FINAL REPORT
of the Commission on the Future of the United States Aerospace Industry

November, 2002

Commission on the Future of the United States Aerospace Industry

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To the President of the United States
To the Congress of the United States

We, the undersigned Commissioners of the Commission on the Future of the United States Aerospace Industry, do hereby send to you the results of our deliberations and our best judgment of policies to assure the vibrancy and success of the United States aerospace industry in the 21st century.

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Executive Summary

Aerospace will be at the core of America's leadership and strength in the 21st century. The role of aerospace in establishing America's global leadership was incontrovertibly proved in the last century. This industry opened up new frontiers to the world, such as freedom of flight and access to space. It provided products that defended our nation, sustained our economic prosperity and safeguarded the very freedoms we commonly enjoy as Americans. It has helped forge new inroads in medicine and science, and fathered the development of commercial products that have improved our quality of life.

The Commission's urgent purpose is to call attention to how the critical underpinnings of this nation's aerospace industry are showing signs of faltering—and to raise the alarm.

Given a continued commitment to pushing the edge of man's engineering, scientific and manufacturing expertise, there is the promise of still more innovations and new frontiers yet to be discovered. It is imperative that the U.S. aerospace industry remains healthy to preserve the balance of our leadership today and to ensure our continued leadership tomorrow.

Our Urgent Purpose

The contributions of aerospace to our global leadership have been so successful that it is assumed U.S. preeminence in aerospace remains assured. Yet the evidence would indicate this to be far from the case. The U.S. aerospace industry has consolidated to a handful of players—from what was once over 70 suppliers in 1980 down to 5 prime contractors today. Only one U.S. commercial prime aircraft manufacturer remains. Not all of these surviving companies are in strong business health. The U.S. airlines that rely upon aerospace products find their very existence is threatened. They absorbed historical losses of over $7 billion in 2001 and potentially more this year.

The industry is confronted with a graying workforce in science, engineering and manufacturing, with an estimated 26 percent available for retirement within the next five years. New entrants to the industry have dropped precipitously to historical lows as the number of layoffs in the industry mount. Compounding the workforce crisis is the failure of the U.S. K-12 education system to properly equip U.S. students with the math, science, and technological skills needed to advance the U.S. aerospace industry.

The Commission's urgent purpose is to call attention to how the critical underpinnings of this nation's aerospace industry are showing signs of faltering—and to raise the alarm.

This nation has generously reaped the benefits of prior innovations in aerospace, but we have not been attentive to its health or its future. During this year of individual and collective research, the Commission has visited and spoken with aerospace leaders in the United States, Europe, and Asia. We noted with interest how other countries that aspire for a great global role are directing intense attention and resources to foster an indigenous aerospace industry. This is in contrast to the attitude present here in the United States. We stand dangerously close to squandering the advantage bequeathed to us by prior generations of aerospace leaders. We must reverse this trend and march steadily towards rebuilding the industry.

VISION: "Anyone, Anything, Anywhere, Anytime."

The time for action is now. This report contains recommendations intended to catalyze action from leaders in government, industry, labor and academia and assure this industry's continued prominence. A healthy aerospace industry is a national imperative. The Administration and the Congress must heed our warning call and act promptly to implement the recommendations in this report.

An Aerospace Vision

This nation needs a national vision to keep alive the flames of imagination and innovation that have always been a hallmark of aerospace. For inspiration, we looked to what aerospace can do for our nation and world. The vision the Commission used to guide its efforts is "Anyone, Anything, Anywhere, Anytime." We offer this to the nation as its vision for aerospace.

Conclusions and Recommendations

The Congress gave our Commission a broad mandate to study the health of the aerospace industry and to identify actions that the United States needs to take to ensure its health in the future. The challenge of looking across military, civil and commercial aspects of aviation and space was an opportunity to take an integrated view of the aerospace sector – government, industry, labor and academia.

The Commissioners represent a broad cross section of the stakeholders responsible for the health of the industry and whose expertise represents the breadth and depth of aerospace issues. Drawing on their extensive experience, and on the hundreds of briefings and public testimony, the Commission has made nine recommendations—one per chapter—that provide our guidance to the nation's leaders on the future of the U.S. aerospace industry. The size and scope of this report reflects an industry that is complex and interdependent.

The following are the conclusions and recommendations in the final report by chapter.

Chapter 1—Vision: Anyone, Anything, Anywhere, Anytime

Conclusions

To achieve our vision for aerospace, the Commission concludes that:

- The nation needs a national aerospace policy;
- There needs to be a government-wide framework that implements this policy;
- The Administration and Congress need to remove prohibitive legal and regulatory barriers that impede this sector's growth and continually seek to level the international playing field; and
- Global U.S. aerospace leadership can only be achieved through investments in our future, including our industrial base, workforce, long-term research and national infrastructure.

Recommendation #1

The integral role aerospace plays in our economy, our security, our mobility, and our values makes global leadership in aviation and space a national imperative. Given the real and evolving challenges that confront our nation, government must commit to increased and sustained investment and must facilitate private investment in our national aerospace sector. The Commission, therefore, recommends that the United States boldly pioneer new frontiers in aerospace technology, commerce and exploration.

Chapter 2—Air Transportation: Exploit Aviation's Mobility Advantage

Conclusions

The Commission concludes that superior mobility afforded by air transportation is a huge national asset and competitive advantage for the United States. Because of the tremendous benefits derived from a highly mobile citizenry and rapid cargo transport, the United States must make consistent and significant improvements to our nation's air transportation system a top national priority.

TRANSFORM THE U.S. AIR TRANSPORTATION SYSTEM AS A NATIONAL PRIORITY. We need national leadership to develop an air transportation system that simultaneously meets our civil aviation, national defense and homeland security needs. Today, leadership and responsibility are dispersed among many federal, state and local organizations that impact the aviation community. In the federal government, this includes the Department of Transportation's Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), Environmental Protection Agency, and the Departments of Defense (DoD), Commerce, and State.

Often these departments and agencies deal with aviation-related issues independently, without adequate coordination, and sometimes at cross-purposes. All have separate authorizing and appropriating Congressional committees. State and local governments also play important aviation development roles and private industry has numerous near-term competing forces that often delay longer-term solutions. Only strong federal leadership, aimed at a national objective, can sustain a transformational effort.

DEPLOY A NEW, HIGHLY AUTOMATED AIR TRAFFIC MANAGEMENT SYSTEM. The core of an integrated 21st century transportation system will be a common advanced communications, navigation and surveillance infrastructure and modern operational procedures. The system needs to allow all classes of aircraft, from airlines to unpiloted vehicles, to operate safely, securely, and efficiently from thousands of communities based on market size and demand. It also needs to be able to operate within a national air defense system and enable military and commercial aircraft to operate around the world in peacetime and in war.

As a first step, the Commission recommended in its Interim Report #2 "the Administration should immediately create a multi-agency task force with the leadership to develop an integrated plan to transform our air transportation system." This task force should be immediately assigned the leadership role to establish a Next Generation Air Transportation System Joint Program Office that brings together needed participation from the FAA, NASA, DoD, Office of Homeland Security, National Oceanographic and Atmospheric Administration, and other government organizations. Within a year, the Joint Program Office should present a plan to the Administration and the Congress outlining the overall strategy, schedule, and resources needed to develop and deploy the nation's next generation air transportation system.

As this transformational plan is developed, the FAA must continue to implement the Operational Evolution Plan. FAA and NASA must also continue to perform critical long-term research. The Commission also recommended in Interim Report #2 "the Administration and Congress should fully fund air traffic control modernization efforts in fiscal year 2003 and beyond, and prioritize FAA and NASA research and development efforts that are the critical building blocks for the future."

PROVIDE CERTIFICATION PROCESS AND AIRBORNE EQUIPAGE INNOVATION. The Commission calls for a new approach to the regulation and certification of aircraft technology, processes and procedures. The government also needs new mechanisms to accelerate the equipage of aircraft in order for the nation to realize broader system benefits. Airborne equipment needed for safe, secure, and efficient system-wide operations should be deemed to be part of the national aviation infrastructure.

- *Shift from product to process certification.* Instead of a focus on rules and regulations that dictate the design and approval of each particular piece of hardware or software, the FAA should focus on certifying that design organizations have safety built into their processes for designing, testing, and assuring the performance of an overall system.

- *Solve the airborne equipage problem.* The government, in partnership with industry, must be more responsible for airborne equipment development and continuous modernization. In addition to current regulatory and operational incentives, the government should consider additional options to motivate a critical mass of early equippers, including full federal funding for system-critical airborne equipment, tax incentives or vouchers for partial funding support, and competitively auctioned credit vouchers.

STREAMLINE THE AIRPORT AND RUNWAY DEVELOPMENT PROCESS. The FAA and other agencies should expedite new runway and airport development as a national priority. Further, because aircraft noise and emissions constrain capacity growth, additional government investment in long-term research in this area is imperative.

ACT NOW. The Commission sees compelling reasons for the Administration and Congress to take immediate action. First, new homeland security and defense requirements call for system capabilities not previously anticipated. Second, an entirely new level of transportation efficiency and national mobility can be enabled by more flexible, scalable, higher precision aviation operations. Third, inherently long lead times required for major aviation changes demand preparation far ahead of anticipated demand. And fourth, there could be no better American response after 9/11 than to rebuild the U.S. air transportation system dramatically better than it was before.

As we approach the 100th anniversary of powered flight, the Commission urges the President and Congress to recognize a pressing national need, and powerful opportunity, and **act now** to create a 21st century air transportation system.

Recommendation #2

The Commission recommends transformation of the U.S. air transportation system as a national priority. This transformation requires:

- Rapid deployment of a new, highly automated air traffic management system, beyond the Federal Aviation Administration's Operational Evolution Plan, so robust that it will efficiently, safely, and securely accommodate an evolving variety and growing number of aerospace vehicles and civil and military operations;
- Accelerated introduction of new aerospace systems by shifting from product to process certification and providing implementation support; and
- Streamlined new airport and runway development.

Chapter 3—Space: Its Special Significance

Conclusions

The Commission concludes that the nation will have to be a space-faring nation in order to be the global leader in the 21st century—our freedom, mobility, and quality of life will depend on it. America must exploit and explore space to assure national and planetary security, economic benefit and scientific discovery. At the same time, the United States must overcome the obstacles that jeopardize its ability to sustain leadership in space.

ACHIEVE BREAKTHROUGHS IN PROPULSION AND SPACE POWER. The ability to access space and travel through the solar system in weeks or months instead of years would help create the imperative to do so. Propulsion and power are the key technologies to enable this capability. Future progress in these areas will result in new opportunities on Earth and open the solar system to robotic and human exploration and eventual colonization. The nation would benefit from a joint effort by NASA and DoD to reduce significantly the cost and time required to access and travel through space.

Develop a Next Generation Communication, Navigation, Surveillance and Reconnaissance Capability. The nation needs real-time, global space-based communications, navigation, surveillance and reconnaissance systems for a wide range of applications. These capabilities will provide the military with the ability to move its forces around the world, conduct global precision strike operations, defend the homeland, and provide for planetary defense. The civil and commercial sectors will also benefit from these capabilities for air transportation management, monitoring global climate change, weather forecasting and other applications. The federal government needs a joint civil and military initiative to develop this core infrastructure.

Revitalize the U.S. Space Launch Infrastructure. NASA and DoD must maintain and modernize their space launch and support infrastructure to bring them up to industry standards. They should implement our recommendations contained in Interim Report #3 concerning federal spaceports, enhanced leasing authority, and utility privatization and "municipalization." We recommended that DoD and NASA should:

- Investigate the feasibility of establishing a national spaceport structure at Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS) under a single management system; and
- Seek Congressional approval for
  - Enhanced leasing authority that allows them to lease real property at fair market value and retain lease proceeds to cover the total costs incurred at KSC and CCAFS; and
  - Privatization of NASA utilities at KSC and CCAFS to overcome the budget burdens associated with capital improvements to outdated infrastructure.

In addition, NASA and DoD need to make the investments necessary for developing and supporting future launch capabilities. NASA should also consider turning over day-to-day management responsibilities for its field centers to the respective state governments, universities, or companies.

Provide Incentives to Commercial Space. Government and the investment community must become more sensitive to commercial opportunities and problems in space. Public space travel may constitute a viable marketplace in the future. It holds the potential for increasing launch demand and improvements in space launch reliability and reusability. Moreover, it could lead to a market that would ultimately support a robust space transportation industry with "airline-like operations." The government could help encourage this by allowing NASA to fly private citizens on the Space Shuttle.

Sustain Commitment to Science and Space. The U.S. government should continue its long-standing commitment to science missions in space and focus on internationally cooperative efforts in the future.

Recommendation #3

The Commission recommends that the United States create a space imperative. The DoD, NASA, and industry must partner in innovative aerospace technologies, especially in the areas of propulsion and power. These innovations will enhance our national security, provide major spin-offs to our economy, accelerate the exploration of the near and distant universe with both human and robotic missions, and open up new opportunities for public space travel and commercial space endeavors in the 21st century.

Chapter 4—National Security: Defend America and Project Power

Conclusions

The Commission concludes that aerospace capabilities and the supporting defense industrial base are fundamental to U.S. economic and national security. While the nation's defense industrial base is strong today, the nation is at risk in the future if the United States continues to proceed without a policy that supports essential aerospace capabilities.

Develop a U.S. Military Industrial Base Policy. The Department of Defense should task the Defense Science Board to develop a national policy that will invigorate and sustain the U.S. aerospace industrial base. The policy should address issues, such as mergers and acquisitions, procurement and budgeting policies, research and development investments, technology transition, international sales and workforce development.

SUSTAIN THE DEFENSE INDUSTRIAL BASE. Today's national defense industrial base is indeed robust, but without constant vigilance and investment, vital capabilities will be lost.

- DoD's annual science and technology (6.1-6.3) funding must be sufficient and stable to create and demonstrate the innovative technologies needed to address future national security threats. An amount no less than three percent of Total Obligational Authority, "fenced" from budget cuts, would be sufficient. The use of more joint technology development and acquisition programs would spread the funding burden and promote interoperability.

- The federal government must remove unnecessary barriers to international sales of defense products, and implement other initiatives that strengthen transnational partnerships to enhance national security. To help reduce the high development and production costs of advanced military systems, the United States must also increase the number of international joint programs (like the Joint Strike Fighter), and continue to foster international interoperability of defense and commercial aerospace system-of-systems.

- DoD acquisition policies should be revised to encourage greater use of commercial standards. DoD should impose government requirements by exception only, allow commercial entities to protect intellectual property, and remove other burdensome regulations that deter providers of commercial products from doing business with the government.

- There are numerous government missions that would benefit from defense technology. For example, the U.S. military has developed capabilities in the areas of communications, navigation, surveillance, and reconnaissance. These technologies could be adapted and transitioned into other government applications that would significantly enhance the capacity of our air traffic management system and, hence, our national defense and homeland security.

- The federal government and the aerospace industry must partner to enhance the operational readiness and capability of new and legacy military aerospace systems. The government should fund research and technology development programs to: reduce total ownership costs and environmental impacts; implement performance-based logistics support; create a structured, timely and adequately funded technology insertion process; and reform its procurement practices accordingly.

INCREASE OPPORTUNITIES TO GAIN EXPERIENCE IN THE WORKFORCE. The U.S. must continuously develop new experimental systems, with or without a requirement for production, in order to sustain the critical skills to conceive, develop, manufacture and maintain advanced systems and potentially provide expanded capability to the warfighter. Furthermore, the federal government and industry must develop approaches to retain and transfer intellectual capital as the workforce retires in greater numbers in the next few years.

MAINTAIN AND ENHANCE CRITICAL NATIONAL INFRASTRUCTURE. The federal government must assume responsibility for sustaining, modernizing, and providing critical, often high-risk, defense-related technologies and infrastructure when it is in the nation's interest. This includes critical design capabilities, solid rocket boosters, radiation hardening, space launch facilities, critical research, development, test and evaluation (RDT&E) infrastructure, Global Positioning System (GPS), and frequency spectrum.

Recommendation #4

The Commission recommends that the nation adopt a policy that invigorates and sustains the aerospace industrial base. This policy must include:

- Procurement policies which include prototyping, spiral development, and other techniques which allow the continuous exercise of design and production skills;
- Removing barriers to defense procurement of commercial products and services;
- Propagating defense technology into the commercial sector, particularly in communications, navigation and surveillance;
- Removing barriers to international sales of defense products;
- Sustaining critical technologies that are not likely to be sustained by the commercial sector, e.g. space launch, solid boosters, etc.; and
- Stable funding for core capabilities, without which the best and brightest will not enter the defense industry.

Chapter 5—Government: Prioritize and Promote Aerospace

Conclusions

The Commission concludes that the government must ensure that the nation has a healthy aerospace industry today and in the future, an industry that can not only meet the security and economic needs of the country but also can compete successfully in the international market place. The government needs to exert leadership and prioritize and promote aerospace by managing its activities efficiently, effectively and as a sector to accomplish national objectives. It needs to create an environment that fosters innovation in the U.S. aerospace industry, ensuring its competitiveness into the 21st century.

CREATE A NATIONAL AEROSPACE CONSENSUS. The federal government does not have a national aerospace consensus that supports broader national security and economic policies, goals and objectives. This will require Presidential and Congressional leadership to develop a consensus of federal, state and local government, industry, labor, academia and non-governmental organizations to sustain a healthy U.S. aerospace sector.

REORIENT GOVERNMENT ORGANIZATIONAL STRUCTURES. The federal government is dysfunctional when addressing 21st century issues from a long-term, national and global perspective. Government is organized vertically while national problems are becoming more horizontal in nature requiring system-of-systems solutions. Key government processes, such as planning and budgeting, are currently spread across multiple departments and agencies, with oversight by numerous Congressional committees. As a result, none of these government groups has an integrated view of our national aerospace efforts.

The executive and legislative branches need to be reoriented to provide a focus on national aerospace needs and priorities, government aerospace plans and budgets, and government management of national aerospace initiatives.

- *Federal Departments and Agencies.* Every federal department and most federal agencies should create an Office of Aerospace Development to prioritize and promote aerospace activities within their organizations and with the public that they serve;
- *Office of Management and Budget (OMB).* OMB should establish a Bureau of Aerospace Management to develop and implement an aerospace strategic plan, establish an acceptable categorical definition of the aerospace sector, prepare an annual aerospace sector budget as an addendum to the President's Budget Request, and manage major national aerospace initiatives; and,
- *White House.* The White House should establish an aerospace policy coordinating council to develop and implement national aerospace policy consistent with national security and economic goals and objectives.
- *Congress.* In response to these executive branch changes, the Commission encourages the legislative branch to create a Joint Committee on

Aerospace to coordinate legislatively the multi-faceted jurisdictional issues.

