U.S. nuclear mission and the unmanned vehicles being utilized worldwide. These assets and the capabilities they provide are the underpinning of U.S. national security.

Space protection can be carried out through a variety of activities, including hardening of satellites and their attendant control and support infrastructures, creating mission and system redundancy and protecting systems from cyber attack. While protection of space systems is necessary, it is not sufficient. Space situational awareness is critical to identify and assess impending threats to those space systems.



Space situational awareness has been and will continue to be provided by ground-based radars. To conduct the precise tracking necessary for ballistic missile defense and orbital debris management, however, a space-based capability is also needed for "cradle-to-grave" tracking, especially to track cold objects against the space background.

Also important is the development and execution of strategies and architectures to tie U.S. space protection efforts together. One challenge is identifying and attributing the source when a space system fails. If U.S. assets are attacked, how will the offending group or nation be accurately identified? If the offender can't be identified, how will a response be determined? If U.S. strategy and situational awareness efforts are insufficient, responding to and preventing attacks will be significantly more difficult.

U.S. adversaries understand the value of NSS to the U.S. economy and national security and will likely target our assets in times of crisis. Sustained and secure operation of space missions — and their capabilities — is vital to U.S. national security and our economy. To that end, greater space protection and situational awareness should be a priority.

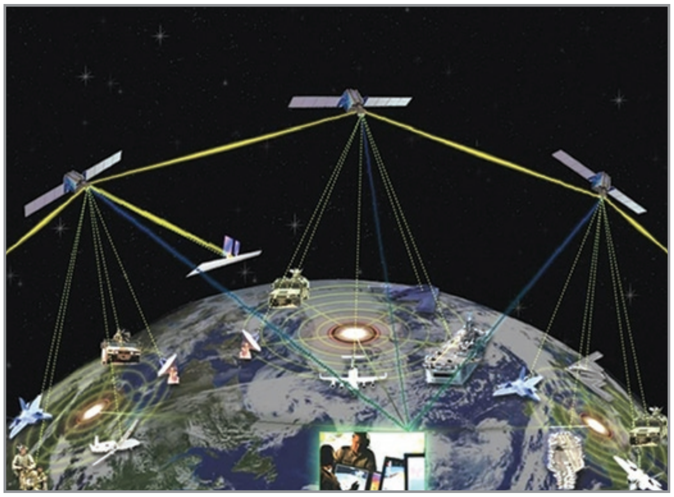
Recommendation

Space protection and space situational awareness programs should be a funded national priority guided by a comprehensive strategy:

- » Promptly establish a comprehensive space protection strategy to guarantee unimpeded and continued space operations.
- » Task our defense and intelligence agencies to consider establishing a national space protection lead reporting to the secretary of defense and director of national intelligence.

More Responsive Space Infrastructure

In addition to replacing, modernizing and protecting our space infrastructure, another key element is developing the capabilities to rapidly augment space systems.



This approach is often referred to as "operationally responsive space" or ORS and offers a new business model to provide the military and intelligence communities services from space. By providing a framework to supplement, augment, reconstitute and provide surge capability of space assets, ORS could help ensure access to NSS systems should space assets on station be devastated by attack or disruption.

DoD's three-tiered strategy for ORS provides for a rapid exploitation of existing capabilities; the use of existing technologies and capabilities to replenish, augment and reconstitute; and the development of new technologies and capabilities to replenish, augment and reconstitute existing systems. While policymakers in both the executive branch and Congress have been supportive of ORS, progress in achieving a three-tiered strategy has been slow and inadequately funded.

Recommendation

Budget levels and funding for ORS should be increased to make sure it becomes a model for fulfilling responsive, affordable and on-demand space support for national security operations.

Export Controls and NSS Industrial Base

The United States relies on a healthy space industrial base for the development and deployment of critical national security assets. Unfortunately, many U.S. export control policies are ineffective or, worse, counterproductive for U.S. industry. Ultimately, they have a negative impact on our security interests.

To protect our capability to lead in space systems, the United States needs a modern export control system that not only would continue to keep sensitive technologies out of the wrong hands but also facilitate, in a timely manner, technology trade and cooperation critical to U.S. interests with our friends and allies.

Instead of preventing foreign space capabilities, barriers to the export competitiveness of U.S. companies have prompted numerous countries to develop their own indigenous aerospace capabilities and leverage their growing market share to support their own R&D and innovation. Many U.S. companies, particularly second- and third-tier suppliers, increasingly rely exclusively on sales to the U.S. government or are considering exiting the space business altogether. Absent a healthy, cutting edge, U.S. space industrial base, our government could be forced to rely on foreign suppliers for key components.

Without meaningful steps to modernize the U.S. export control system specifically related to space technologies, the United States faces a real and daunting possibility of losing our preeminence in space.

Recommendation

The U.S. government should undergo a careful review of critical space technologies to determine technologies that should be controlled under the State Department ITAR process and those that are truly commercial and could be controlled under the Commerce Department process. This review must be followed with meaningful and careful legislation that would ensure the right technologies are controlled the right way.

Some of our nation's next generation of aeronautical engineers are seen competing at the annual Team America Rocketry Challenge for middle school and high school teams. For more, go to www.rocketcontest.org.

SUMMARY

In the last 50 years space technologies have increasingly become an important part of our nation's economic, science and national security capabilities. Over time, all sectors of the U.S. economy and national security have placed a greater reliance upon our space systems.

At the same time, we face challenges: aging constellations of Earth observation and national security space satellites; a space-supporting ground infrastructure in need of modernization; and continued access to our International Space Station investment in the years between the retirement of the space shuttle and our new, next-generation space transportation systems coming on line. Many critical space systems are aging and facing gaps as U.S. civil, national security and commercial leadership cope with competition from abroad. Disruption to these systems and failure to explore and implement new systems could send shock waves through our economy and weaken national security.

It is time to design a national space strategy that guides the development and growth of our nation's space capabilities and is consistent with our national interests, goals and objectives. It would provide the foundation for making the complex technological and resource decisions involved in guaranteeing that U.S. decisionmakers and military commanders have space-based situational awareness, space protection and responsive capabilities to meet near- and far-term policy and operational needs.

The strategy should address the future course of U.S. space exploration and the role of space-based observation on global and climate change. The strategy should also encompass existing space systems development and deployment for current civil, commercial, national security and international requirements and commitments.

The pursuit of a national space strategy will also facilitate a coordinated, singular space enterprise at the highest levels of government that is supported by stable and adequate funding and programmatic stability in order to avoid disruptions in development and execution.

Our nation's complex space infrastructure will benefit from guidance at the national level and a more coordinated approach to establish — effectively and efficiently — national architectures, plans, strategies and budgets to meet the domestic, national security and international demands of the future.

End Notes

1. Dr. Charles Vest, President, MIT, at SASC hearing in April 1997 on Defense Acquisition and Technology.
2. National Association of Manufacturers (April 2008 Newsletter).
3. General Charles Wald, USAF (retired), before the U.S. Senate Committee on Foreign Relations, May 9, 2007.
4. *Commission to Assess United States National Security Space Management and Organization*, http://www.dod.mil/pubs/spaceabout.html.
5. *The President's National Security Telecommuni-cations Advisory Committee*, Satellite Task Force Report Fact Sheet, February 2004, ES-1.

Space Activities of the U.S. Government • Historical Table of Budget Authority (in millions of inflation-adjusted FY 2007 dollars)