STREAMLINE AND INTEGRATE KEY GOVERNMENT PROCESSES. Government processes for policy, planning, and budgeting, and for developing and acquiring aerospace products and services are vestiges of the Cold War. As a result, they tend to be ad hoc, complex, lengthy and inefficient. The Administration and the Congress need to make a concerted effort to streamline these key government processes to reflect the new realities of a highly dynamic, competitive and global marketplace. Specifically, they should work together to create: an integrated federal planning, budgeting and program management process; an integrated government science, technology and acquisition process; and an environment that fosters rather than impedes innovation in the aerospace sector.

PROMOTE PRIVATE-PUBLIC PARTNERSHIPS. Partnerships and interconnectedness are keys to competitiveness in the future. Government, industry, labor and academia play different, but important, roles in developing and deploying new aerospace products and services. They cannot perform these roles separately and in isolation. But today, cultural and institutional biases hinder their ability to partner and achieve national goals. We need to create an environment and the incentives that will foster private-public partnerships.

Recommendation #5

The Commission recommends that the federal government establish a national aerospace policy and promote aerospace by creating a government-wide management structure. This would include a White House policy coordinating council, an aerospace management office in the OMB, and a joint committee in Congress. The Commission further recommends the use of an annual aerospace sectoral budget to establish presidential aerospace initiatives, assure coordinated funding for such initiatives, and replace vertical decision-making with horizontally determined decisions in both authorizations and appropriations.

Chapter 6—Global Markets: Open and Fair

Conclusions

Open global markets are critical to the continued economic health of U.S. aerospace companies and to U.S. national security. In order to remain global leaders, U.S. companies must remain at the forefront of technology development. They must also have access to global customers, suppliers and partners in order to achieve economies of scale in production needed to integrate that technology into their products and services.

Government intervention continues to distort global markets, from subsidies to anti-competitive restrictions on partnerships and collaboration to biased standards and regulations. U.S. companies frequently find themselves competing against foreign competitors supported directly or indirectly by their governments. We need to move to a different model of business characterized by competition between companies instead of between countries.

REFORM EXPORT CONTROLS AND DEFENSE PROCUREMENT POLICIES. U.S. national security and procurement policies represent some of the most burdensome restrictions affecting U.S. industry competitiveness.

We call for a fundamental shift away from the existing transaction-based export-licensing regime to process-based licensing. Under this new system, the government would rely on companies to safeguard against the sale of controlled technologies to unacceptable parties through internal company controls certified by the government. The government then would monitor and audit those company operations for compliance. Such a process-based licensing regime would improve security, reduce licensing costs and enable our companies to collaborate with international partners and sell to global customers.

Additional reforms, including those outlined in Interim Report #2, are necessary to make this new system effective. As quickly as possible, the government should revise the U.S. Munitions List, remove barriers to global project licenses, expand waivers for trading with friendly nations, and update country risk surveys to facilitate better policy decisions.

U.S. procurement regulations currently are too restrictive and must be modified to be supportive of a global industrial base to meet military requirements, while maintaining U.S. industrial capacity in critical technologies and capabilities. We need to reform DoD procurement regulations to permit integration of commercial components into military products even if they are provided by non-U.S. companies or worked on by foreign nationals.

Establish a Level International "Playing Field". U.S. companies have lost market share to foreign companies supported by protectionist and market distorting policies. The U.S. government must take immediate action to neutralize these distortions and enable fair and open competition.

We must continue to meet our responsibilities of setting national goals and priorities for basic research, reverse declines in basic research and experimentation funding and expand efforts to fund technology diffusion through U.S. industry.

We also must work bilaterally and multilaterally to get foreign governments out of the business of commercial "product launch." In spite of inadequacies of the current World Trade Organizations (WTO) system, the U.S. government should work in the WTO Doha round of negotiations to strengthen the existing WTO provisions restricting the use of subsidies to distort the market. The U.S. government also should work with other WTO members to adopt more effective trade remedies that are usable and effective in a market characterized by increased globalization. When countries do violate existing provisions, we should not shy away from taking action.

We must ensure that U.S. companies are not disadvantaged by differences between U.S. and foreign tax policies as exemplified in the current WTO dispute over U.S. Foreign Sales Corporation/Extra Terrritorial Income regulations. In the near term we must seek to delay European trade sanctions while both parties negotiate a solution to this dispute. We urge the Administration and Congress to authorize changes to U.S. tax law that are WTO compliant but that continue to offset the advantage enjoyed by European companies. In the longer term, the Administration should initiate changes in the WTO rules to remove the current inequity in the treatment of direct and indirect taxes that caused the dispute in the first place.

Official export credit support for commercial and military products is an essential tool to facilitate U.S. aerospace exports. In addition to continued funding for U.S. Export-Import Bank programs, we should seek to reduce international reliance on official export credits for export financing assistance, such as through ratification of the "Cape Town convention." For military exports, the Defense Export Loan Guarantee should be modernized to permit the DoD to create an effective unsubsidized export credit organization to facilitate the financing of defense exports to U.S. allies and friendly nations abroad.

The U.S. government should remove policy and regulatory obstacles to increased commercial mergers and teaming within the U.S. and with international partners. The U.S. government should assist in developing and policing international anti-trust treaties relating to mergers and teaming between commercial entities to minimize divergence of requirements and the methods of assessment in antitrust reviews, presumably making reviews more objective. The U.S. government also must continue to work bilaterally with key countries to remove barriers to foreign investment.

Global standards and regulations are critical to the efficient operation of the global aviation system and international markets. The U.S. government needs to step up its commitment to the development of global standards in International Civil Aviation Organization (ICAO) and via other forums. This will help to mitigate the efforts of other countries seeking to provide a competitive advantage for their companies through biased domestic standards or regulations.

COMMIT TO GLOBAL PARTNERSHIPS. International partnerships are essential to the creation of system-of-systems solutions to global challenges.

In order to meet our goal of transforming the way we use airspace through the use of advanced technology and improved procedures, we must act in concert with other countries around the world. We must commit to developing common standards and recommended practices for satellite navigation in ICAO, and ensure that global cooperative efforts are not thwarted by disputes over radio spectrum allocation. We strongly urge U.S. officials to work bilaterally and multilaterally to ensure that U.S. GPS and European Galileo systems are compatible and complementary in the event that Galileo becomes a reality.

U.S. policy makers should work toward global standards for safety certification as a way to prevent the use of safety certification by some governments to enhance their domestic competitiveness. We also call for increased liberalization of air transport services through negotiation of open skies agreements in order to expand the demand for all countries' air transport services and alleviate undue congestion at the largest airports.

The success or failure of our future activities in space is fundamentally linked to our ability to work effectively with international partners. It is in our country's best interest to work cooperatively with partner nations in space exploration and protection of our planet from the threat of near-earth objects.

Recommendation #6

The Commission recommends that U.S. and multilateral regulations and policies be reformed to enable the movement of products and capital across international borders on a fully-competitive basis, and establish a level playing field for U.S. industry in the global market place. U.S. export control regulations must be substantially overhauled, evolving from current restrictions on technologies through the review of transactions to controls on key capabilities enforced through process controls. The U.S. government should neutralize foreign government market intervention in areas such as subsidies, tax policy, export financing and standards, either through strengthening multilateral disciplines or providing similar support for U.S. industry as necessary.

Chapter 7—Business: A New Model for the Aerospace Sector

Conclusions

The Commission concludes that for our aerospace industry to be globally preeminent, now and in the future, it must be able to attract vitally needed capital at a reasonable cost. We further conclude that the defense and aerospace sector is viewed as a low growth industry with low margins, unstable revenue and a capricious major customer, the government. Without a significant change in the business model, the future of the aerospace industry, so critical to our national economic and homeland security, is uncertain and at risk.

PROVIDE INVESTMENT OPPORTUNITIES. Predictability, stability and performance are critical to the health and growth of a robust aerospace industry. The government must stabilize program requirements and protect adequate long-term investment funding, enact reforms that increase the financial flexibility of industry and the government, and improve program management stability.

ENABLE INDUSTRY TO ATTRACT AND RETAIN HIGH-TECH PARTNERS AND SUPPLIERS. The future of the aerospace industry is intrinsically tied to the ability of the sector to attract and retain high-tech partners and suppliers throughout the supply chain. The government should pursue near-term reforms to realign purchasing processes to lower costs and gain access to new technology by eliminating, or at least lowering, barriers that make government business inefficient and unattractive to commercial firms. DoD should implement changes to permit greater profitability and financial flexibility of industry working on government efforts. A government-wide review of functions and services should be conducted to identify those functions that are not "core" to the effective operation of government and those functions that could best be performed by the private sector.

CREATE A FAVORABLE DOMESTIC AND INTERNATIONAL BUSINESS CLIMATE. Certain U.S. tax and trade laws and regulations that affect a wide variety of industries weigh particularly heavily on defense and aerospace, both in competition with domestic commercial entities as well as in the international markets. The government should act promptly to replace burdensome tax laws and outdated trade laws with laws and regulations that remove unnecessary administrative burdens from industry and recognize the unique contribution of defense and aerospace companies to our nation's defense and economic security. In addition, the Administration and Congress should review and consider reducing user fees on the airlines and their customers.

ENSURE LONG-TERM GROWTH AND FINANCIAL HEALTH. Government and industry must recognize that a healthy, competitive, and innovative industry meeting security and aerospace needs must be closely integrated with the global commercial marketplace. Major challenges to this desired climate include the need for dramatic personnel and training reform and recognition of the dynamic interrelated global environment. Government and industry should work together to develop and implement training and exchange programs that would educate and expose their workforces to those challenges and responsibilities. All government officials with budget and program acquisition, management, or review responsibilities, both appointed and elected, should be required to have a business or financial background or training. Finally, government must develop and implement a policy regarding international cooperation in defense and aerospace that recognizes the global industrial base. The Administration is urged to undertake a review of the current policy regarding both domestic and international business combinations, based on an analysis of the U.S. defense industrial base, including the supplier industrial base.

Recommendation #7

The Commission recommends a new business model, designed to promote a healthy and growing U.S. aerospace industry. This model is driven by increased and sustained government investment and the adoption of innovative government and industry policies that stimulate the flow of capital into new and established public and private companies.

Chapter 8—Workforce: Launch the Future

Conclusions

Clearly, there is a major workforce crisis in the aerospace industry. Our nation has lost over 600,000 scientific and technical aerospace jobs in the past 13 years. These layoffs initially began as a result of reduced defense spending following the conclusion of the Cold War. This led to an industry shift from reliance on defense sales to one dependent upon commercial markets. Increasing foreign competition in the commercial aerospace market has led to contractions in the industry, resulting in mergers and acquisitions. Job losses from this consolidation have been compounded by the cyclical nature of the industry.

Due to these uncertainties, most of the workers who have lost their jobs are unlikely to return to the industry. These losses, coupled with pending retirements, represent a devastating loss of skill, experience, and intellectual capital to the industry.

REVERSE THE DECLINE AND PROMOTE THE GROWTH OF TODAY'S AEROSPACE WORKFORCE. The Commission was unable to agree to any immediate solutions to help stem the loss of jobs within the industry. It hopes that its recommendations for a high-level federal management structure focused on establishing a national aerospace consensus (Chapter 5) and other actions to promote the industry will have a positive effect in the future. What is clear is that industry, government, and labor must begin to work now to restore an aerospace industry that will be healthy, stable, and vibrant.

U.S. policy towards domestic aerospace employment must reaffirm the goal of stabilizing and increasing the number of good and decent jobs in the industry. The Administration and the Congress should consider the impact of domestic and international policies on U.S. aerospace employment.

Address the Failure of the Math, Science, and Technology Education. The aerospace industry must have access to a scientifically and technologically trained workforce. In the long term, the Commission stresses that action must be taken to improve mathematics and science instruction across the entire education range—K-12 through graduate school. These actions and investments should include scholarships and internship programs to encourage more U.S. students to study and work in mathematics, science, and engineering fields. In addition, investments should be made in vocational education to develop a highly skilled workforce, including registered apprenticeship programs for skilled and technical occupations. Further, as recommended in Commission Interim Report #3, targeted tax credits should be made available to employers who invest in the skills and training programs needed by the industry.

In addition, the Commission concludes that emphasis must be placed on the concepts of "lifelong learning" and "individualized instruction" as key elements of education reform. It is likely that individuals now entering the workforce will hold five or more jobs in their lifetime and the education system must be prepared to deliver training and education to meet these changing skill requirements and meet labor market needs. U.S. community colleges are adept at designing and delivering workforce training and individualized instruction.

Our policymakers need to acknowledge that the nation's apathy toward developing a scientifically and technologically trained workforce is the equivalent of intellectual and industrial disarmament and is a direct threat to our nation's capability to continue as a world leader.

Recommendation #8

The Commission recommends the nation immediately reverse the decline in, and promote the growth of, a scientifically and technologically trained U.S. aerospace workforce. In addition, the nation must address the failure of the math, science and technology education of Americans. The breakdown of America's intellectual and industrial capacity is a threat to national security and our capability to continue as a world leader. The Administration and Congress must therefore:

- Create an interagency task force that develops a national strategy on the aerospace workforce to attract public attention to the importance and opportunities within the aerospace industry;
- Establish lifelong learning and individualized instruction as key elements of educational reform; and
- Make long-term investments in education and training with major emphasis in math and science so that the aerospace industry has access to a scientifically and technologically trained workforce.

Chapter 9—Research: Enable Breakthrough Aerospace Capabilities

Conclusions

The United States must maintain its preeminence in aerospace research and innovation to be the global aerospace leader in the 21st century. This can only be achieved through proactive government policies and sustained public investments in long-term research and RDT&E infrastructure that will result in new breakthrough aerospace capabilities.

Over the last several decades, the U.S. aerospace sector has been living off the research investments made primarily for defense during the Cold War—intercontinental ballistic missiles, the Saturn V, space-based reconnaissance, the global positioning system, stealth and unmanned aerial vehicles. The challenges posed by our rapidly changing world—asymmetric threats, international competition, environmental awareness, advances in technology—demand that we, like the Wright brothers 100 years ago, look at the challenges as opportunities for aerospace and turn them into reality.

Government policies and investments in long-term research have not kept pace with the changing world. Our nation does not have bold national aerospace technology goals to focus and sustain federal research and related infrastructure investments. It lacks a streamlined innovation process to transform those investments rapidly into new aerospace products, processes and services.

The United States has unlimited opportunities to revolutionize aerospace in the 21st century, opening up new markets and launching a new era of U.S. global aerospace leadership. The nation needs to capitalize on these opportunities, and the federal government needs to lead the effort. Specifically, it needs to invest in long-term enabling research and related RDT&E infrastructure, establish national aerospace technology demonstration goals, and create an environment that fosters innovation and provide the incentives necessary to encourage risk taking and rapid introduction of new products and services.

Increase Public Funding for Long-Term Research and RDT&E Infrastructure. The Administration and Congress should sustain significant and stable funding in order to achieve national technology demonstration goals, especially in the area of long-term research and related RDT&E infrastructure. Research areas that provide the potential for breakthroughs in aerospace capabilities include:

- Information Technology;
- Propulsion and Power;
- Noise and Emissions;
- Breakthrough Energy Sources;
- Human Factors; and
- Nanotechnology.

Establish National Technology Demonstration Goals. The Administration and Congress should adopt the following aerospace technology demonstration goals for 2010 as a national priority. These goals, if achieved, could revolutionize aerospace in the next half century much like the development of the jet, radar, space launch, and satellites did over the last half-century.

Air Transportation

- Demonstrate an automated and integrated air transportation capability that would triple capacity by 2025;
- Reduce aviation noise and emissions by 90 percent;
- Reduce aviation fatal accident rate by 90 percent; and
- Reduce transit time between any two points on earth by 50 percent.

Space

- Reduce cost and time to access space by 50 percent;
- Reduce transit time between two points in space by 50 percent; and
- Demonstrate the capability to continuously monitor and surveil the earth, its atmosphere and space for a wide range of military, intelligence, civil and commercial applications.

Time to Market and Product Cycle Time

- Reduce the transition time from technology demonstration to operational capability from years and decades to weeks and months.

Accelerate the Transition of Government Research to the Aerospace Sector. The U.S. aerospace industry must take the leadership role in transitioning research into products and services for the nation and the world. Government must assist by providing them with insight into its long-term research programs. The industry must aggressively develop business strategies that can incorporate this research into new products and services. Industry also needs to provide input to government on its research priorities. Together industry and government need to create an environment that will accelerate the transition of research into application. The Departments of Defense, Transportation, Commerce and Energy, NASA, and others need to work with industry and academia to create new partnerships and transform the way they do business.

Recommendation #9

The Commission recommends that the federal government significantly increase its investment in basic aerospace research, which enhances U.S. national security, enables breakthrough capabilities, and fosters an efficient, secure and safe aerospace transportation system. The U.S. aerospace industry should take a leading role in applying research to product development.

Promise for the Future

The aerospace industry has always been a reflection of the spirit of America. It has been, and continues to be, a sector of pioneers drawn to the challenge of new frontiers in science, air, space, and engineering. For this nation to maintain its present proud heritage and leadership in the global arena, we must remain dedicated to a strong and prosperous aerospace industry. A healthy and vigorous aerospace industry also holds a promise for the future, by kindling a passion within our youth that beckons them to reach for the stars and thereby assure our nation's destiny.

The Hon. Norm Dicks (D-WA)
Mr. Jeff Foote, President, ATK Aerospace
Mr. Dain Hancock, President, Lockheed-Martin Aerospace Company
Mr. Gerald Daniels, President & CEO, Military Air & Missile Systems, The Boeing Company

Preface

Congress established the Commission on the Future of the United States Aerospace Industry in Section 1092 of the fiscal year (FY) 2001 National Defense Authorization Act (P.L.106-398). The Commission was established as a Federal Advisory Committee under the Executive Office of the President, National Science and Technology Council. The purpose of the Commission is to "study the issues associated with the future of the U.S. aerospace industry in the global economy, and the industry's future importance to the economic and national security of the United States." The twelve commissioners, appointed by the President and the Congress, are experts representing the breadth of aerospace issues and stakeholders. The President designated the Honorable Robert S. Walker as Chairman.

The Commission defines the U.S. aerospace sector as the sum of those activities needed to develop, operate, and/or use aerospace capabilities, including the activities of commercial enterprises and government—from general aviation to space exploration, and from civil transport to national security. The human capital, national infrastructure and research needed to support these activities were also considered to be key elements of the sector.

From November 27, 2001, through November 18, 2002, the Commission held six public meetings, received public testimony from over 60 witnesses, and issued three interim reports outlining its preliminary findings and recommendations. The Commission visited Europe and Asia to meet with leaders from their aerospace sectors and learn about their issues and future plans.

The Commission staff gathered information about the aerospace sector from over one hundred government, industry, labor, university and non-governmental organizations. The Commission also created a website to share information about the Commission with the public. It received over 150,000 inquiries during the life of the Commission.

Opposite page top:
Commissioners Walker, Tyson and Stevens in Soyuz Simulator, Star City, Russia.

Opposite page bottom:
Commission meeting May 14, 2002
Department of Commerce Auditorium


ANYONE
ANYTHING
ANYTIME
ANYWHERE

RECOMMENDATION #1: The integral role aerospace plays in our economy, our security, our mobility, and our values makes global leadership in aviation and space a national imperative. Given the real and evolving challenges that confront our nation, government must commit to increased and sustained investment and must facilitate private investment in our national aerospace sector. The Commission therefore recommends that the United States boldly pioneer new frontiers in aerospace technology, commerce, and exploration.

Chapter 1

Vision: Anyone, Anything, Anywhere, Anytime

The 20th century was America's century. Our nation thrived on previously unimagined advances in ground, air and space transportation, rapidly becoming the world's leader in nearly every economic sector driven by the progress of science and technology. What future does the 21st century hold for us and for the world?

The Congress gave our Commission a broad mandate to study the health of the aerospace industry and to identify actions that the United States needs to take to ensure its health in the future. The challenge of looking across military, civil and commercial aspects of aviation and space was an opportunity to take an integrated view of the aerospace sector – government, industry, labor and academia.

The Commissioners represent a broad cross section of the stakeholders responsible for the health of the industry and whose expertise represents the breadth and depth of aerospace issues. Drawing on their extensive experience, and on the hundreds of briefings and public testimony, the Commission has made nine recommendations—one per chapter—that provide our guidance to the nation's leaders on the future of the U.S. aerospace industry. The size and scope of this report reflects an industry that is complex and interdependent.

From the big picture we describe, the Commission encourages the reader to recognize the importance of the aerospace industry to America, and to build the consensus we need for action.

"It is scarcely possible that the twentieth century will witness improvements in transportation that will be as great as were those in the nineteenth century."

Brooklyn Daily Eagle,
December 30, 1900

Aerospace is Vital to the United States

One hundred years ago, the slogan "Anyone, Anything, Anywhere, Anytime" would have meant leaving home when transportation permitted and then allowing nearly a week to travel between widely separated American cities.

Today, New York to London is a day trip. A package of any size mailed tonight arrives tomorrow morning anywhere in the country. We fly across the world on a moment's notice, at an altitude of 41,000 feet, on an airplane that holds 400 people, getting fed in our seats, while watching feature-length movies, calling home or checking our e-mail. When we arrive at our destination, our biggest complaint may be the delays encountered getting to, from and through the airports.

As America prepares to celebrate the 100th anniversary of the Wright brothers' historic achievement in aviation, our Commission was struck with how the U.S. aerospace industry has shaped the 20th century not only for America but also for the world. Indeed, U.S. leadership has been responsible for superior achievement in many important industries, but aerospace has been our crown jewel.

Our national security, economic growth, quality of life, and scientific achievements now depend on a myriad of aerospace products and services. These benefits we enjoy as a nation are the direct result of U.S. leadership in aerospace. Unfortunately, most Americans take the benefits of aerospace leadership for granted. Meanwhile, foreign nations clearly recognize the potential benefits from aerospace and are attempting to wrest global leadership away from us.

Nevertheless, where we have the national will, such as in defense, we continue to be the world leader. Where we do not have the national will, such as in civil aviation and commercial space, our leadership position is at risk.

National Security. Aerospace technologies form the strategic and tactical backbone of U.S. military capabilities, providing global mobility, space-based communications and intelligence, defense against airborne threats, sea and aerospace control, long-range precision strike, and protection and tactical mobility for ground forces. Aerospace capabilities provide unique contributions to U.S. national security as well as underwrite the capabilities of allied coalitions with whom we are involved in the vital work of maintaining international peace and security.

Economic Growth. The aerospace industry is a powerful force within the U.S. economy and one of the nation's most competitive sectors in the global marketplace. It contributes over 15 percent to our Gross Domestic Product and supports over 15 million high quality American jobs. Aerospace products provide the largest trade surplus of any manufacturing sector. Last year, more than 600 million passengers relied on U.S. commercial air transportation and over 150 million people were transported on general aviation aircraft. Over 40 percent of the value of U.S. freight is transported by air. Aerospace capabilities have enabled e-commerce to flourish with overnight mail and parcel delivery, and just-in-time manufacturing.

Quality of Life. Aerospace products and services are important contributors to both the business sector and the quality of life of the American public. Air travel is the fastest and safest form of personal and business mobility. Personal travel now accounts for more than 50 percent of air transportation and is increasingly accessible to all segments of American society. The public continues to benefit immeasurably from aerospace applications, including improved weather forecasting, cellular telephones,

THE AEROSPACE SECTOR MISSION

- Develop, manufacture and/or operate systems used in the earth's atmosphere and/or in space;
- Provide services in and from the earth's atmosphere and/or space; and
- Provide the workforce and infrastructure and perform the research needed to develop and support the systems and services.

precision farming, new medical devices, and hundreds of other benefits.

Scientific Achievement. Ongoing scientific discoveries have not only enabled the preceding benefits but have also provided fundamental knowledge of our planet, the universe, and the origins of life itself. Space-based observatories, such as the Hubble telescope, enable us to look back in time to the creation of the universe. The International Space Station is the first step toward permanent international colonization of outer space. Interpretation of climate change, and new discoveries about the formation and evolution of our solar system now have practical relevance and are essential elements of the nation's political, cultural, and scientific agenda.

SEGMENTS OF THE AEROSPACE SECTOR

- National Security
  - Defense
    - Air (e.g., combat aircraft, airlift, unmanned aerial vehicles, guided missiles)
    - Space (e.g., space launch, communications, navigation and reconnaissance satellites)
  - Intelligence (e.g., air and space-based communications, reconnaissance)
- Civil (other government)
  - Air (e.g., air traffic management system, safety regulation, accident investigation, environmental permitting, noise and emission standards)
  - Space (e.g., weather satellites, air- and space-based earth monitoring, International Space Station, Space Shuttle, Hubble Space Telescope, robotic missions to the planets)
- Commercial
  - Air (e.g., aircraft manufacturing, air carriers, general aviation, airport operations)
  - Space (e.g., space launch, launch vehicles and satellite manufacturing, telecommunications, remote sensing)

Government, Industry, Labor and Academia Each Play an Important Role

There are four major stakeholder groups that play important roles in the aerospace sector—government (at all levels), industry, labor, and academia. In performing these roles, they contribute to the three major segments of aerospace—national security (defense and intelligence), civil (other government) and commercial. Each segment has air, ground and space components. All of the stakeholders need to work together in partnership to deliver quality aerospace products and services to the American people.

For example, in the area of air transportation, the Federal Aviation Administration (FAA) in the U.S. Department of Transportation (DOT) develops and operates the nation's civil air traffic control system for military, civil and commercial aircraft operating in domestic and oceanic airspace. That system depends on the military's Global Positioning System for navigation information and air- and space-based sensors for surveillance information. It uses military, civil and commercial communications for ground-to-air and air-to-ground communications. Local airport authorities build and operate the airports; while aircraft and airport security is provided by DOT's Transportation Security Administration.

Unfortunately, most Americans take the benefits of aerospace leadership for granted.

The FAA also regulates and certifies civil and commercial aircraft safety and works with the Department of Defense to provide the air traffic controllers that manage the nation's air traffic control system. The Environmental Protection Agency regulates the environmental permitting of new runway construction.

The Departments of State, Commerce and Transportation negotiate international aviation agreements, standards and regulations. The National Aeronautics and Space Administration develops technology to improve aviation safety and reduce environmental impacts as well as develop tools for improving the air traffic control system. It also invests in long-term aerospace research and development for the commercial aerospace industry.

The commercial sector develops and manufactures the equipment used in the aircraft as well as the ground, air and space systems used in the air transportation management system. The commercial sector also manufactures the aircraft and operates the airlines that transport the public, business passengers and goods—both domestically and abroad.

As this example illustrates, a vast array of organizations make up the aerospace sector, including: federal, state and local government organizations; multi-national corporations, suppliers and small businesses; labor unions and trade schools; colleges and universities; professional associations and societies; and non-governmental organizations. The government (military and civil) and the commercial sector need to work together to provide the nation with safe and secure air transportation anywhere in the world.

In addition, the aerospace sector generates a wide range of jobs across the fabric of the American economy. This includes jobs in: runway and airport construction; ground transportation; retail stores and restaurants at airports; and agricultural, urban planning and weather services.

The World is Changing Rapidly

The Commission has identified a number of forces that are changing the world and the aerospace sector. Among these changes are significant shifts in the global threat, mobility and environmental awareness, economic growth, governance, and technology. Understanding these changes is critical if the United States is to move forward in the second hundred years of human flight and sustain its global aerospace leadership position.

Looking ahead, U.S. dependence on new aerospace capabilities and technologies will only continue to grow. Military priorities include defense against ballistic missiles, more rapid global power projection, and more emphasis on aerospace-based communications, intelligence, surveillance, and reconnaissance, among others. Civil priorities include more effective and efficient air traffic management, advanced navigation aids, and other infrastructure needs. Space will open up new opportunities for expanding human presence in the solar system and enriching life on earth through its exploitation in such areas as energy and materials.

How the United States addresses these military, civil and commercial priorities will significantly impact the American economy as well as our national security posture.

FORCES OF CHANGE ON AEROSPACE

HISTORIC	EMERGING
Super Power Threat	Terrorism Threat
Explosives	Cyber, Chemical, Bio
Vehicle Centric	Network Centric
Foreign Adversaries	International Partners & Competitors
Hub and Spoke	Point-to-Point
Airlines	Range of Air Vehicles
Human Control	Human Oversight
System-by-System	System-of-Systems
Prescriptive Specifications	Performance-based Solutions and Regulations
Local & Regional	National & Global Markets
U.S. Companies	Multi-national Corporations
Predominantly White Male Workforce	Diverse Workforce
Large Physical Infrastructure	Virtual & Flexible
Mass Production	Custom Built Atom-by-Atom

U.S. Aerospace Global Leadership is in Jeopardy

Our Commission has met with many organizations—both foreign and domestic—over the past year. We have gathered information on the health and future of the aerospace industry, at home and abroad. Based on this, we believe that U.S. aerospace leadership is in jeopardy. Here is what we see:

We believe that U.S. aerospace leadership is in jeopardy.

At Home. The U.S. aerospace sector, most notably the commercial air sector, is seen increasingly as a mature industry lacking in capital investment, innovation, and capacity for growth. Aerospace sector market capitalization, research and development investments and return on investments/assets are down and consolidations are up. The U.S. is losing global market share and its positive balance of trade in aerospace manufacturing is eroding. Jobs are going overseas.

The U.S. economic downturn, coupled with the additional security costs resulting from the September 11 terrorist attacks, is crippling the airlines and causing massive layoffs. Meanwhile, today's air transportation system—based on 1960s technology and operational concepts—is reaching capacity, resulting in increasing delays and costs for both passengers and shippers.

At the same time, government investments in long-term civil aerospace research are static, if not declining in real terms. The lack of sustained, long-term investment is stifling innovation and preventing the establishment of new economic growth curves for air transportation and space. While the military has recently received significant increases, both in research and development and in procurement accounts, those increases focus on near-term counter-terrorism and homeland security problems and may be short-lived. The aerospace workforce and infrastructure are aging, and there is a lack of compelling vision or robust financial outlook to draw our youth into this important business sector.

Abroad. Around the world, foreign competitors are aggressively implementing policies to take global aerospace leadership away from the United States. The European Union has a stated policy objective of being the world's leader in aerospace by 2020. Asian nations are aggressively trying to capture the U.S. systems engineering and integration expertise needed to develop state-of-the-art aerospace systems. The international competition continues to gain global market share in commercial aviation. Often desirable, but ever-tightening environmental requirements on noise and emissions are limiting worldwide flight operations and creating international conflict. And, in spite of excess capacity and low demand for space launch capabilities, foreign governments continue to subsidize their commercial space launch industry.

The Commission finds this situation unacceptable.

A Vision for America

What could "Anyone, Anything, Anywhere, Anytime" mean a century from now? A one-hour sub-orbital trip from the United States to Japan? A lunar vacation? A Martian hiking expedition? Whatever our future holds, the aerospace sector will be at its foundation, providing our nation and the world with the ability to move people, goods, services and ideas whenever they are needed and wherever they are wanted.

Unfortunately, the nation has not articulated a compelling aerospace vision for over forty years—not since 1961, when President Kennedy challenged the nation to put humans on the Moon and to bring them back safely before the end of the decade. Although spurred by the Cold War and early successes by the Soviet Union in space, the Apollo program transformed America into a space-faring nation, while establishing us as the global aerospace leader. The human space flight program, with each mission more ambitious than the last, further motivated an entire generation of the nation's best and brightest students to pursue careers in science and engineering.

As we now coast on investments made by the generations that came before us, the technological and economic preeminence we have taken for granted is in jeopardy. Based largely on perspectives and expectations borne of the Apollo era, Americans commonly view aerospace as the highest of high-tech industries. Aerospace was the unique purview of the advanced society that is America. Today, however, aerospace and other high-tech industries flourish globally, offering strong and unprecedented international competition in these sectors.

The time is now to shape a bold new aerospace vision for this century that does not leave us wondering whether the 20th century saw the ultimate advances in mobility. In particular, the nation faces a new imperative for which the aerospace industry is uniquely positioned to shine: America and its allies must win the war against terrorism while taking aggressive measures to strengthen our economy and improve the quality of life for all Americans.

The nation needs to build on the vision that President Eisenhower had in 1956 of an interstate highway system, which transformed America into a mobile society. Now is the time to provide that same mobility to all Americans in the air and in space.

We need a bold vision for air transportation that creates a new, highly automated "Interstate Skyway System." The system needs to be safe, secure and efficient and be able to accommodate the large volume and variety of civil and military aerospace vehicles the nation will require in the coming decades.

We also need an audacious vision of space exploration that recognizes the solar system as our backyard, the Milky Way galaxy as our neighborhood, and the universe as our hometown. We should do this not simply because it is fun, or thrilling, or challenging, or enlightening… but because it, too, represents an efficient investment in our economic strength and, ultimately, in our capacity to defend ourselves against enemies known and unforeseen.

It's America's choice.

The vision that aerospace offers America and the world is:

Anyone, Anything, Anywhere, Anytime

Just as the Wright brothers' historic flight in December 1903 set the course for U.S. global aerospace leadership in the 20th century, the Commission believes that its national vision for aerospace—Anyone, Anything, Anywhere, Anytime—will help sustain our leadership in the 21st century. If we value technologically-driven prosperity, and if we value security in times of need, and if we do not want the 20th century to fade as a distant memory of America's greatness, then this vision will:

- Provide a new era of fast, efficient, global air mobility;
- Enhance our homeland and international security;
- Enable a new era of scientific discovery and space exploration;
- Open new markets and high-paying jobs for Americans; and
- Enable technology applications that spread across the entire economy.

Sustaining Our Global Leadership

Sustaining U.S. aerospace sector leadership needs to be a national priority. Today, the nation is responding to a national imperative similar to winning the Cold War—winning the war against terrorism while strengthening our global economic leadership. Aerospace will play a pivotal role in our ability to respond to this imperative, but the nation needs to unleash its full potential.

Now is the time for the aerospace sector—government, industry, labor and academia—to come together to address these critical issues, remove the bureaucratic and other impediments to progress that have long since outlived their usefulness, and embrace our vision for aerospace in the 21st century. This vision will help set and prioritize national goals—goals that would help to focus both public and private sector investments and rekindle the flame of innovation and determination that once drove the U.S. to develop the interstate highway system and to leave American footprints on the surface of the moon.

Conclusions

To achieve our vision for aerospace, the Commission concludes that:

- The nation needs a national aerospace policy;
- There needs to be a government-wide framework that implements this policy;
- The Administration and Congress need to remove prohibitive legal and regulatory barriers that impede this sector's growth and continually seek to level the international playing field; and
- Global U.S. aerospace leadership can only be achieved through investments in our future, including our industrial base, workforce, long-term research and national infrastructure.

RECOMMENDATION #1

The integral role aerospace plays in our economy, our security, our mobility, and our values makes global leadership in aviation and space a national imperative. Given the real and evolving challenges that confront our nation, government must commit to increased and sustained investment and must facilitate private investment in our national aerospace sector. The Commission therefore recommends that the United States boldly pioneer new frontiers in aerospace technology, commerce, and exploration.

RECOMMENDATION #2: The Commission recommends transformation of the U.S. air transportation system as a national priority. The transformation requires:

- Rapid deployment of a new, highly automated Air Traffic Management system, beyond the Federal Aviation Administration's Operational Evolution Plan, so robust that it will efficiently, safely, and securely accommodate an evolving variety and growing number of aerospace vehicles and civil and military operations;
- Accelerated introduction of new aerospace systems by shifting from product to process certification and providing implementation support; and
- Streamlined new airport and runway development.

Chapter 2

Air Transportation: Exploit Aviation's Mobility Advantage

Whether aviation's mobility advantage is used for economic productivity, military strength, or greater personal quality of life, it is clearly in the U.S. national interest to increase both the efficiency and the use of air transportation.

Efficient air transportation is a tremendous national asset. U.S. airlines carry more than 600 million passengers per year.[1] General aviation aircraft carry an additional 150 million passengers per year.[2] Cargo airlines have made overnight shipping a consumer and business utility. Airports are regional economic powerhouses, and more than 11 million American jobs and $900 billion in U.S. economic activity derive from aviation's pervasive reach.[3] Productivity growth and our Gross Domestic Product are directly related to an efficient and growing air transportation system (Figure 2-1).

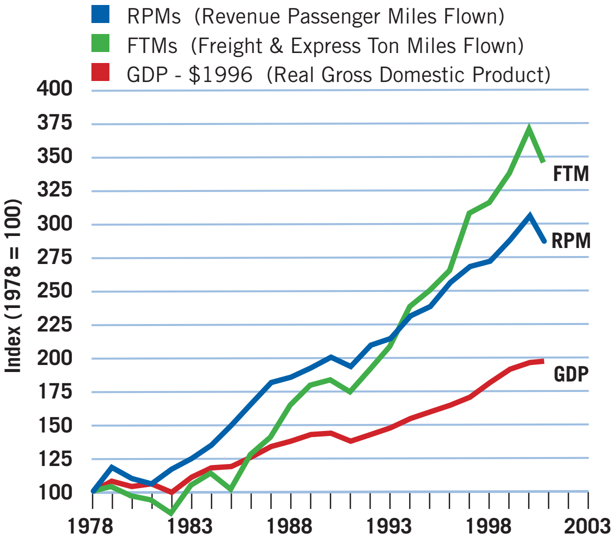
Even before the events of September 11th, the U.S. faced serious aviation challenges.