FY	Inflation Factors	NASA Total	NASA Space	DOD	Other	DOE	DOC	Interior	USDA	NSF	DOT	Total Space
1959	5.699	1,886	1,487	2,792	194	194	0	0	0	0	0	4,474
1960	5.611	2,940	2,592	3,148	241	241	0	0	0	0	0	5,981
1961	5.544	5,345	5,134	4,513	377	377	0	0	0	0	0	10,024
1962	5.466	9,976	9,823	7,095	1,088	809	279	0	0	0	0	18,006
1963	5.405	19,854	19,600	8,378	1,389	1,157	232	0	0	0	0	29,367
1964	5.338	27,226	26,777	8,536	1,137	1,121	16	0	0	0	0	36,450
1965	5.275	27,696	27,105	8,304	1,271	1,208	63	0	0	0	0	36,680
1966	5.186	26,839	26,268	8,759	1,110	970	140	0	0	0	0	36,137
1967	5.078	25,215	24,525	8,449	1,082	934	147	0	0	0	0	34,056
1968	4.919	22,563	21,791	9,454	857	713	138	1	5	0	0	32,102
1969	4.750	18,958	18,156	9,562	809	561	95	1	5	148	0	28,527
1970	4.543	17,017	16,113	7,623	641	468	36	5	5	127	0	24,376
1971	4.307	14,262	13,357	6,513	698	409	116	9	4	159	0	20,568
1972	4.103	13,567	12,599	5,772	547	226	127	25	8	162	0	18,918
1973	3.916	13,339	12,113	6,356	577	211	157	39	8	162	0	19,046
1974	3.752	11,395	10,352	6,626	593	158	225	34	11	165	0	17,572
1975	3.500	11,300	10,201	6,621	552	105	224	28	7	188	0	17,374
1976	3.170	11,253	10,223	6,286	534	73	228	32	13	188	0	17,042
TQ*	2.957	2,756	2,510	1,360	127	15	65	9	3	35	0	3,997
1977	2.866	10,941	9,858	6,912	555	63	261	29	17	185	0	17,324
1978	2.751	11,167	9,965	7,531	622	94	283	28	22	195	0	18,118
1979	2.577	11,844	10,385	7,824	639	152	253	26	21	188	0	18,848
1980	2.385	12,497	11,161	9,177	551	95	222	29	33	172	0	20,889
1981	2.193	12,099	10,946	10,586	514	90	191	26	35	172	0	22,046
1982	1.997	12,070	11,040	13,339	625	122	290	24	30	159	0	25,003
1983	1.869	12,850	11,828	16,858	611	73	333	9	37	159	0	29,297
1984	1.790	13,351	12,277	18,250	707	61	422	5	34	184	0	31,234
1985	1.726	13,074	11,955	22,043	1,008	59	730	3	26	189	0	35,006
1986	1.672	13,054	11,981	23,620	797	59	517	3	38	180	0	36,398
1987	1.634	17,849	16,029	26,615	761	78	454	13	31	183	2	43,405
1988	1.593	14,432	13,253	28,154	1,180	384	561	22	29	183	2	42,588
1989	1.544	16,936	15,589	27,646	865	150	465	26	32	187	5	44,100
1990	1.486	18,316	17,032	23,209	752	117	361	46	37	184	6	40,992
1991	1.433	20,085	18,695	20,321	1,107	360	360	42	37	303	6	40,122
1992	1.381	19,774	18,230	20,749	1,102	308	452	47	40	250	6	40,080
1993	1.347	19,279	17,601	19,004	985	222	437	44	34	242	5	37,590
1994	1.317	19,194	17,155	17,345	833	97	411	41	41	236	7	35,333
1995	1.290	17,867	16,176	13,727	978	77	454	40	41	358	8	30,882
1996	1.263	17,536	15,876	14,543	1,046	58	596	45	47	291	8	31,464
1997	1.239	16,989	15,438	14,533	978	43	555	52	48	272	7	30,949
1998	1.218	16,623	15,007	15,053	1,023	125	530	52	48	260	7	31,083
1999	1.203	16,430	14,993	15,889	1,182	126	692	71	45	241	7	32,064
2000	1.188	16,156	14,873	15,372	1,254	195	683	71	52	245	7	31,498
2001	1.164	16,568	15,490	16,680	1,236	169	672	70	42	270	14	33,406
2002	1.137	16,912	15,778	17,904	1,342	189	733	73	32	303	14	35,023
2003	1.116	17,148	16,027	21,639	1,456	213	724	83	47	376	13	39,122
2004	1.094	16,824	15,668	20,911	1,602	229	815	78	67	400	13	38,180
2005	1.066	17,270	16,243	20,994	1,654	244	860	75	78	384	13	38,890
2006	1.033	17,173	16,287	22,846	1,702	253	888	85	87	376	12	40,834
2007	1.000	16,285	15,568	22,418	1,680	200	912	87	65	404	12	39,666