- Commercial air transport had become unpredictable, with frustrating and expensive delays. Our air traffic system—based on 1960s technology and operating concepts—was approaching gridlock.
- Economic problems of major U.S. airlines were becoming evident.

"The Wright Brothers created the single greatest cultural force since the invention of writing. The airplane became the first World Wide Web, bringing people, language, ideas, and values together."

— Bill Gates,
Founder, Microsoft Corporation

Figure 2-1 Demand for Air Transportation Outpaces Economic Growth



Note: FedEx incorporated into DOT data in 1986
Source: ATA Annual Reports and U.S. Department of Commerce (Bureau of Economic Analysis) via www.bea.gov/bea/dn/gdplev.xls

- Environmental limits on noise and emissions were impacting worldwide flight operations and creating international disputes.
- Our aerospace market leadership was being challenged as an explicit goal of foreign competitors.
- And, our country's investments in long-term aeronautics research and development were insufficient.

The repercussions of September 11 have compounded most of these problems. Decreases in the demand for commercial air travel, caused in part by security concerns, additional security costs, and passenger inconvenience are crippling many airlines and causing massive layoffs. U.S. airline losses in 2001 totaled over $7 billion and are expected to grow to $9 billion in 2002.[4] Several airlines have filed for bankruptcy and more may follow, with ripple effects on the health of the entire aerospace manufacturing sector.

The United States needs a 21st century global air transportation system.

As this report is written, the economic health of America's airlines continues to decline. The Commission's concern over these ongoing events is deepened by the lack of consensus among the stakeholders in the industry, the Administration, and Congress regarding the near-term solutions that could or should be employed to return the industry to a profitable status. There is consensus, however, that the solutions to this situation are complex and must involve cooperation among government, industry, and labor. The airline industry is currently subject to a myriad of charges and fees that add up to a significant percentage of a ticket's total cost. In fact, the airlines are subject to more federal taxes and fees than even the alcohol or tobacco industries, which have been specifically targeted for "sin taxes."[5] A healthy airline industry is a national resource that should be enabled and allowed to prosper.

Any one of these challenges would be cause for serious concern. Taken together—and we do not have the choice to ignore any of them—they call for immediate and bold action.

The nation's aviation system must be the best in the world—and we must ensure that the disruption of transportation and services that followed the events of September 11 never occurs again.

The United States needs a 21st century global air transportation system that provides safe, secure, efficient and affordable transportation of people and

The U.S. economic downturn coupled with additional security costs resulting from the September 11 terrorist attack are crippling many airlines and causing massive layoffs.

goods in peacetime and wartime. We need a system that:

- Enhances national security, strengthens homeland defense, and enables civil and U.S. military aircraft to operate without undue restrictions;
- Increases U.S. economic competitiveness with a more efficient, higher capacity air transportation system; and
- Improves the quality of life of all Americans by enabling them to go where they want, when they want.

It is now clear that for too long, we have delayed the development of policies, systems and technologies needed to solve our air transportation problems. For too long, we have lacked the national will necessary to make the required investments and guide them through to application and implementation.

We should wait no longer.

Objective: Delivering People and Goods Quickly and Affordably—When and Where Needed

We envision a future in which anywhere, anytime mobility will enable dramatic improvements in the productivity of U.S. companies, military capabilities, and the lives of our citizens.

We believe that air mobility can provide the fastest, safest, most secure, most reliable, and most affordable doorstep-to-destination travel. Business travelers

A new generation of small jets may enable low-cost, high-speed air taxi service.

Both point-to-point and hub-and-spoke operations will continue to grow.

should be able to plan an important 8:45 a.m. airport meeting in any community and be sure that the flight scheduled to arrive at 8:25 a.m. will be on time, regardless of weather, visibility, or air traffic conditions. No longer should extra hours, or even a day-before arrival, be required. Fast, safe, and secure point-to-point transportation should be available not just between major hub airports, but also between convenient local airports via low-cost, jet air-taxis.

A whole new generation of unpiloted vehicles should support our homeland security and enable revolutionary commercial applications. Supersonic business jets could rapidly connect growing transoceanic partnerships. Rotorcraft should be used to efficiently shuttle an increasing amount of passengers and goods to locations beyond traditional airports. Lighter-than-air vehicles should provide heavy lift, security patrols, and high-altitude platforms for sensors and communications. Orders placed on the Internet in the morning could arrive at your home or business that afternoon. Our military should be capable of operating more freely in domestic airspace. Aircraft should be so quiet and produce so few emissions that airports will become welcomed assets in all communities.

Issues

The nation's aviation sector is staggering under the combined load of many challenges. Some of the challenges are discussed in other chapters of this report. The lack of coordinated government policies and integrated actions will be discussed in Chapter 5. International issues, government support for foreign manufacturers, and the diminishing U.S. influence in the definition of global aviation standards will be discussed in Chapter 6. The immediate financial crisis of the airlines and its effects on U.S. manufacturers will be discussed in Chapter 7. The dramatic decline in the U.S. workforce and long-term aeronautics research will be discussed in Chapters 8 and 9 respectively. Beyond these very serious issues, however, lies a fundamental roadblock—the need to transform the U.S. air transportation system.

ISSUES

- U.S. Air Transportation System
  - – Air Traffic Management Infrastructure
  - – Certification Process and Airborne Equipage
  - – New Runway and Airport Development

The U.S. Air Transportation System: Does Not Meet Future Demand

Our current air transportation system is severely limited in its ability to accommodate America's growing need for mobility. The basic system architecture, operational rules and certification processes developed several decades ago do not allow today's technologies to be fully utilized and do not allow needed innovations to be rapidly implemented.

In response to air traffic delays that reached a peak in the year 2000, the Federal Aviation Administration (FAA) developed an Operational Evolution Plan (OEP) to expand the capacity of our air transportation system by 30 percent by the year 2012.[6] The Commission supports this plan and, in Interim Report #2, recommended that it be fully funded. However, the current OEP does not give the nation sufficient capacity to meet long-term demand.

The nation must commit to developing and implementing a new air transportation system. This system needs to be robust, efficient, safe, secure, and accommodate an evolving variety and growing number of aerospace vehicles (e.g., unpiloted, tilt-rotor, lighter-than-air) and civil and military operations. Without such a system, the delays that plagued air travel in the summer of 2000 will be more than a painful memory—they will be a constant reality.

Getting new technologies, policies and procedures approved or "certified" for use in our national air transportation system will require changes in our current certification process. An RTCA, Inc. study[7] of the FAA's certification process found that:

- Technology development and associated product cycle times have outpaced the applicable FAA regulations, policy, guidance and oversight capacity;
- The time and cost to market for new technology communication, navigation, surveillance and air traffic management (CNS/ATM) products is prohibitive to the FAA's National Airspace System modernization plans and priorities;
- The lack of international agreements concerning the interoperability of CNS/ATM products and the harmonization of applicable regulations is a barrier to defining International Airspace System

(INAS) operations and to any significant development or certification cost efficiencies for the associated products and systems; and

- Current methods, policies and practices do not support the types of operations necessary for efficient use of the INAS by the aviation community.

To transform our air transportation system, government and industry must work in partnership to enable certification regulations and processes that keep pace with advancing technical innovations. We must be able to efficiently certify the airborne information technologies, integrated systems, and communications links that will comprise our future system.

The FAA is already starting to move in this direction for certification of operators in its Air Transportation Oversight System (ATOS). European regulators have adopted a similar approach to bring advanced new aviation technologies to the marketplace rapidly. We should learn from the European experience and apply such concepts to FAA certification of aircraft and equipment.

Even when certified for use, airborne equipment that would enhance the overall capacity and safety of the aviation system faces a major implementation hurdle. Because significant system benefits do not result until a large number of aircraft become similarly equipped, operators have strong disincentives to be among the first to upgrade their aircraft. This problem must be resolved before the nation's air transportation system can be effectively modernized.

We also recognize that simply moving aircraft through the airspace more efficiently will not be enough to accommodate America's need for mobility. We need to be able to land at destinations where people want and need to go. New runways at a handful of key locations around the country could increase the capacity of our air transportation system significantly. Unfortunately, the current regulatory approval process for runway construction is so Byzantine and unpredictable that it currently takes 10 to 15 years to lay just two miles of concrete at one of our nation's airports.[8]

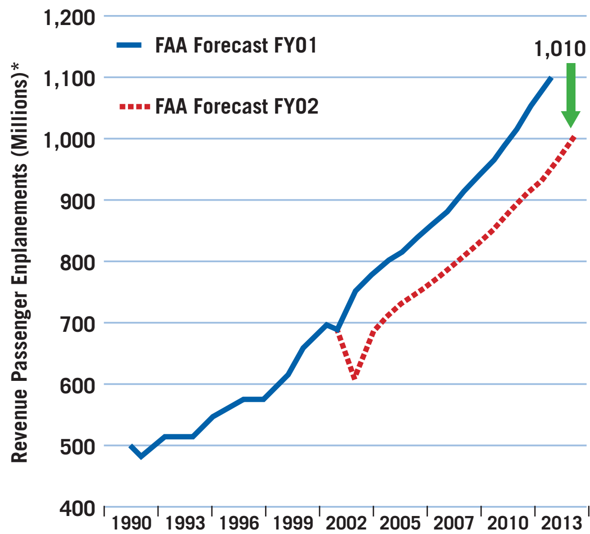
Runways need to be developed in a timely manner without lowering our environmental standards or running roughshod over local community concerns. Environmental studies need to be performed concurrently rather than sequentially. They also must follow a timely review process to adjudicate disputes.

These three key barriers—the air traffic management infrastructure, certification and equipage processes, and new runway and airport development—are discussed in more detail below.

U.S. Air Traffic Management Infrastructure: Not Scalable and Vulnerable. Air transportation's inherent speed advantage is being limited by air traffic infrastructure and operating concepts not designed for high-volume hub and spoke operations. Steadily increasing delays in the 1990's are evidence of a system operating very near its capacity limits. On-time flights fell from 81.5 percent in 1994 to 72.6 percent in 2000, despite increases in scheduled flight times.[9] Aviation's speed advantage is now nearly lost over shorter distances. For trips less than 500 miles, doorstep to destination travel time is between 35 and 80 miles per hour.[10] Estimates of the cost of aviation delays to the U.S. economy range from $9 billion in 2000 to over $30 billion annually by 2015.[11] Without improvement, the combined economic cost of delays over

Without improvement, the combined economic cost of delays over the period 2000 to 2012 will be an estimated $170 billion.

Figure 2-3 The decline in air travel and system delays following 9/11 is providing temporary capacity margins that should not be misinterpreted as permanent.



*Scheduled Revenue Passenger Enplanements (Millions), Certificated U.S. Carriers
Source: FAA Aerospace Forecasts, Based on DOT Forms 41 and 298-C

the period 2000 to 2012 will total an estimated $170 billion.[12]

Business globalization, economic growth, population growth, and the inherent value of more efficient mobility will continually increase air travel demand and exacerbate capacity shortfalls. The decline in air travel and system delays following the terrorist attack of September 11, 2001 is providing temporary capacity margins that should not be misinterpreted as permanent. Growing demand will return and expose a huge underlying problem.

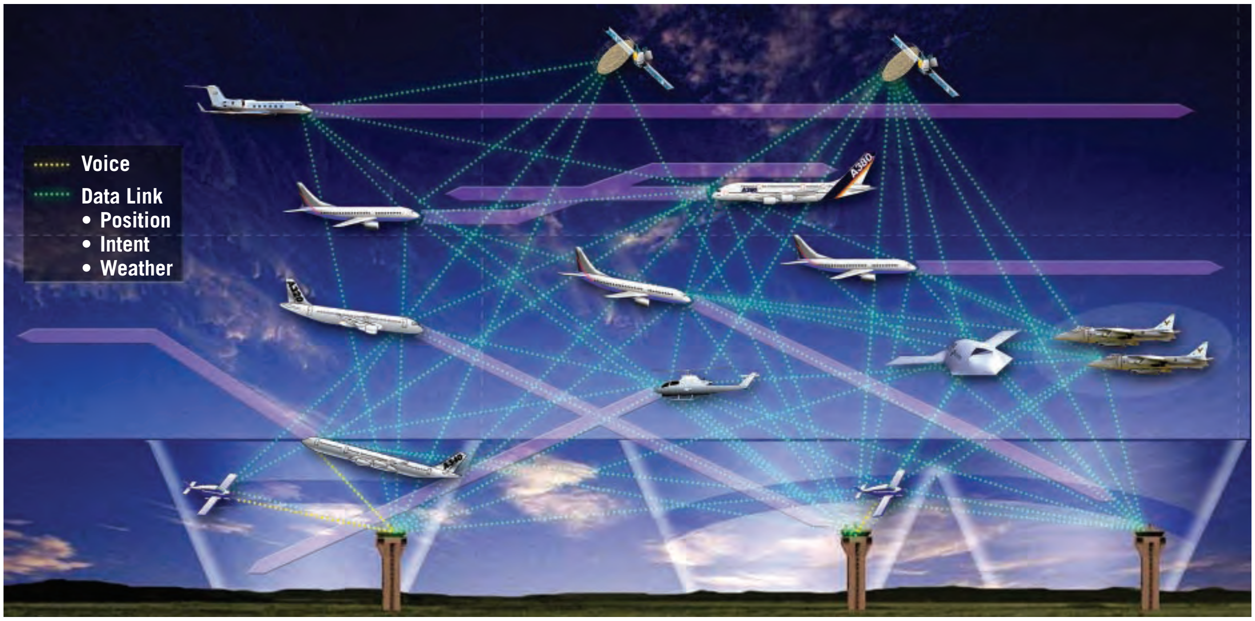
A typical air traffic controller can maintain awareness of 4 to 7 aircraft at a time.

In addition, new air transportation services are emerging that will add even greater capacity challenges. Point-to-point, low cost airlines (Southwest, Jet Blue, and others) are growing rapidly even in the midst of currently depressed demand. The Internet and the pace of global business will continue to accelerate airborne cargo delivery demand. Demand for fractional ownership of small private aircraft will continue to increase business aviation growth. Point-to-point air taxi services are in development by entrepreneurs seeking to capitalize on new, low cost, small jet aircraft designs. And an extraordinary variety of unpiloted air vehicles, rotorcraft and lighter-than-air platforms are emerging to meet a growing number of military—and perhaps eventually civil—applications.

Just as important, the nation has new security requirements for the air transportation system. Surveillance systems monitoring aircraft flightpaths need full continental coverage at all altitudes—a severe challenge for ground-based radar, even with additional sites. New communications requirements for voice, data, and ultimately video connections to in-flight aircraft need to be made secure and continuously available. Commercial and private pilots need information about restricted airspace and protected ground sites displayed in their cockpits to avoid accidental intrusions and potentially dangerous security responses. None of these capabilities are currently operational.

The FAA's OEP is the only current national development effort targeted to address the projected capacity shortfall. It should be fully funded. While the OEP is an evolving plan, it falls short of meeting the nation's long-term needs. Even if all of the projects in the OEP were completed on schedule, flight delays in 2012 would be at least as great as they were in 2000.[13] In addition, the OEP strategy and resources do not accommodate the surveillance and communications requirements that have emerged since 9/11.

The nation's civil aviation infrastructure is at a similar juncture as the nation's highway infrastructure was in the 1950s. At that time, the nation sought dramatically improved ground mobility for both civil and military needs. More country roads,



Future air traffic management operations will likely exploit a network of ground, airborne, and space-based systems to safely seperate a growing number of aircraft.

more intersections and more stoplights were not acceptable solutions. The answer was to build an entirely new concept designed for the future. The introduction of the interstate highway system was a bold change and investment that has helped spur the country's growth and economic success for the last 50 years.

Today's air traffic management system for civil aviation is not much different from that used in the 1960's. It is still fundamentally based on radar tracking, reliance on analog voice radios and the guidance of air traffic controllers. Although the system is safe, reliable, and still largely capable of handling today's traffic flow, greater use must be made of satellite and other new technologies for the system to keep pace with the projected demands of aviation. The Capstone program in Alaska, the datalink demonstration in Miami, and the early introduction of Required Navigation Performance (RNP) are already demonstrating the potential benefits of satellites and other new technologies. In addition, new automation and display technologies, such as the Standard Terminal Automation Replacement System (STARS) and the Display System Replacement (DSR), provide technology platforms for integrating near-term safety and capacity features. However, the aviation community must also look past the near horizon and develop a future concept of operations and a detailed transition plan to an air traffic management system that will require far greater flexibility and capacity.

The nation needs a new, highly automated "Interstate Skyway System" that is safe, secure and efficient and accommodates the volume and variety of civil and military air transportation that will be demanded by the nation in the coming decades.

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The Commission sees a powerful opportunity to develop a common advanced technology infrastructure that forms the foundation of this new system and simultaneously enhance civil aviation, homeland security and national defense. Key technologies being developed by the Department of Defense (DoD), National Aeronautics and Space Administration (NASA), FAA, National Oceanic and Atmospheric Administration (NOAA) and private industry should be brought together to establish that infrastructure, including:

- Secure, high bandwidth digital communication systems replacing today's analog voice radios.
- Precision navigation reducing position errors for all aircraft to within a few meters.
- Precision surveillance systems accurately locating all aircraft, and automatically detecting any deviations from an approved path within seconds.
- High-resolution weather forecasts creating 4-dimensional (space and time) profiles, accurate for up to 6 hours for all atmospheric conditions affecting aviation, including wake vortices.
- Highly accurate digital data bases depicting terrain, obstacle, and airport information no matter what visibility conditions exist.

All of this information should be readily accessible and shared among all intended users through a common information system. In short, the nation needs an air traffic system of "networked precision."

With the notable exception of accurate short-term weather prediction and wake vortex forecasting, many of the basic technologies for these capabilities exist. The DoD, in particular, has developed and used such systems for many years. This investment and experience should be aggressively exploited by the civil sector and supported by the DoD.

Each of the above capabilities would improve aviation. It is their integrated application, however, that would enable a revolution in air mobility. Conflict-free pathways for the most efficient and weather-safe routes could be automatically defined and approved. Closer—and safer—traffic spacing would use available airspace and parallel runways much more efficiently. Slot departure and arrival schedule accuracy could be reduced to less than 30 seconds. Small unpiloted vehicles could safely mix with piloted traffic. Poor visibility could be eliminated as a capacity or safety restriction at any public airport. Air traffic controllers would manage

WHAT WILL THE "NEW" AIRLINE OPERATIONS LOOK LIKE IN 10 YEARS?

The answer is… no one knows. Hub and spoke airlines may become more cost efficient. Low cost carriers may dominate. New small aircraft markets may open up. Or maybe not.

We need a system so robust and adaptable that we don't need to guess at what the future will look like.

Future air traffic control concepts can be explored through computer simulation.

BUT ISN'T OUR ATTENTION FOCUSED ON FIGHTING A WAR ON TERRORISM?

It is—and aerospace will help win that war.

But, the Commission also notes—even in the midst of tremendous national crises—strong U.S. leaders have always been able to see the long-term picture and invest in the future.

In 1863, at the height of the Civil War, Abraham Lincoln chartered the construction of the first transcontinental railroad.

overall traffic flows in a highly automated system rather than direct the movement of every flight.

The design, development, and implementation of this next-generation ATM system will be an exceedingly complex challenge. While the basic system components can be readily identified, their integration with new air traffic operating concepts and procedures will require extremely careful development, test, and evaluation. Major long-term investments and commitment will be required from the Administration and Congress. Government and industry, civil and military leadership, need to work together to overcome not only technology issues but also disagreements among aviation's many interest groups.

A federal inter-departmental group, working collaboratively with industry, labor, and other stakeholders should be formed to plan this new, highly automated air traffic management system. The new system operational concept should provide operational benefits, harmonize with the international community, and exploit aircraft performance capabilities. The new system should not merely be an extension of the

traditional concepts based on ground navigation systems. The plan should take an integrated systems approach to achieving improved operational performance and should address needed changes in everything from policies, procedures, and airspace design to the procurement of hardware and software.

Initial implementation efforts should focus on changing those federal policies and procedures that will provide early and significant operational benefits with little or no added out-of-pocket investments. The FAA should clearly define requirements and timelines for Required Navigation Performance and standardize precision instrument approach procedures. Additionally, it should focus on operationally exploiting available technologies like Automatic Dependent Surveillance-Broadcast (ADS-B)—a data link that provides situation and intent information to all pilots and controllers in a geographic area—as well as capitalize on DoD research and development investments that have already produced applicable system capabilities.

Certification Process and Airborne Equipage: Innovation Needed

Certification Process. FAA certification is the gate through which all new aircraft technologies must pass before entering the national airspace system. The bulk of certification regulations and processes were written and developed in an era whose time has passed and have not kept pace with new technologies. The reality of today is that systems are more integrated and rely more heavily on software than current regulations and certification processes can adequately handle. FAA regulations and standards are mostly designed for components, boxes, and subsystems, not for integrated aviation systems.

As a result, an applicant for a new design that incorporates new technologies may have to design and build a system and propose its certification basis prior to an FAA determination as to whether such an approach is viable. Certification for new technologies has, therefore, become highly uncertain in time, cost, regulatory baseline, and varying FAA regional office interpretations. Innovations are slowed further if, because of the uncertainties, manufacturers and airlines hesitate to proceed with innovative technology or operational developments that are not already covered by existing certification rules. The regulatory process needs to be streamlined to enable timely development of regulations needed to address new technologies.

Just as certification regulations and processes have failed to keep pace with the state of technology, so too have procedural regulations. For example, over sixty years ago, a margin of safety for landing distances was applied to commercial airplanes. The procedural regulation required an aircraft to be able to land on sixty percent of the available runway. Sixty percent was picked because, at the time the regulation was developed, little was known about runways, or rubber, or braking system performance. No standardized braking tests or manufacturing processes existed. For all these reasons, the safety cushion was made very large. Today, despite the fact that much more is known about system and landing performance, the 60 percent rule has not changed.[14] As a result, aviation's operational procedures are not taking full advantage of progress in the known performance of aviation systems.

The Commission therefore believes that a new approach to certification is needed to foster innovations that will take advantage of a constantly improving knowledge base and new technologies that make aviation safer, more secure, and more efficient.

A fundamental barrier to progress is the cost and lack of operator incentives for implementing system innovations.

Current certification processes ensure bit by bit that a design complies with specific regulations covering each piece of hardware or software. Instead, the FAA should focus on certifying that manufacturing organizations have internal design, simulation, testing, and quality assurance processes for assuring their products comply with all applicable regulations and are delivered in a condition for safe operation. Such an approach would allow FAA personnel to more effectively focus on the most critical safety aspects of an overall system and safety oversight. Regulations could also better keep up with technological progress by becoming less design-specific and more safety-process focused. The FAA's ATOS, mentioned earlier as a model for flight standards inspections, is a good example of such an approach. These principles should be examined for extension and application to hardware and software certification.

The Equipage Problem. As noted previously, many of the technical capabilities to create a next generation air traffic control system already exist, such as digital data links, Global Positioning System (GPS), ADS-B, advanced flight deck displays and digital surface mapping. In fact, these capabilities have existed for many years, some even decades. But, the civil aviation system has not been able to incorporate such information-age innovations into its system infrastructure.

One reason for the extremely slow evolution is the certification process and the inherent cautiousness in government and industry over introducing unforeseen risks into a system where safety is a prime concern. Another reason is a challenging labor environment within the FAA air traffic organization, where system modifications can become entangled with union negotiations. While these issues are quite real, the move to a new air traffic management infrastructure is widely seen as a national necessity by nearly all parties. Yet, system progress comes at a glacial pace.

Another, more fundamental barrier to progress is the lack of operator incentives for implementing system innovations.

Traditionally, the federal government purchases, operates, and maintains ground and space-based communication, navigation, and surveillance systems. Municipalities, with support from federal and state governments, develop and operate airports. Airlines and general aviation operators, however, must purchase and maintain all their aircraft equipment with no federal support.

Thus, the FAA can design, purchase, and install only the non-airborne portion of a system-wide modernization. Airports can do the same only for the ground portion of local improvements. However, the future air traffic architecture must be an interconnected system of information exchanges and distributed decision making among all parts of the network, including every aircraft. Aircraft operators must equip with compatible hardware and systems in order for a modernized air traffic network to succeed.

Unfortunately, individual airlines and general aviation operators who are expected to pay for aircraft equipage have neither the incentives nor the money to do so. Voluntary airline equipage for air traffic control modernization has always been a problem. From an operator's view, the reason is simple: economics and risk. "Early equippers" of upgraded air traffic systems technologies take on a number of additional risks because:

- The system may not work as needed;
- Early devices and installations are more expensive;
- Proposed standards or requirements may change; and
- Better technology may overtake early systems.

Most important, "early equippers" generally receive few operating efficiency benefits until a critical mass of similarly equipped aircraft make air traffic operational changes and system efficiencies practical. Unilaterally equipping a few aircraft with digital data links, GPS position reporting, and/or reduced wake vortex designs provides no significant individual operator benefits even though they would provide major capacity and safety benefits if installed system-wide.

"Late equippers," on the other hand, face few of the early system development, design standard, cost, or installation risks. And, if the critical mass has already formed to create air traffic efficiency changes, late equippers accrue immediate operational benefits.

The results of this situation are disastrous for modernization. Individual airlines and operators clearly find it in their best interests to delay equipage, especially given their current weak financial situation. As a result, system developments are continuously deferred. Just as damaging, avionics suppliers do not aggressively develop innovative products for network improvements when there are no reliable customers. The circle is vicious and quite real.

The FAA currently has two regulatory levers it can use to address the equipage problem:

- *Establish a rule mandating equipage.* While rulemaking can be very effective, it has not been aggressively employed for operational as opposed to safety improvements. Rulemaking is typically used only when a broad new capability is clearly ready and development risks are low. It is subject to a legal process that can take significant time, and is subject to "least common denominator"

pressure to accommodate weaker or more reluctant participants. Rulemaking is also generally not "targetable," and seeks to cover a broad range of users in a single action. As a result, if a significant number of users strenuously object, the rule may not be issued or its deadline for implementation is delayed.

- *Offer equippers various levels of operational benefits.* These incentives could include preferred airspace, routings, runway access, or others. Operational benefits are limited to those aircraft or operators that can clearly exploit the advantage. Importantly, the payback for a given operational advantage is typically best seen from a total system perspective, not an individual operator perspective. Operational benefits do not typically save enough fuel or time for an individual operator that they quickly pay for themselves. Equipage proposals with such multi-year paybacks are generally rejected by a typical airline. It is also not reasonable to expect that a small aircraft operator would equip with avionics that exceed the cost of his or her aircraft.

These two levers are insufficient to motivate the aggressive operator investments in airborne equipment needed for system-wide infrastructure improvements. The Commission sees the need for more direct government action and support to overcome the equipage problem.

THE "EARLY IMPLEMENTER" CHALLENGE IS NOT UNIQUE TO AVIATION

Cities and towns that desire real estate development in an area not served by existing roads, sewers, electrical, and water utilities recognize that the first builder in an area will not pay for common infrastructure if subsequent builders do not also share the cost. Otherwise, all developers would wait for someone else to build first.

Municipalities often overcome this problem by overseeing the reimbursement of the developer who first installs the required infrastructure with fees collected from subsequent builders.

The Commission believes that airborne equipment needed for safe, secure, and efficient system-wide operations should be deemed part of the national aviation infrastructure. The FAA should be encouraged to also utilize a third incentive lever to support and motivate operator equipage. The form of that support could be any of the following:

- *Full federal funding for system-critical airborne equipment.* Even if the government fully financed the communication, navigation, and other airborne equipment required for a next-generation ATM network, the total cost would be well below the costs of system delays and inefficiencies to the national economy. In addition, it might cost less and provide additional security to equip the civil fleet with modified military technology than it would to retrofit military aircraft with civil systems.

- *Partial equipage funding.* At less cost to the government than full funding, a defined credit in the form of a voucher or tax incentives could partially offset the initial cost of equipage. The government would need to estimate the voucher value necessary to motivate early adaptation by a critical mass of aircraft operators.

- *Auctioned investment credits.* The government could motivate a limited number of installations with a credit voucher whose value is determined by an auction process. Airlines or operators could competitively bid on the offered support level until a pre-determined number of users committed to early equipage. Thus market forces would determine the minimum level of federal funding support needed to overcome the "early equipage" problem.

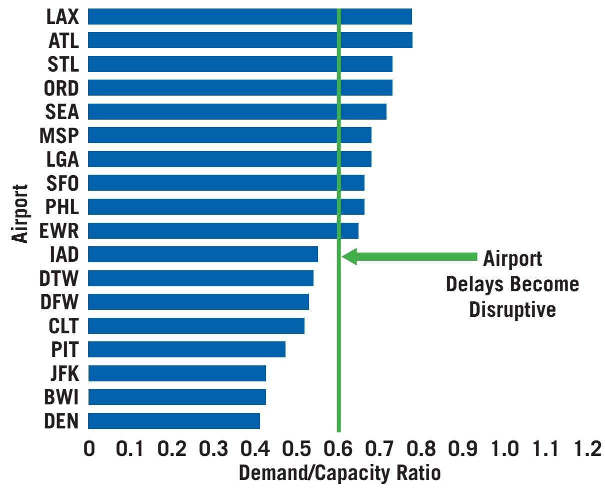
The Commission believes that the equipage problem is real, critical to future increases in the nation's air traffic capacity and must not be ignored. It makes no sense for federal and local governments to invest billions of dollars in modernizing the air traffic system infrastructure if a required piece of that infrastructure is left for voluntary funding by private entities that have little or no incentive to invest.

New Runway and Airport Development: Takes Too Long. Meeting the nation's demand for air transportation, and fully exploiting its benefits will also require a ground infrastructure that accommodates significant traffic increases. The airport infrastructure is a national asset that needs system-level attention. Many of the nation's major airports are currently operating near or at their capacity limits during large portions of the day (Figure 2-4). More significantly, airport delays begin to grow rapidly when the demand/capacity ratio reaches just 60 percent.[15] Although U.S. air passenger traffic has increased 40 percent since 1991, only 7 new major airport runways (an approximately 5 percent increase in the number of runways at the top 50 airports) and a single new major airport were constructed during that time. The Air Transport Association has noted that during that same time, 47 sports stadiums were constructed in those cities with the top 30 most delay-prone airports.

The environmental approval process, and in particular, objections to aircraft noise and emissions are the primary barriers to building new airports or adding new runways at existing airports.

The Approval Process. While many airports around the country have realized the need to add capacity, construction projects had been held up due to a lack of financial investment by the federal government and an inefficient approval process. With the passage of the Aviation Investment and Reform Act for the 21st century (AIR-21) in 2000, airports now have an increased and dependable funding stream. But lengthy and duplicative environmental reviews of proposed projects remain. As stated earlier, even without opposition, a review for a proposed airport construction project can take 10 years. In many cases, the reviews take 15 to 20 years, and some cases go on for over 20 years.

Figure 2-4 An Increasing Number of Major Airports Are Nearing Capacity Limits.

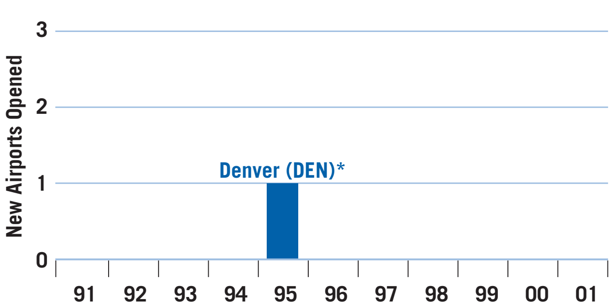


Source: FAA/George L. Donohue, Aviation Systems Engineering

Given the importance of air mobility to the national interest and the integral role that major airports play in providing that mobility, this review timeframe is simply unacceptable. It can and should be significantly shortened through federal legislation that includes the following considerations:

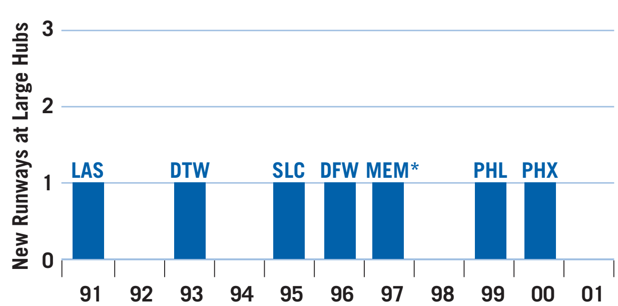
- The federal government should recognize that major airports are an instrumental part of the national air transportation infrastructure. A balance of national need with valid local priorities must be maintained.

Figure 2-5 Large Hub Airports Opened Since 1990



Note: Replaced Stapleton Airport; features five runways
Source: FAA / Air Transport Association

Figure 2-6 Major New Runways Built Since 1990



*MEM is a medium hub, but has a substantial cargo operation
Source: FAA / Air Transport Association

- The FAA should assume a lead agency role for developing and implementing a coordinated airport capacity project review process across the government. Working with aviation stakeholders, an inter-agency group should be established to develop a national plan for airport improvements that would identify critical airport capacity projects. The FAA and other federal agencies should expedite their environmental reviews as a national priority for these critical airport capacity projects. Analyses, permits, licenses, and approvals should be conducted concurrently to the maximum extent possible.
- Under current law, the FAA and other agencies must study whether a reasonable alternative exists to a proposed capacity project. At major airports where delays are significant and affect the functioning of the entire national airspace system, it should be clear that no alternative other than another capacity project at that same airport is a reasonable solution. The FAA Administrator should be able to declare an "alternatives analysis" unnecessary for projects at designated critical airports.
- Existing environmental laws and regulations should not be weakened or changed. Arguments for or against a particular project should be considered carefully and publicly, but unending delays through court challenges should be minimized. Reasonable judicial review should be conducted in the U.S. Court of Appeals or higher courts.

The Commission believes the President has taken a significant step toward implementing these actions with an Executive Order signed on September 18, 2002. The Commission believes Congressional action to support streamlined airport and runway development should now follow.

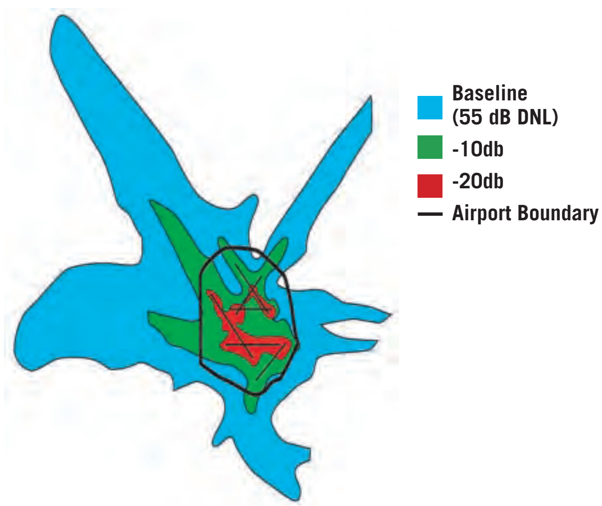
Aircraft Noise and Emissions. Aircraft noise remains the single most significant local objection to airport construction. Although airplanes are much quieter today than they were in the past, objectionable noise levels still depress local real estate values and impact the quality of life in localities receiving the economic benefits of air transport.

Aviation is a truly global enterprise. Recognizing this, the United Nations established the International Civil Aviation Organization (ICAO) to develop international aviation standards and recommended practices.

ICAO standards, a vital element of a balanced approach to environmental management, are set on the basis of "best available" aircraft noise and emissions technology. The steady progress in setting more stringent environmental standards reflects the tremendous community benefits achieved by the aviation industry through reduced aircraft noise and emissions. But, these accomplishments have only been possible because of historically well-funded public-private NASA/industry research and development partnerships responsible for the development of advanced technologies. Today, these vital programs are threatened by critical under-funding.

The substantial reduction in local noise resulting from the phase-out and conversion of noisier Stage 2 aircraft is a significant accomplishment for the nation. Of the 7.5 million people affected by unacceptable (greater than 65 dB Day-Night Level (DNL)) noise levels in 1975, less than 400,000 are affected today.[16] Airlines spent over $4 billion to achieve this end.[17] But, more remains to be done.

Figure 2-7 Computer Model Contours of Noise Boundaries Around Chicago's O'Hare Airport Show Projected Impact of Reducing Aircraft Noise



Source: NASA

With adequate research, major noise reduction breakthroughs may be possible. NASA's recently released Aeronautics Blueprint highlights a combination of engine, aerodynamics, materials, flight systems, and other technologies that offer the hope of reducing noise by 90 percent (10 dB).[18]

Yet, despite continued existence of noise problems and the possibility of significant improvements, the federal government invests only $20 million per year in basic, pre-competitive research to reduce engine and airframe noise.[19] Current funding levels are inadequate to achieve the long-term FAA goal of reducing community noise exposure to the confines of the airport, a goal dependent on NASA research and development, the seed corn of a viable U.S. commercial aviation industry.