* Transition Quarter   Found in Appendix D-1B "Aeronautics and Space Report of the President —Space Activities of the U.S. Government" (1957–2006 or 2007)

Glossary

Altair Lunar Lander: The *Altair* spacecraft is the planned moon lander component of NASA's Project Constellation, which astronauts are to use for landings on the moon by 2020. *Altair* will be used both for lunar sortie and lunar outpost missions. NASA is currently developing conceptual designs for *Altair*.

Ares I : *Ares I* is the crew launch component of the Constellation Program, designed to launch the *Orion* spacecraft. The first stage is a more powerful and reusable solid fuel rocket derived from the space shuttle. The upper stage is to be propelled by the J-2X rocket engine fueled by liquid hydrogen and oxygen. *Ares I–X* will be the first test flight of the launcher with a live first stage and mock-ups of the second stage and *Orion* capsule.

Ares V: The *Ares V* is the cargo heavy launch component of the Constellation Program and will launch the Earth Departure Stage and *Altair* lunar lander when NASA returns to the moon. The *Ares V* will be able to carry about 188 tones to Low-Earth orbit (LEO) and 71 tones to the moon. The first stage utilizes both solid and liquid propulsion; the second stage will be liquid and utilize the J-2X rocket engine.

Ballistic Missile Defense (BMD): Ballistic Missile Defense is a layered, integrated system capable of destroying a ballistic missile in all phases of flight. The system requires accurate identification and tracking of the target with sensors and advanced interceptor missiles or directed energy weapons as well as the associated command and control, battle management and communication systems to direct and integrate a BMD system.

Climate Change: Long-term significant changes in the "average weather" that a given region experiences. Average weather might include average temperature, precipitation and wind patterns.

Commercial Orbital Transportation Services (COTS): Commercial Orbital Transportation Services is a NASA program to coordinate the development of commercial delivery of cargo and eventually crew to the International Space Station. Instead of flying payloads on government operated vehicles, NASA would purchase services from commercial providers. The proposed spacecraft are intended to be owned and financed primarily by the companies themselves and will be designed to serve both the U.S. government and commercial customers.

Commercial Space Launch Act (CSLA): The Commercial Space Launch Act of 1984 regulates the U.S. commercial launch industry through the Department of Transportation's Federal Aviation Administration Office of Commercial Space Transportation. The act serves as the cornerstone of domestic regulation of the private space transportation industry.

Commercial Space Launch Indemnification: Commercial space launch indemnification refers to U.S. government payment of claims on third-party liability that might result from commercial launch-related activities. These funds are not automatic and must be approved and appropriated by Congress.

Constellation: NASA's program for developing our next generation human spacecraft and other systems for returning to the moon. Key Constellation systems include the *Orion* spacecraft for our astronauts, the *Ares I* Launch Vehicle to carry *Orion* to orbit, the *Ares V* Heavy Lift Launch Vehicle to transport large cargo elements such as the *Altair* Lunar Lander to orbit and to the moon and the supporting infrastructure.

Exploration Systems Architecture Study (ESAS): The 2005 NASA report outlining system definitions for the *Orion* spacecraft, launch systems to support crew and cargo for the International Space Station, moon and Mars programs, a reference lunar exploration architecture concept to support sustained human and robotic lunar exploration operations and the key technologies required.

Federal Aviation Administration (FAA): The Federal Aviation Administration contains the Office of Commercial Space Transportation that ensures protection of the public, property and the national security and foreign policy interests of the United States during a commercial launch or re-entry activity. It also encourages, facilitates and promotes U.S. commercial space transportation.

Federal Enterprise Architecture (FEA): Federal Enterprise Architecture (or simply Enterprise Architecture) is a structured, systematic approach led by OMB to simplify business processes and systems that unify work across federal agencies and within the lines of business of the government. The purpose is a more citizen-centered, customer-focused government that maximizes technology investments to better achieve mission outcomes.