Emissions problems are similar to the noise problem, and the two are very interrelated. The local community effect from oxides of nitrogen (NOx) and high altitude effect from carbon dioxide are becoming limiting factors to aviation's growth. Solutions to reduce noise and carbon dioxide often cause the production of nitrogen oxides to increase, creating a significant challenge to reducing noise and emissions simultaneously. In addition, carbon monoxide, unburned hydrocarbons and particulate matter, water vapor, sulfur oxides, and aromatics must also be reduced, but face similar trade-off challenges. NASA research and development programs aim to overcome these severe challenges.

Power, propulsion, and fuel design breakthroughs are achievable. However, the national research and development effort is exceedingly small compared to the magnitude of the problem and the payoff for its mitigation. The Commission believes that additional government investment in long-term research is imperative to solve the serious challenges of aircraft noise and emissions. Chapter 9 of this report further describes these needs.

Conclusions

The Commission concludes that superior mobility afforded by air transportation is a huge national asset and competitive advantage for the United States.

Because of the tremendous benefits derived from a highly mobile citizenry and rapid cargo transport, the United States must make consistent and significant improvements to our nation's air transportation system a top national priority.

TRANSFORM THE U.S. AIR TRANSPORTATION SYSTEM AS A NATIONAL PRIORITY. We need national leadership to develop an air transportation system that simultaneously meets our civil aviation, national defense and homeland security needs. Today, leadership and responsibility are dispersed among many federal, state and local organizations that impact the aviation community. In the federal government, this includes the Department of Transportation's Federal Aviation Administration, NASA, Environmental Protection Agency, and the Departments of Defense, Commerce, and State.

Often these departments and agencies deal with aviation-related issues independently, without adequate coordination, and sometimes at cross-purposes. All have separate authorizing and appropriating Congressional committees. State and local governments also play important aviation development roles and private industry has numerous near-term competing forces that often delay longer-term solutions. Only strong federal leadership, aimed at a national objective, can sustain a transformational effort.

Deploy a New, Highly Automated Air Traffic Management System. The core of an integrated 21st century transportation system will be a common advanced communications, navigation and surveillance (CNS) infrastructure and modern operational procedures. The system needs to allow all classes of aircraft, from airlines to unpiloted vehicles, to operate safely, securely, and efficiently from thousands of communities based on market size and demand. It also needs to be able to operate within a national air defense system and enable military and commercial aircraft to operate around the world in peacetime and in war.

As a first step, the Commission recommended in its second Interim Report "the Administration should immediately create a multi-agency task force with the leadership to develop an integrated plan to transform our air transportation system." This task force should be immediately assigned the leadership role to establish a Next Generation Air Transportation System Joint Program Office that brings together needed participation from the FAA, NASA, DoD, Office of Homeland Security, National Oceanographic and Atmospheric Administration, and other government organizations. Within a year, the Joint Program Office should present a plan to the Administration and the Congress outlining the overall strategy, schedule, and resources needed to develop and deploy the nation's next generation air transportation system.

As this transformational plan is developed, the FAA must continue to implement the Operational Evolution Plan. FAA and NASA must also continue to perform critical long-term research. The Commission also recommended in Interim Report #2 "the Administration and Congress should fully fund air traffic control modernization efforts in fiscal year 2003 and beyond, and prioritize FAA and NASA research and development efforts that are the critical building blocks for the future."

Provide Certification Process and Airborne Equipage Innovation. The Commission calls for a new approach to the regulation and certification of aircraft technology, processes and procedures. The government also needs new mechanisms to accelerate the equipage of aircraft in order for the nation to realize broader system benefits. Airborne equipment needed for safe, secure, and efficient system-wide operations should be deemed to be part of the national aviation infrastructure.

- *Shift from product to process certification.* Instead of a focus on rules and regulations that dictate the design and approval of each particular piece of hardware or software, the FAA should focus on certifying that design organizations have safety built into their processes for designing, testing, and assuring the performance of an overall system.
- *Solve the airborne equipage problem.* The government, in partnership with industry, must be more responsible for airborne equipment development and continuous modernization. In addition to current regulatory and operational incentives, the government should consider options to motivate a critical mass of early equippers, including full federal funding for system-critical airborne equipment, tax incentives or vouchers for partial funding support, and competitively auctioned credit vouchers.

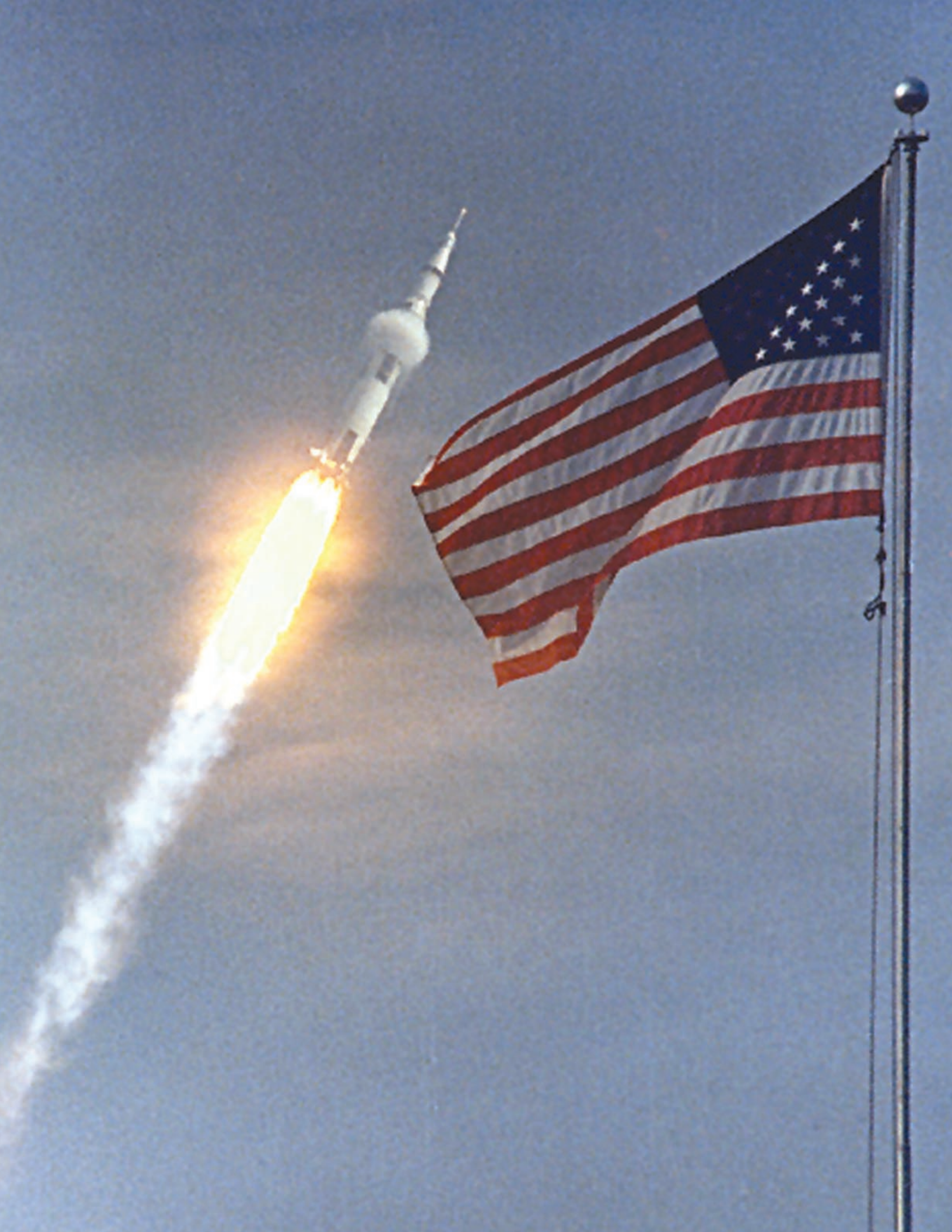
Streamline Airport and Runway Development. The FAA and other agencies should expedite new runway and airport development as a national priority. Further, because aircraft noise and emissions constrain capacity growth, additional government investment in long-term research in this area is imperative.

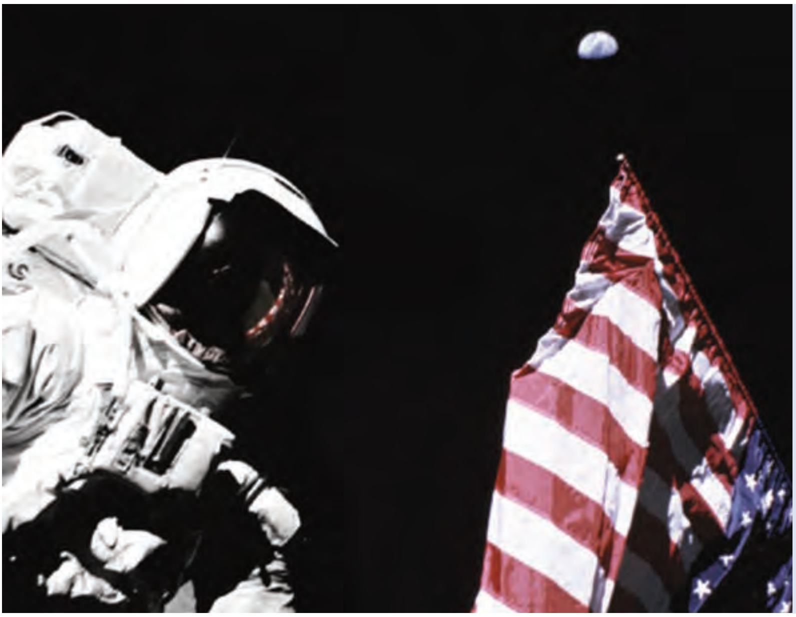
Act Now. The Commission sees compelling reasons for the Administration and Congress to take immediate action. First, new homeland security and defense requirements call for system capabilities not previously anticipated. Second, an entirely new level of transportation efficiency and national mobility can be enabled by more flexible, scalable, higher precision aviation operations. Third, inherently long lead times required for major aviation changes demand preparation far ahead of anticipated demand. And fourth, there could be no better American response after 9/11 than to rebuild the U.S. air transportation system dramatically better than it was before.

As we approach the 100th anniversary of powered flight, the Commission urges the President and Congress to recognize a pressing national need, and powerful opportunity, and **act now** to create a 21st century air transportation system.

RECOMMENDATION #2: The Commission recommends transformation of the U.S. air transportation system as a national priority. The transformation requires:

- Rapid deployment of a new, highly automated Air Traffic Management system, beyond the Federal Aviation Administration's Operational Evolution Plan, so robust that it will efficiently, safely, and securely accommodate an evolving variety and growing number of aerospace vehicles and civil and military operations;
- Accelerated introduction of new aerospace systems, by shifting from product to process certification and providing implementation support; and
- Streamlined new airport and runway development.





RECOMMENDATION #3: The Commission recommends that the United States create a space imperative. The Department of Defense, the National Aeronautics and Space Administration and industry must partner in innovative aerospace technologies, especially in the areas of propulsion and power. These innovations will enhance our national security, provide major spin-offs to our economy, accelerate the exploration of the near and distant universe with both human and robotic missions, and open up new opportunities for public space travel and commercial space endeavors in the 21st century.

Chapter 3

Space: Its Special Significance

Nations aspiring to global leadership in the 21st century must be space-faring. Freedom, mobility, quality of life and the ability to do the difficult things that define leadership will be enhanced and discovered on the space frontier. For the vision and the commitment that leadership requires, space is an imperative.

The United States should recognize the space imperative from its own history. The global legacy we achieved in the latter half of the 20th century was in large part tied to space successes. Humans on the moon, orbiting in space laboratories, space science discoveries and profound new military capabilities all played a role in showing the world our technological prowess and helped us succeed in Cold War competition.

Today, however, a sense of lethargy has infected the space industry and community. Instead of the excitement and exuberance that dominated our early ventures into space, we at times seem almost apologetic about our continued investments in the space program. Yet Japan, China, Russia, India and France, to name a few, see space as a strategic and economic frontier that should be aggressively pursued.

So should we.

Objective: The Ability to Do Great Things

The challenge we face on the space frontier is to build from dreams and concepts, to new technologies and destinations, to the political will to move forward. For nearly two decades, we have been satisfied to limit our dreams, rely upon proven technologies and invest little in building public or political support for space initiatives. But the potential to do great new things has never been clearer.

The truth is that the limitations to space progress are real: significant expense to get to orbit, a hostile and highly limited environment once on-orbit and a lack of strong public advocacy for moving ahead. We must overcome these limitations and move forward.

Issues

Access to Space: Cost to Orbit is High

Clear consensus exists in the space community that reducing the cost to orbit is an essential ingredient for progress. The expense per pound of lifting humans, cargo and satellites into orbit has effectively limited us to utilizing space for only the most critical national missions. The result has been a narrowing, rather than a broadening, of our space ambitions.

Decreasing launch costs has been a fundamental goal for the space launch industry. However, little progress has been made to date. A heavy lift Expendable Launch Vehicle (ELV) costs approximately $10,000 per pound to orbit. The Space Shuttle, although originally designed to reduce costs per pound to orbit from $10,000 to $1,000, never achieved its promised cost savings.[1]

Survey data indicate that launch demand has significantly decreased. We would expect that significantly lowering the cost to orbit might reverse this trend. A second or third generation launch vehicle based on new, advanced technology could phase out today's expensive ELV and Space Shuttle operations and open new commercial markets. Associated technology could also: improve control center operations and operational security; reduce environmental concerns; and mitigate launch, flight and recovery operational and environmental constraints. The operational model for a next generation space launch vehicle needs to move incrementally closer to the turnaround capabilities of today's passenger airline operations.

ISSUES

- Access to Space
- Propulsion for the Solar System and Beyond
- Power for Space Operations
- National Security
- Space Launch Infrastructure
- Commercial Space
- Science

Figure 3-1 NASA Derived Cost Estimate per Pound to Orbit

AVERAGE / MEDIAN US LAUNCH COSTS PER POUND					
Vehicle	**LEO (lb)**	**GTO (lb)**	**Cost Median ($M)**	**Avg. LEO Cost/lb**	**Avg. GTO Cost/lb**
Pegasus XL	975	N/A	$25	$25,652	N/A
Minotaur	1,406	N/A	$13	$8,892	N/A
Athena I	1,804	N/A	$17	$9,146	N/A
SSLV Taurus	2,904	880	$19	$6,543	$21,591
Taurus 2X10	3,036	986	$34	$11,199	$34,497
Titan II	4,180	N/A	$35	$8,373	N/A
Athena II	4,543	1,298	$24	$5,283	$18,490
Delta II 73XX	6,151	1,960	$56	$9,023	$28,313
Delta II 74XX	7,042	2,508	$56	$7,881	$22,129
Delta II 79XX	11,224	3,483	$63	$5,613	$18,090
Delta II 79XX Heavy	13,517	4,807	$70	$5,142	$14,458
Atlas IIA	16,095	6,745	$80	$4,970	$11,860
Delta III	18,238	8,382	$85	$4,661	$10,141
Delta IV M	18,920	8,580	$97	$5,127	$11,305
Atlas IIAS	18,960	8,182	$98	$5,143	$11,917
Atlas IIIA	19,008	8,881	$95	$4,972	$10,640
Atlas IIIB	23,580	9,849	$95	$4,008	$9,594
Atlas V 400	27,500	11,000	$99	$3,582	$8,955
Delta IV M+	29,920	13,464	$97	$3,242	$7,204
Atlas V 500	44,110	18,040	$114	$2,584	$6,319
Titan IVB	47,696	19,000	$400	$8,386	$21,053
Delta IV H	56,760	27,280	$155	$2,731	$5,682
Average Cost/lb				**$6,916**	**$15,124**
Median Cost/lb				**$5,213**	**$11,888**

LEO: Low Earth Orbit **GTO: Geostationary Transfer Orbit**

Reducing the cost to orbit could change the economic calculus of space. The use of revolutionary reusable launch vehicles (RLV) is well within our grasp in this decade. Developing the next generation of RLVs (in low, medium and heavy lift configurations) could dramatically improve both the affordability and reliability of access to space. The National Aeronautics and Space Administration (NASA) and Department of Defense (DoD) have begun discussions to achieve this goal.

NASA's Space Launch Initiative (SLI) is a funded development effort intended to look at more reliable, cheaper and more frequent access to space through the development of a second generation reusable launch system. However, to date, NASA's SLI program does not include funding for demonstration flights.

Whereas the National Aerospace Initiative (NAI), a joint DoD and NASA program, is focused on exploiting and developing new and innovative technological capabilities in the areas of high-speed/hypersonics, access-to-space and space technology. The NAI will develop and demonstrate a portfolio of critical technologies that will enable the achievement of many common DoD and NASA goals such as: supersonic/hypersonic capabilities; safe, affordable, launch on demand space access; and responsive payloads for quick deployment and employment of space capabilities.

Prototype of a NASA X-38 Crew Return Vehicle.

Space Shuttle Launch from the Kennedy Space Center, Florida.

Integrating the SLI and NAI initiatives could provide the nation with RLV technologies needed to enable the development of revolutionary air and space systems. The DoD could contribute significantly to air-breathing propulsion technologies, serving air mission needs and simultaneously providing a first stage platform for an RLV. NASA is working toward a next generation spacecraft that could provide a powered crew vehicle as a second stage of a two-stage RLV.

"Attempts at developing breakthrough space transportation systems have proved illusory."

Commissioner Buzz Aldrin

The Commission believes that the nation would benefit from a joint effort by NASA and DoD to significantly reduce the cost and time required to access space by integrating NAI and SLI. Such an effort would not only build on the capabilities of both organizations but also provide the "critical mass" of funding needed to create the necessary breakthroughs in propulsion.

Propulsion for the Solar System and Beyond: In Need of Breakthrough

To date, all spacecraft that have left Earth have simply coasted to their destination on ballistic trajectories. After they leave low-Earth orbit, their engines generally do not turn on again until it is time to slow down at the destination. In some cases the spacecraft gain additional energy along trajectories that "sling shot" them past other planets. Transit times will be significantly reduced if fuel were burned along the way, vastly increasing the craft's speed.

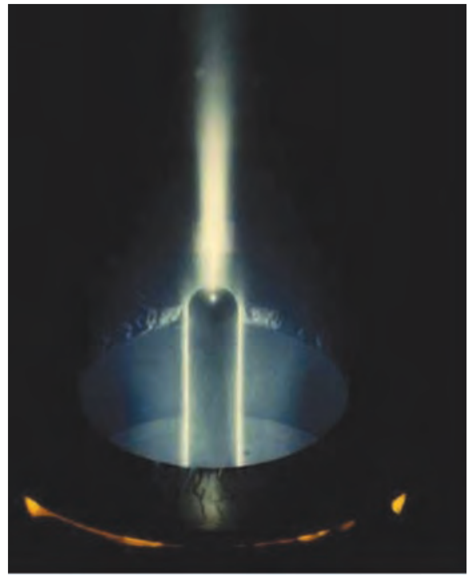
Over the longer term, investment in the development of more advanced propulsion systems (e.g., nuclear—by splitting or fusing atoms—to produce hot plasmas, matter/anti-matter annihilation reactions) will lead to faster transit times, improve operational flexibility and reduce the radiation impacts for long duration human exploration missions.

Nuclear energy could produce a high-temperature plasma that would potentially reduce the transit time for a manned mission to Mars from seven or eight months to about twelve weeks. Since powered flight would be much less dependent on orbital mechanics, the crew would also benefit from having the flexibility to return to Earth on their own schedule. A successful plasma design would reduce transit times and also result in a tremendous advantage for spacecraft payloads since less weight would have to be allotted for fuel. NASA and the Department of Energy (DOE) currently conducts antimatter research. Although matter/antimatter reactions as a source of propulsion are far from being reality, the initial research results are encouraging. See Chapter 9 for additional information on propulsion.

Figure 3-2 Example Transit Times to Mars for Different Propulsion Types

Destination	Propulsion	Transit Time - One Way
Mars	Chemical / Gravity Assist	28 - 32 weeks
Mars	Nuclear / Plasma	12 weeks
Mars	Antimatter	6 weeks

Source: NASA



Plasma propulsion will help reduce transit times through the solar system.

The Commission believes that, once the time to explore many parts of the solar system has been reduced to reasonable durations—months instead of years—the political imperative to do so will follow.

Power for Space Operations: A Limiting Factor

What limits the performance of most spacecraft, including the International Space Station (ISS), is the amount of power that can be generated from solar energy. Increasing available power, both on orbit and beyond orbit, could expand opportunities in military, civil, and commercial space applications.

The Commission believes that the nation would benefit from a joint effort by NASA and DoD to significantly reduce the cost and time required to access space.

International Space Station, October 16, 2002.

The concept of using solar power satellites to beam power to Earth has been a distant dream. But, the use of such satellites as a "refueling station," to collect solar energy and beam it to on-orbit assets is worth exploring.

Solar or nuclear power stations capable of supplying on-orbit power could also have commercial potential. Selling power as a space utility is the kind of business arrangement that the space community has long needed. The enhanced power would prove to be a huge benefit to ISS. It could provide sufficient energy to conduct commercial activities not now possible within the station's limited power capabilities.

In addition, others looking to commercial use of space could design their own free-flyer modules equipped with an antenna to receive power, thus needing little more than an emergency backup capability on board. See Chapter 9 for additional information on power.

The Commission believes that once there is affordable, abundant power in orbit, public and private investments in space systems and exploration will follow.

National Security: Not Capitalizing on Space-Based Opportunities

The U.S. military continues to benefit from a generation of satellites that were built during the Cold War. Advanced technologies, however, will open up opportunities for a new generation of space capabilities, such as laser communications, space-based radar and on-demand access to space. These would transform military operations while simultaneously addressing other national needs, such as homeland defense and air transportation.

MILITARY USE OF SPACE. The military will increasingly rely on space-based communications, navigation, surveillance and reconnaissance systems for: moving its forces around the world; conducting global, precision power projection operations; and defending the homeland. The military and intelligence community will also use global reconnaissance and surveillance systems to continuously monitor the intentions and actions of terrorists, rogue nations and emerging world powers. The civil aviation system should use these same capabilities to improve dramatically the safety, security and capacity of the nation's air transportation system.

The Titan IVB is the largest unmanned space booster used by the Air Force.

Planetary Defense. Near-Earth Objects (NEOs) pose a potentially serious threat for humankind. Scientists are now certain that a major asteroid or comet was responsible for the mass extinction of the dinosaurs.

The U.S. Air Force (USAF) is currently conducting concept exploration studies for a constellation of satellites designed to detect and track man-made satellites in Earth's orbit.[2] The Commission believes that these studies should be broadened to include detection of asteroids. U.S. Strategic Command officials are also reviewing a concept for a clearinghouse that gathers and analyzes data on potential Earth impacts from asteroids. In addition, the National Security Space Architect is currently, as part of the Space Situational Awareness Architecture, integrating the use of space and ground-based surveillance systems. Given these actions, planetary defense should be assigned to DoD in cooperation with NASA.

The Commission believes that the nation needs a joint civil and military initiative to develop a core space infrastructure that will address emerging national needs for military use and planetary defense.

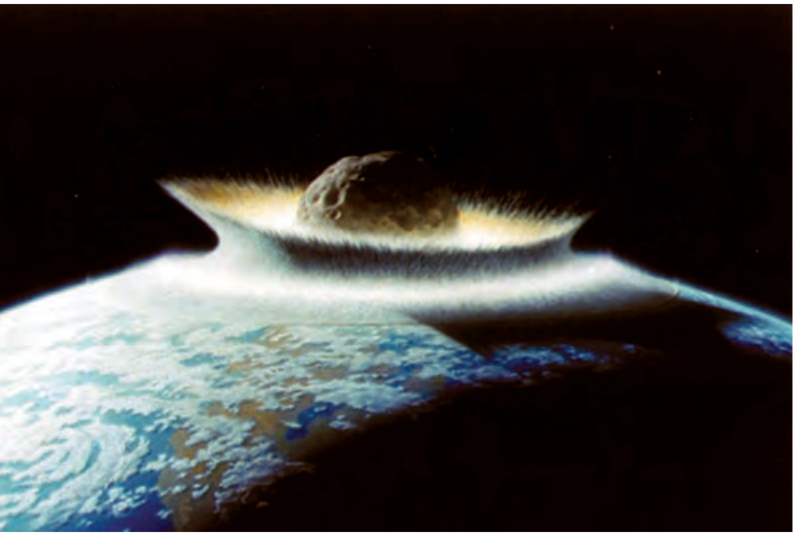
Space Launch Infrastructure: Aging

The current replacement value (CRV) of infrastructure at NASA's Kennedy Space Center (KSC) is estimated to be $3.9 billion; and $3.0 billion at DoD's Cape Canaveral Air Force Station (CCAFS). Current maintenance funding at KSC is below the National Research Council's recommended minimum of 2 to 4 percent of CRV. NASA's investment has been about 1.5 percent of CRV.

As a result, at NASA's KSC:[3]

- The cable plant has 275 miles of tar-paper ducts that are collapsing; the air pressurized cable jackets are failing to keep water out thus producing shorts; and cable insulation in the plant is deteriorating leaving bare wire exposed.
- The Vehicle Assembly Building has sustained siding and bolt failures due to hurricanes and seasonal high winds. Its 35 year-old roof requires frequent external patching, and platforms and nets have been installed below the roof deck to catch falling debris. Overall, the structure is badly deteriorated and severely corroded.
- Ten miles of 4-inch high-pressure gaseous nitrogen and helium pipelines to the Space Shuttle launch

Artist's concept of a catastrophic asteroid impact with the Earth. Life near the impact would be instantly wiped out from the effects of high temperatures and pressures.



The Crawler/Transporters, used to move the assembled Space Shuttle system to the launch pad, are over 30 years old.

complexes are also 35 years old and severely corroded.

- The Crawler/Transporters, used to move the assembled Space Shuttle system to the launch pad, are over 30 years old, reaching the end of their useful life, and many subsystems are unsupportable due to age.
- The checkout, control and monitoring subsystem developed in the 1970s for shuttle testing and launch is so old that there aren't enough spare parts for 10 percent of its components. NASA began to upgrade this subsystem in 1996, but it will not be completed until 2007.

DoD support infrastructure at CCAFS has similar problems:[4]

- Many systems have numerous components that have exceeded their life expectancy. This includes electrical distribution; water distribution; waste water system; heating, ventilation and air conditioning; and fire protection systems; as well as the airfield.
- Some supporting infrastructure systems are 45 to 55 years old.
- Multiple components have no replacement parts due to either obsolete technology or no manufacturer.
- A corrosive environment leads to unplanned failures.

The Commission believes that clearly a new structure for operation and management structure for these space facilities would be desirable. Such a structure would have to take into account the different missions of the USAF and NASA while at the same time assuring timely and consistent upgrades of vital infrastructure. Therefore, the USAF and NASA should explore privatization and "municipalization" options to deal with their space infrastructure problems. NASA should also consider encouraging additional public and private investment in its field centers by turning over day-to-day management responsibilities to state government, universities and/or companies. This could also help deal with the problem of operational costs.

Commercial Space: A Capacity and Demand Mismatch

In the future, the civil and commercial sectors will look to space for new products and services that will create new markets, much as they did for telecommunications and commercial remote sensing. The scientific community will have the opportunity to explore the universe and gain access to information about our planet, its atmosphere and the solar system. The public will benefit by having the opportunity some day to live, work, and vacation in space.

But the reality is that today we are not even close to achieving those opportunities and dreams. Domestic launch vehicle capacity and satellite manufacturing capabilities far exceed both domestic and international launch market demand. The U.S. commercial space industry continues to lose access to markets as demand decreases and international competition increases. This industry segment will not overcome these obstacles without government support. New regulations and incentives will be necessary to bolster this important market until there is a turnaround in demand, not unlike what was done in the early rail and airline industries. Additionally, if government expects industry to be a partner in developing the

Kennedy Space Center's Vehicle Assembly Building.

tremendous expensive supporting infrastructure, then there must be an expectation that these investments will result in a strong business case. Data from the Federal Aviation Administration (FAA) shows a decline in launch activity since 1967. See Figure 3–3.

The launch activity forecast shows that most organizations expect launch service demand to continue to decrease. While the ability to forecast launch demand is not an exact science, the agencies and organizations providing this information all agree on the declining trend.

Launch demand trends hold little promise for resurgence in the U.S. space launch industry.

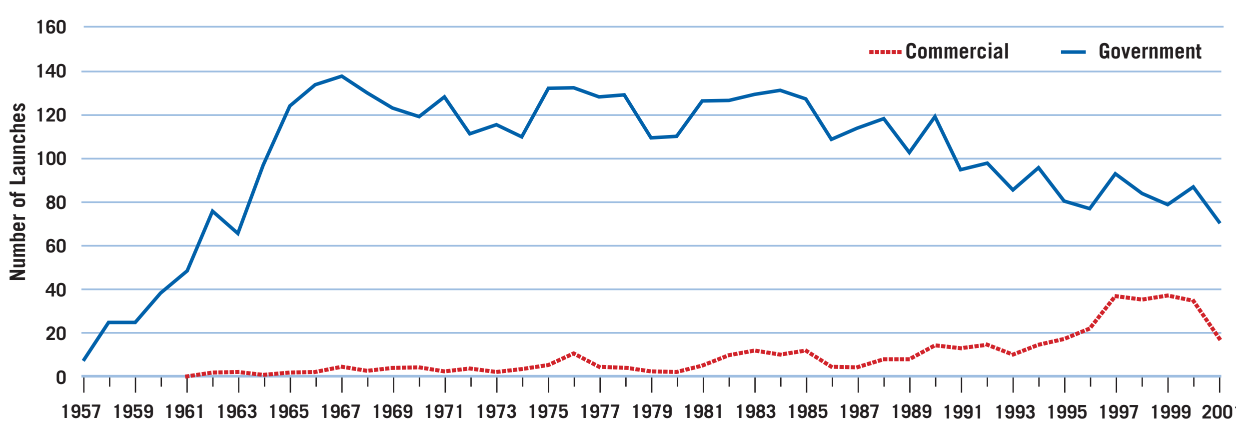
Both launch activity and their associated revenues are declining. Overall, the FAA recorded 16 worldwide commercial orbital launches in calendar year 2001. (See Figure 3-3.) This number is significantly less than in prior years. There were 39 in 1999 and 35 in 2000. Arianespace captured 50 percent of the world market during 2001. In that year, the United States and Russia each had 19 percent, while the Sea Launch Company had 12 percent. Revenues from the 16 commercial launch events in 2001 were an estimated $1.5 billion, a 44 percent decrease from the 2000 total of approximately $2.7 billion. European revenues were estimated at about $948 million, while Russian revenues were about $178 million, Sea Launch earned approximately $170 million, and U.S. commercial launch revenues were about $167 million. Launch revenues are attributed to the country in which the primary vehicle manufacturer is based, with the exception of Sea Launch, which is a multinational company.[5]

The FAA continues to scale back its forecast of commercial launch activity over the next decade. It expects that 268 commercial launches will take place during the next decade—a figure that is 16.5 percent lower than the agency's forecast in 2001.[6]

The Teal Group, a national research organization, publishes an annual forecast of "proposed payloads" for launch. While this is a slightly different approach to the FAA model, the data show a corresponding decrease for the next decade of about 18.4 percent for these four worldwide categories of payloads: commercial, military, civil, and university/other. The Teal Group outlook for just the commercial sector shows a "23 percent decline compared to last year , and a 47 percent drop compared to our 2000 model."[7]

Space Tourism and Launch Markets. To understand future dynamics for launch markets, NASA commissioned the ASCENT Study as part of the

Figure 3-3 Historical Commercial and Government Launches (1957-2001)



Source: FAA

SLI. This study concluded that the only space launch sector with growth potential over the next two decades is passenger space travel. All other sectors—both commercial and governmental—have flat-line outlooks.

Throughout the period 2002 through 2020, the forecast for launches is, in essence, constant at between 60 to 80 launches per year. The figure below provides a forecast for public space travel over that period. The forecast assumed a cost of $20 million per seat for an orbital flight and was based on a highly credible survey of public space travel, where a statistically valid sample of high net worth individuals was interviewed. Seven percent of the sample indicated that they would be willing to pay $20 million for an orbital flight, if available.

Respondents to the ASCENT Study survey were aware that it would be necessary to go to Russia for a six-month training period and would be a risky venture. To arrive at projected launch forecasts, the survey responses were discounted for a number of considerations, such as health, and in order to allow a build-up curve for this new industry to become established. Even with these caveats, there is a potential demand for 50 passengers a year at current prices. Most of the respondents, however, indicated a preference for training and flying from the United States. The survey results also showed that demand for a 15-minute sub-orbital flight costing $100,000 could produce a market for up to 500 passengers per day by 2020.[8]

While today there is an extremely limited number of people in the world who can afford a $20 million vacation, we should marvel not at the price but at the fact that the demand exists at all. Given what people do spend on vacations and amusement park rides and adventure travel, we have no reason to doubt that the demand will rise without limit as the price drops.

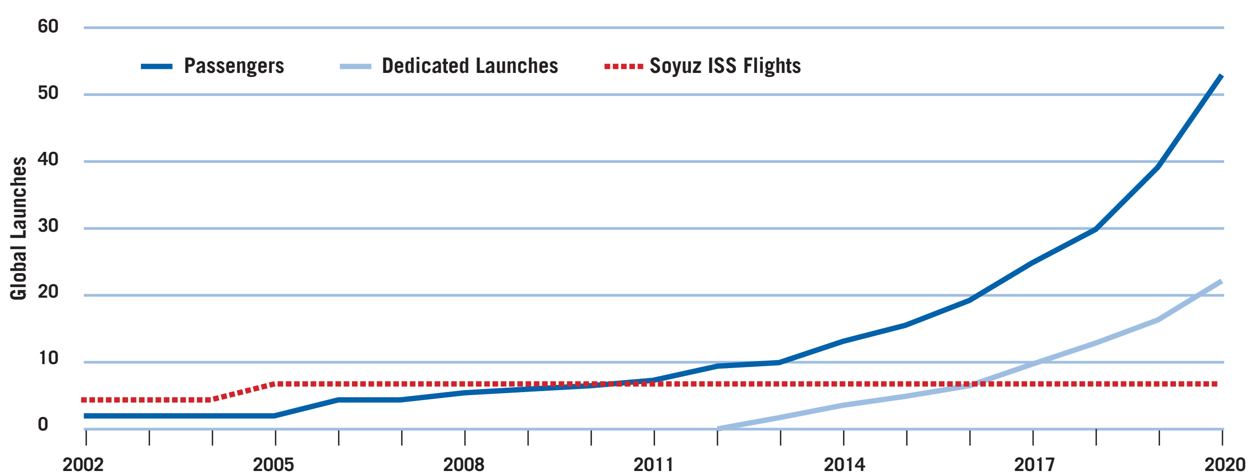
The Commission believes that there are opportunities to help alleviate the capacity and demand mismatch in the commercial launch market. Space tourism markets may be key to help fund the launch industry through the current market slump by providing increased launch demand and thus helping to drive launch costs down.

Science: Untapped Opportunities

The quest for knowledge, which has universal appeal, brings with it the need for attendant technological and engineering feats that make discovery possible.

These feats will afford the scientific community the opportunity to explore the universe and gain access to information about the planet, its atmosphere and the solar system. Basic science can produce more and

Figure 3-4 Public Space Travel Forecasts (Orbital)

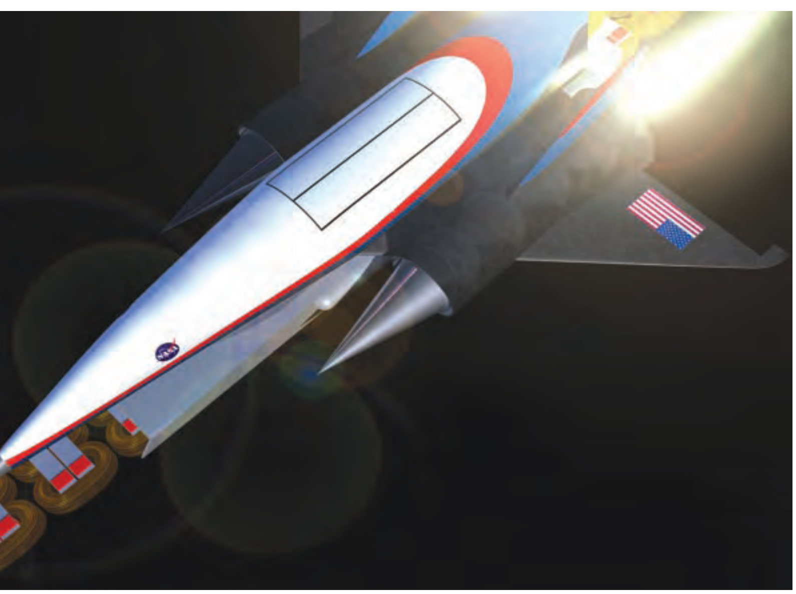


Source: NASA

more insights about our relationship to the universe through increasingly sophisticated astronomical missions. Science can help us find laboratory solutions to high-end technologies, such as anti-matter and anti-gravity propulsion concepts. Science can use on-orbit assets to develop consumer products in pharmaceuticals and materials. The frontiers of science are extended significantly by expanding our reach into new environments and shrinking the boundaries of the unknown. What follows is a short list of what could be done.