Global Change: The interaction between the natural and man-made environment, such as demographics, climate change, severe weather and natural events, urban development, changes in availability of natural resources, mapping disease vectors, etc.

Global Earth Observation System of Systems (GEOSS): Global Earth Observation System of Systems is a comprehensive, coordinated and sustained set of systems to provide global change measurements and monitoring to improve models and decision support tools around the world.

Global Positioning System (GPS): The Global Positioning System uses a constellation of satellites that transmit precise signals that enable GPS receivers to determine their location, speed, direction and time. GPS was developed by the U.S. Department of Defense. Similar satellite navigation systems include the partially completed Russian GLONASS system, the upcoming European Galileo system and the proposed Chinese COMPASS and Indian IRNSS systems.

International Space Station (ISS): The International Space Station is a research facility assembled in orbit. It is a joint project among the space agencies of the U.S., Russia, Japan, Canada, and 11 European countries. The ISS has been continuously staffed since 2000, thereby providing a permanent human presence in space. The projected completion date is 2010 at which point the station will be utilized for research.

International Traffic in Arms Regulations (ITAR): International Traffic in Arms Regulations is a set of U.S. government regulations that control the export and import of defense-related articles and services on the U.S. Munitions List. These regulations implement the provisions of the Arms Export Control Act. The State Department interprets and enforces ITAR.

National Aeronautics and Space Administration (NASA): The National Aeronautics and Space Administration is responsible for the nation's civil space program. In addition to the space program, it is also accountable for long-term aerospace research. NASA's mission is to pioneer the future in space exploration, scientific discovery and aeronautics research.

National Oceanic and Atmospheric Administration (NOAA): The National Oceanic and Atmospheric Administration is within the U.S. Commerce Department and focused on the conditions of the oceans and the atmosphere. NOAA warns of dangerous weather, charts seas and skies and conducts research to improve understanding and stewardship of the environment. NOAA runs the National Environmental Satellite, Data, and Information Service (NESDIS) that operates the nation's environmental satellite programs and manages the data gathered by its National Weather Service as well as other government agencies and departments. NESDIS operates and manages many of our geosynchronous satellites.

National Space Council: National Space Council existed from 1958 until 1973 and again from1989 to 1993 as a coordination body reporting to the president to encourage improved interagency cooperation. The latter council was chaired by the vice president and included the following members: the secretaries of state, treasury, defense, commerce and transportation; the director of OMB; the chief of staff to the president; the assistants to the president for national security affairs and science and technology; the director of central intelligence and the administrator of the National Aeronautics and Space Administration.

National Space Policy: The National Space Policy establishes overarching national policy that governs the conduct of U.S. space activities. The current policy was authorized on August 31, 2006, superseding the policy dated September 14, 1996. The policy goals and objectives have been relatively consistent across administrations. The current version of this policy can be accessed at: http://www.ostp.gov/galleries/default-file/Unclassified%20National%20Space%20Policy%20–%20FINAL.pdf.

Next-Generation Air Traffic System (NGATS or Next-Gen): The Next Generation Air Transportation System is the name given to the project that is set to completely overhaul the U.S. National Airspace System (NAS). The goal is to increase the capacity of NAS while increasing efficiency and safety through the use of leading edge technology, including communication and GPS satellites.

Office of Space Commercialization : The Office of Space Commercialization, part of the National Oceanic and Atmospheric Administration, is the principal unit for space commerce policy activities within the Commerce Department. Its mission is to foster conditions for the economic growth and technological advancement of the U.S. commercial space industry.

Office of Commercial Space Transportation: Under FAA, the Office of Commercial Space Transportation ensures protection of the public, property and the national security and foreign policy interests of the United States during a commercial launch or re-entry activity. It also encourages, facilitates and promotes U.S. commercial space transportation.

Operationally Responsive Space (ORS): Operationally Responsive Space embodies U.S. policy to demonstrate, acquire and deploy an effective, operationally responsive capability to support military users from space through responsive satellite payloads, launch vehicles and supporting range operations and to use small satellite buses built to common technical standards.

Orion: *Orion* (originally called the Crew Exploration Vehicle or CEV) is a spacecraft under development as part of the Constellation Program. Each *Orion* spacecraft will carry a crew of four to six astronauts and will be launched by the *Ares I.*

Remote Sensing: Remote Sensing is the science identifying, observing and measuring an object without coming into direct contact with it. Earth observation often uses remote sensing from satellites.

Satellite: In spaceflight a satellite is an object that has been placed into orbit by humans (as compared to natural satellites like our moon). Satellites generally consist of a Bus and the Payload. The Bus includes supporting systems like telemetry, power, thermal control and attitude control. The Payload provides instruments for the satellite service (communications, remote sensing, surveillance, scientific measurements, etc).

Science, Technology, Engineering and Mathematics (STEM): Refers to the study of workforce disciplines that require knowledge of science, technology, engineering and mathematics.

Space Situational Awareness (SSA or Space Protection): Space Situational Awareness refers to understanding what objects are in space and what capabilities they have or to know if a satellite's operations have been intentionally affected by an adversary.

United States Space Exploration Policy (USSEP): United States Space Exploration Policy (previously referred to as the Vision for Space Exploration or simply the Vision) calls for the space program to complete the International Space Station and the retirement of the space shuttle, develop a new human rated spacecraft, explore the moon with robotic spacecraft and with humans returning to the moon by 2020 and to explore Mars and other destinations with robotic and crewed missions.

Vision for Space Exploration: See United States Space Exploration Policy.

The Aerospace Industries Association of America

CONTACT INFORMATION

The Aerospace Industries Association has a number of papers and reports on these and other subjects relating to Space, Civil Aviation, National Security, and other aerospace issues. They can be quickly accessed at:

www.aia-aerospace.org/library/reports/reports.cfm

THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA

The Aerospace Industries Association of America (AIA) was founded in 1919, only a few years after the birth of flight.

Today, nearly 300 major aerospace and defense companies and suppliers are members of the association, embodying every high-technology manufacturing segment of the U.S. aerospace and defense industry from commercial aviation and avionics, to manned and unmanned defense systems, to space technologies and satellite communications.

AIA represents the nation's leading designers, manufacturers and providers of:

- Civil, military and business aircraft
- Helicopters
- Unmanned aerial vehicles
- Space systems
- Aircraft engines
- Missiles
- Materiel and related components
- Equipment
- Services
- Information technology

AIA MEMBER COMPANIES

3M Company
AAR
Accenture
Aerojet
AeroVironment, Inc.
AirLaunch LLC
Agilent Technologies, Inc.
Allfast Fastening Systems, Inc.
American Pacific Corporation
AmSafe Aviation
AMT II Corporation
Analytical Graphics, Inc.
Andrews Space
Aurora Flight Sciences
AUSCO, Inc.
B&E Group, LLC
BAE Systems, Inc.
Barnes Aerospace
B/E Aerospace, Inc
Belcan Advanced Engineering and Technologies
Best Foam Fabricators, Inc.
The Boeing Company
BreconRidge Manufacturing
CAE USA Inc.
Celestica Corporation
Click Bond, Inc.
Click Commerce
Cobham
Computer Sciences Corporation
Crane Aerospace & Electronics
Curtiss-Wright Corporation
    Curtiss-Wright Controls Systems, Inc.
    Metal Improvement Company
Dassault Falcon Jet Corporation
Doncasters, Inc.
DRS Technologies, Inc.
Ducommun Incorporated
DuPont Company
Eaton Aerospace Operations
Eclipse Aviation
EDS
Elbit Systems of America
Embraer Aircraft Holding Inc.
Erickson Air-Crane Incorporated
ESIS, Inc.
Esterline Technologies
Exostar LLC
Flextronics International USA
FlightSafety International Inc.
FTG Circuits, Inc.
General Atomics Aeronautical Systems, Inc.
General Dynamics Corporation
General Electric Company
GKN Aerospace
Goodrich Corporation
W.L. Gore & Associates, Inc.
Groen Brothers Aviation Inc.
Harris Corporation
Hawker Beechcraft Corporation
HEICO Corporation
Hexcel Corporation
HITCO Carbon Composites
Honeywell
IBM Corporation
ITT Corporation
Kaman Aerospace Corporation
L-3 Communications
LAI International, Inc.
LMI Aerospace, Inc.
Lockheed Martin Corporation
LORD Corporation
Marotta Controls
McKechnie Aerospace
Meggitt Vibro-Meter Inc.
Micro-Coax, Inc.
MicroSat Systems, Inc.
MOOG Inc.
Natel Engineering Co., Inc.
National Machine Group
    National Machine Company
    National Aviation Products, Inc.
    National Technical Systems
Naverus, Inc.
The NORDAM Group
Northrop Grumman Corporation
NYLOK Corporation
Omega Air Inc.
Oracle USA
Pall Aeropower Corporation
Parker Aerospace
Pinkerton Government Services, Inc
PPG Aerospace – Sierracin Corporation
Proficiency Inc.
Raytheon Company
Remmele Engineering, Inc.
Rockwell Collins
Rolls-Royce North America Inc.
RTI International Metals, Inc.
Satyam Computer Services Ltd
Science Applications International Corporation
Siemens PLM Software
SITA
SM&A
Southern California Braiding Company
Space Exploration Technologies Corporation
Sparton Corporation
Spirit AeroSystems
Textron Inc.
Timken Aerospace Transmissions, LLC Purdy Systems
United Technologies Corporation
    Hamilton Sundstrand
    Pratt & Whitney
    Sikorsky
Vought Aircraft Industries, Inc.
WIPRO Inc.
Woodward Governor Company

AIA ASSOCIATE MEMBER COMPANIES

ADI American Distributors, Inc.
AirBorn Operating L.P.
Airfasco Industries, Inc.
Air Industries Machining Corporation
Albany Engineered Composites
Alcoa Fastening Systems
Alken Industries Inc.
Allegiant Global Services, LLC
Allen Aircraft Products, Inc.
American Brazing
AMETEK Aerospace & Defense
Arkwin Industries, Inc.
Arrow/Zeus Electronics, A division of Arrow Electronics
Astronautics Corporation of America
Astronic
Athena Technologies, Inc.
Avnet Electronics Marketing
Ballistic Recovery Systems, Inc.
Banneker Industries, Inc.
Bearing Point, Inc.
Blenheim Capitol Services
Brogdon Tool & Die, Inc.
Brookfield Atlantic
Brush Wellman Inc.
BTC Electronic Components
Burton Industries Aerospace Heat Treating, Inc.
California Manufacturing Technology Consulting
Capo Industries Inc.
Celltron Inc.
Chandler/May, Inc.
Cherokee Nation Distributors
CMC Electronics
Coalition Solutions Integrated, Inc.
Consolidated Precision Products
Co-Operative Industries Defense, LLC
CPI Aero, Inc.
Crestwood Technology Group
Cytec Engineered Materials
Dassault Systems of America
Data Conversion Laboratory, Inc.
Dayton T. Brown Inc.
Dexter Magnetic Technologies, Inc.
Doyle Center for Manufacturing Technology
DynaBil Industries, Inc.
East West Associates
Electronic/Fasteners, Inc.
Ellison Surface Technologies
Embry-Riddle Aeronautical University
Emhart Teknologies, A Black & Decker Company
Endicott Interconnect Technologies, Inc.
ENSCO, Inc.
Exotic Metals Forming Company LLC
The Ferco Group
Ferguson Perforating and Wire Company
Frontier Electronic Systems Corporation
Greene, Tweed & Company
G.S. Precision, Inc.
GuardianEdge Technologies
Harvard Custom Manufacturing
Haas TCM
H&S Swansons' Tool Company
HCL Technologies
HDL Research Lab, Inc.
Heartland Precision Fasteners
Aerospace Plating Company
HGS Aerospace
J.F. Hubert Enterprises
Hitachi Consulting
Hi-Temp Insulation Inc.
Hobart Machined Products, Inc.
Hughes Bros. Aircrafters, Inc.
IDD Aerospace Corp.
Industrial Metals International LTD
Infotech Enterprises America
Ingenium Technologies Corp
Inmedius
International Technegroup Inc.
TranscenData Division
ION Corporation
ITW CIP
Jabil Defense & Aerospace
JRH Electronics, LLC.
A.T. Kearney Public Sector & Defense Services LLC
KPMG LLP-Risk Advisory Services
Kreisler Manufacturing Corporation
Kreisler Industrial Corporation
Kreisler Polska sp. z. o o.
Kubotek USA
Kulite Semiconductor Products, Inc.
LMI
Loos & Co., Inc.
M/A-COM, Inc.
McCann Aerospace Machining Corporation
Meyer Tool Inc
Michigan Aerospace Manufacturers Association
Microsemi Corporation
Mid-State Aerospace Inc.
Millitech, Inc.
Mil Spec Sales Co.
Morris Machine Company, Inc.
MPC Products Corporation
Nasmyth Precision Products Inc.
Navigant Consulting, Inc.
New Breed Corporation
NMC Group, Inc.
Norfil Manufacturing, Inc.
Nor-Ral Plastics Inc.
Ohio Aerospace Institute
O'Neil & Associates, Inc.
Orion Industries
P3-North America, Inc.
Parkway Products, Inc.
PCA Aerostructures
PCC Airfoils, LLC
Performance Software Corporation
Perillo Industries, Inc.
PGM of New England, LLC
Plexus Corporation
Plymouth Extruded Shapes
Plymouth Tube Company
Powerway Inc.

Precision Aircraft Machining Company
Precision Gear
Precision Machine & Manufacturing Co.
Precision Tube Bending
Premier Precision Group
PRTM Management Consultants, LLC
PTC
QuEST
Radant Technologies, Inc.
RAF Tabtronics LLC
REMEC Defense & Space, Inc.
Renaissance Services
Rubbercraft
Sample Machining, Inc. dba Bitec
Sanmina-SCI Corporation
Sea Air Space Machining & Molding
SEAKR Engineering
Sechan Electronics, Inc.
SELEX Sensors and Airborne Systems US Inc.
Senior Aerospace
Service Steel Aerospace
Servotronics, Inc.
SIFCO FORGE GROUP
Signal International
Southco, Inc.
Spectralux Corporation
Spincraft
Spirit Electronics, Inc.
SPX Precision Components
Starwin Industries
Sunshine Metals
TechSolve, Inc.
Tedopres International, Inc.
TEK Precision Co. Ltd
Telephonics Corporation
Therm, Inc.
Thermal Solutions, Inc.
TIGHITCO, Inc.
Tiodize Co., Inc.
TMX Aerospace
Tri Polus Inc.
TTI, Inc.
TTM Technologies
TW Metals
UMA, Inc.
Unicircuit Inc.
United Performance Metals
University of Tennessee - Aerospace Defense Clearing House
Vishay
Vulcanium Metals Incorporated
Waer Systems
West Cobb Engineering & Tool Co. Inc.
The Wharton School – Executive Education
Wind River Systems
Windings, Inc.
Xerox Corporation
X-Ray Industries
XyEnterprise
Yarde Metals

Photo Credits

Cover: Images courtesy of U.S. Defense Department, NASA, NOAA and Northrop Grumman Corporation.

Page 6: U.S. Air Force/Mike Kaplan

Page 7: U.S. Defense Department

Page 8: U.S. Air Force

Page 9: NASA

Page 10: NASA

Page 12: U.S. Joint Forces Command

Page 13: NASA

Page 14: NASA

Page 15: NASA

Page 16: NASA

Page 18: NASA

Page 19: U.S. Defense Department

Page 23: U.S. Air Force

Page 24: The Boeing Company (left), AIA (right)

AIA
AEROSPACE INDUSTRIES ASSOCIATION

Aerospace Industries Association
1000 Wilson Boulevard, Suite 1700
Arlington, VA 22209-3928
703-358-1000
www.aia-aerospace.org