Access to space allows us to answer some of the basic questions about our universe and ourselves. With the discovery of sub-surface water on Mars and billion-year-old oceans beneath frozen ice sheets on Jupiter's moon Europa, the prospect of finding life in places other than Earth are higher than ever. If life once thrived on Mars but is now extinct, planetary geologists will need the services of paleontologists.

Why did the running water once on the surface of Mars disappear? What atmospheric instability destroyed its ecosystem, leading to this catastrophe? Why does the planet Venus, often called Earth's twin for its similarity in size and mass, have a runaway greenhouse effect? What went wrong there? How will the answers to these questions help us protect the stability of our own atmosphere?



Space tourism could create a demand for a commercial spaceliner, like this artist concept.

Asteroids are remarkable resources of minerals and heavy metals. While not all of their material is economically feasible to mine and return to Earth, it may be possible to extract materials for delivery to other planets, where expeditions are underway. In any case, we will want to learn how to land on asteroids and analyze their makeup. The day will arrive when an asteroid is discovered on a collision course with Earth. The more we know about their orbit and structure, the more effective we can be in attempting to deflect it from harm's way.

Space also provides science with the opportunity to look at the origins and future of the universe. Earth's surface is one of the worst places to build a telescope. Our atmosphere is largely opaque to gamma rays, x-rays, and ultraviolet light, and wreaks havoc with the infrared spectrum. Furthermore, our turbulent atmosphere, and the radio and light emanations of civilization are incompatible with high-quality observational data. Earth orbit, such as where we operate the Hubble Space Telescope, provides a much better environment for such research. But other orbits are also possible, such as the stable Lagrangian points of either the Earth-Moon or the Sun-Earth systems. Another location for telescopes is the far side of the Moon, which is completely shielded from Earth's cacophony of radio signals. This radio-quiet zone would enable astrophysicists to observe all windows to the universe, pollution-free, and continue a century of cosmic discovery unmatched in recorded history.

The Commission believes that this search for cosmic knowledge will not only answer fundamental questions, but also inspire our children and provide a source of future products and services. This will require that the U.S. government sustain its long-standing commitment to science and space technology and continue to focus on internationally cooperative efforts in the future.

Mining the moon for ores and isotopes might make sound commerical business opportunities in the future.

Conclusions

The Commission concludes that the nation will have to be a space-faring nation to be the global leader in the 21st century—our freedom, mobility, and quality of life will depend on it. America must explore and exploit space to assure national and planetary security, economic benefit and scientific discovery. At the same time, the United States must overcome the obstacles that jeopardize its ability to sustain leadership in space.

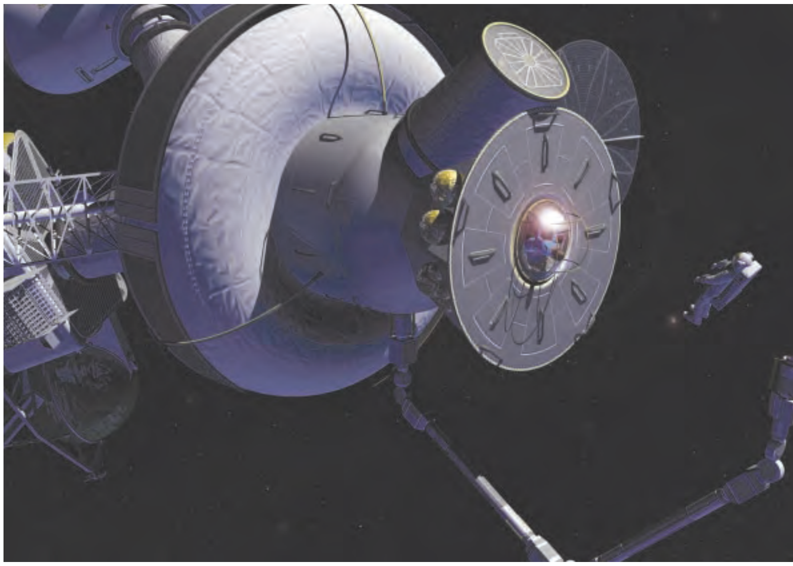
ACHIEVE BREAKTHROUGHS IN PROPULSION AND SPACE POWER. The ability to access space and travel through the solar system in weeks or months instead of years would help create the imperative to do so. Propulsion and power are the key technologies to enable this capability. Future progress in these areas will result in new opportunities on Earth and open the solar system to robotic and human exploration—and eventual colonization. The nation would benefit from a joint effort by NASA and DoD to reduce significantly the cost and time required to access and travel through space.

DEVELOP A NEXT GENERATION COMMUNICATION, NAVIGATION, SURVEILLANCE AND RECONNAISSANCE CAPABILITY. The nation needs real-time, global space-based communications, navigation, surveillance and reconnaissance systems for a wide range of applications. These capabilities will provide the military with the ability to move its forces around the world, conduct global precision strike operations, defend the homeland, and provide for planetary defense. The civil and commercial sectors will also benefit from these capabilities for air transportation management, monitoring global climate change, weather forecasting and other applications. The federal government needs a joint civil and military initiative to develop this core infrastructure.

REVITALIZE THE U.S. SPACE LAUNCH INFRASTRUCTURE. NASA and DoD must maintain and modernize their space launch and support infrastructure to bring them up to industry standards. They should implement our recommendations contained in Interim Report #3 concerning federal spaceports, enhanced leasing authority, and utility privatization and "municipalization." We recommended that DoD and NASA should:

- Investigate the feasibility of establishing a national spaceport structure at KSC and CCAFS under a single management system; and

A logistics depot in space for human exploration of the solar system.



- Seek Congressional approval for
  - Enhanced leasing authority that allows them to lease real property at fair market value and retain lease proceeds to cover the total costs incurred at KSC and CCAFS; and
  - Privatization of NASA utilities at KSC and CCAFS to overcome the budget burdens associated with capital improvements to outdated infrastructure.

In addition, NASA and DoD need to make the investments necessary for developing and supporting future launch capabilities. To deal with the problem of operating costs, NASA should also consider turning over day-to-day management responsibilities for its field centers to state governments, universities, or companies.

Provide Incentives to Commercial Space. Government and the investment community must become more sensitive to commercial opportunities and problems in space. Public space travel may constitute a viable marketplace in the future. It holds the potential for increasing launch demand and improvements in space launch reliability and reusability. Moreover, it could lead to a market that would ultimately support a robust space transportation industry with "airline-like operations." The government could help encourage this by allowing NASA to fly private citizens on the Space Shuttle.

Sustain Commitment to Science and Space. The U.S. government should continue its long-standing commitment to science missions in space and focus on internationally cooperative efforts in the future.

RECOMMENDATION #3

The Commission recommends that the United States create a space imperative. The Department of Defense, the National Aeronautics and Space Administration and industry must partner in innovative aerospace technologies, especially in the areas of propulsion and power. These innovations will enhance our national security, provide major spin-offs to our economy, accelerate the exploration of the near and distant universe with both human and robotic missions, and open up new opportunities for public space travel and commercial space endeavors in the 21st century.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RECOMMENDATION #4: The Commission recommends that the nation adopt a policy that invigorates and sustains the U.S. aerospace industrial base. This policy must include:

- Procurement policies which include prototyping, spiral development, and other techniques which allow the continuous exercise of design and production skills;
- Stable funding for core capabilities, without which the best and brightest will not enter the defense industry;
- Removing barriers to international sales of defense products;
- Removing barriers to defense procurement of commercial products and services;
- Propagating defense technology into the civil sector, particularly in communication, navigation and surveillance; and
- Sustaining critical technologies that are not likely to be sustained by the commercial sector, e.g., space launch, solid rocket boosters, etc.

Chapter 4

National Security: Defend America and Project Power

For at least the next quarter century or more, the effectiveness of the American defense posture will be a crucial determinant of world peace, prosperity, and stability. The relationship between advanced technology and national security is a metaphor for the manner in which our society will grow and prosper in the 21st century.[1] It is essential that the public policy environment in the 21st century reflect an appreciation of these circumstances.

During the 20th century, the development of advanced technology for national security applications stimulated the introduction and diffusion of such technology to the world. The policy and institutional setting of the 20th century will not work for the 21st. In the 21st century, the sources of the enabling technologies for vital military capabilities will be in both the commercial and the defense sectors. The co-dependence of the commercial and military sectors for advanced technology development and applications requires new approaches to the policy environment that sustains the defense component of the aerospace sector.

The core competencies of the U.S. defense industrial sector—systems engineering and system(s) integration—are the decisive enabling skills that must transform widely accessible technologies into superior military capabilities. The transformation of the U.S. defense posture, from one dependent on industrial

> Before the war in Afghanistan, that area was low on the list of major planning contingencies. Yet, in a very short time, we had to operate across the length and breadth of that remote nation, using every branch of the armed forces. We must prepare for more such deployments by developing assets such as advanced remote sensing, long-range precision strike capabilities, and transformed maneuver and expeditionary forces. This broad portfolio of military capabilities must also include the ability to defend the homeland, conduct information operations, ensure U.S. access to distant theaters, and protect critical U.S. infrastructure and assets in outer space.
>
> National Security Strategy, September 20, 2002

age technology to one led by the technologies of information and decision superiority, will require the modernization of existing policies, institutions, and public resource allocation.

The Contribution of Aerospace to National Security

Defending our nation against its enemies is the first and fundamental commitment of the federal government.[2] This translates into two broad missions—Defend America and Project Power—when and where needed.

In order to defend America and project power, the nation needs the ability to move manpower, materiel, intelligence information and precision weaponry swiftly to any point around the globe, when needed. This has been, and will continue to be, a mainstay of our national security strategy.

The events of September 11, 2001 dramatically demonstrated the extent of our national reliance on aerospace capabilities and related military contributions to homeland security. Combat air patrols swept the skies; satellites supported real-time communications for emergency responders, imagery for recovery, and intelligence on terrorist activities; and the security and protection of key government officials was enabled by timely air transport.

As recent events in Afghanistan and Kosovo show, the power generated by our nation's aerospace capabilities is an—and perhaps **the**—essential ingredient in force projection and expeditionary operations. In both places, at the outset of the crisis, satellites and reconnaissance aircraft, some unmanned, provided critical strategic and tactical intelligence to our national leadership. Space-borne intelligence, command, control and communications assets permitted the rapid targeting of key enemy positions and facilities. Airlifters and tankers brought personnel, materiel, and aircraft to critical locations. And aerial bombardment, with precision weapons and cruise missiles, often aided by the Global Positioning System (GPS) and the Predator unmanned vehicle, destroyed enemy forces. Aircraft carriers and their aircraft also played key roles in both conflicts.

Today's military aerospace capabilities are indeed robust, but at significant risk. They rely on platforms and an industrial base—measured in both human capital and physical facilities—that are aging and increasingly inadequate. Consider just a few of the issues:

- Much of our capability to defend America and project power depends on satellites. Assured reliable access to space is a critical enabler of this capability. As recently as 1998, the key to near- and mid-term space access was the Evolved Expendable Launch Vehicle (EELV), a development project of Boeing, Lockheed Martin and the U. S. Air Force. EELV drew primarily on commercial demand to close the business case for two new launchers, with the U.S. government essentially buying launches at the margin. In this model, each company partner made significant investments of corporate funds in vehicle development and infrastructure, reducing the overall need for government investment. Today, however, worldwide demand for commercial satellite launch has dropped essentially to nothing—and is not expected to rise for a decade or more—while the number of available launch platforms worldwide has proliferated. Today, therefore, the business case for EELV simply does not close, and reliance on the economics of a commercially-driven market is unsustainable. A new strategy for assured access to space must be found.

Today, the business case for EELV simply does not close and reliance on the economics of a commercially-driven market is unsustainable.

- The U.S. needs unrestricted access to space for civil, commercial, and military applications. Our satellite systems will become increasingly important to military operations as today's information revolution, the so-called "revolution in military affairs," continues, while at the same time satellites will become increasingly vulnerable to attack as the century proceeds. To preserve critical satellite networks, the nation will almost certainly need the capability to launch replacement satellites quickly after an attack. One of the key enablers for "launch on demand" is reusable space launch, and yet within the last year all work has been stopped on the X-33 and X-34 reusable launch programs

- The challenge for the defense industrial base is to have the capability to build the base force structure, support contingency-related surges, provide production capacity that can increase faster than any new emerging global threat can build up its capacity, and provide an "appropriate" return to shareholders. But the motivation of government and industry are different. This is a prime detraction for wanting to form government-industry partnerships. Industry prioritizes investments toward near-term, high-return, and high-dollar programs that make for a sound business case for them. Government, on the other hand, wants to prioritize investment to ensure a continuing capability to meet any new threat to the nation. This need is cyclical and difficult for businesses to sustain during periods of government inactivity. Based on the cyclic nature of demand, the increasing cost/complexity of new systems, and the slow pace of defense modernization, aerospace companies are losing market advantages and the sector is contracting. Twenty-two years ago, today's "Big 5" in aerospace were 75 separate companies, as depicted by the historical chart of industry consolidation shown in Chapter 7.

One of the key enablers for "launch on demand" is reusable space launch, and yet within the last year all work has been stopped on the X-33 and X-34 reusable launch programs.

> "Our goal is not to bring war into space, but rather to defend against those who would. Protecting U.S. military and commercial assets in space from attack from foreign aggressors must be a priority in the 21st century."
>
> Defense Secretary Donald Rumsfeld[3]

- Tactical combat aircraft have been a key component of America's air forces. Today, three tactical aircraft programs continue: the F/A-18E/F (in production), the F/A-22 (in a late stage of test and evaluation), and the F-35 Joint Strike Fighter (just moving into system design and development). Because of the recentness of these programs, there are robust design teams in existence. But all of the initial design work on all three programs will be completed by 2008. If the nation were to conclude, as it very well may, that a new manned tactical aircraft needs to be fielded in the middle of this century, where will we find the experienced design teams required to design and build it, if the design process is in fact gapped for 20 years or more?

- More than half of the aerospace workforce is over the age of 40[4], and the average age of aerospace defense workers is over 50.[5] Inside the Department of Defense (DoD), a large percent of all scientists and engineers will be retirement eligible by 2005. Given these demographics, there will be an exodus of "corporate knowledge" in the next decade that will be difficult and costly to rebuild once it is lost. There will be a critical need for new engineers, but little new work to mature their practical skill over the next several decades. Further, enrollment in aerospace engineering programs has dropped by 47 percent in the past nine years[6], and the interest and national skills in mathematics and science are down. Defense spending on cutting-edge work is at best stable, and commercial aircraft programs are struggling and laying workers off. As the DoD's recent Space Research and Development (R&D) Industrial Base Study[7] concluded, "[s]ustaining a talented workforce of sufficient size and experience remains a long-term issue and is likely to get worse." In short, the nation needs a plan to attract, train and maintain a skilled, world-class aerospace workforce, but none currently exists.

- The current U.S. research, development, test and evaluation (RDT&E) infrastructure has a legacy dating back to either World War II or the expansion during the Space Age in the 1960s. It is now suffering significantly from a lack of resources required for modernization. In some cases, our nation's capabilities have atrophied and we have lost the lead, as with our outdated wind tunnels, where European facilities are now more modern and efficient. In the current climate, there is inadequate funding to modernize aging government infrastructure or build facilities that would support the development of new transformational capabilities, such as wind tunnels needed to design and test new hypersonic vehicles. The aerospace industry must have access to appropriate, modern facilities to develop, test and evaluate new systems.

Throughout this dynamic and challenging environment, one message remains clear: a healthy U.S. aerospace industry is more than a hedge against an uncertain future. It is one of the primary national instruments through which DoD will develop and obtain the superior technologies and capabilities essential to the on-going transformation of the armed forces, thus maintaining our position as the world's preeminent military power.

Objective: A Safe and Secure World

The U.S. aerospace industry's future contribution to national security is captured in the Commission's overall vision of "Anyone, Anything, Anywhere, Anytime". For national security, this provides the ability to:

- Rapidly, safely, and securely send and receive information;
- Move troops, equipment, and supplies to anywhere on the globe or into space, at anytime; and
- Prosecute effects-based warfare.

National security organizations must be able to monitor, detect, neutralize and/or defeat future conventional and asymmetric threats anywhere in the world by applying new technologies and operational capabilities to implement our national security strategy and address our national security needs.

Included in these capabilities are a better understanding of space situational awareness and more serious attention to the threat to global security posed by space debris and by Near-Earth Objects, such as asteroids. Space- and ground-based surveillance systems can provide time-critical detection of these threats, making a valuable contribution to this emerging and very demanding national security requirement. The issue of planetary defense is also discussed in Chapters 3 and 6.

To deliver the required capabilities and to address any national security needs quickly and affordably, the U.S. must possess an aerospace industry that is 'right-sized', healthy, highly flexible, and responsive to its customers. The government can help by removing unnecessary paperwork and oversight on government programs and eliminating restrictions on contractor-developed intellectual property. It can also help by continuing to increase investment in

DoD TRANSFORMATION GOALS[8]

- Defend the U.S. homeland and other bases of operation, and defeat nuclear, biological and chemical weapons and their means of delivery
- Deny enemies sanctuary—anytime, anywhere
- Project and sustain forces in distant theaters in the face of access denial threats
- Conduct effective operations in space
- Assure information security and conduct effective information operations
- Provide a common operational picture for joint forces

next-generation aerospace capabilities. Increased investment will have the dual effect of improving defense capabilities and attracting the "best and brightest" workforce to the aerospace sector.

Issues

Enhancement and, indeed, the preservation of our current military capabilities in air and space require a comprehensive, cross-cutting national industrial base policy. Many elements of such a policy are discussed in this report.

The Commission believes that the key to any policy is maintaining the manufacturing capacity and human capital required to build, integrate and maintain aerospace systems. There are three key elements of such a policy: (1) sustaining the defense industrial base; (2) building experience in the workforce; and (3) maintaining our critical national infrastructure.

ISSUES

- The Defense Industrial Base
  - Funding
  - Transnational Partnerships and International Sales
  - Defense Procurement of Commercial Products and Services
  - Transition of Defense Technologies to Civil Applications
  - Technology Insertion and Operational Support for Defense Systems
- Experience in the Workforce
  - Opportunities to Learn
  - Skills Transfer to the Next Generation
  - Intellectual Capital
- Critical National Infrastructure
  - Facilities
  - Capabilities

The Defense Industrial Base: Consolidations and Unstable Demand

In the past, the DoD had the luxury of drawing on a large workforce employed in a large number of U.S. aerospace companies that, as a whole, dominated world markets. That is not the case today. The number of U.S. aerospace companies has significantly reduced over the past 22 years. The total U.S. aerospace workforce has shrunk by approximately 700,000 in the last decade.[9] There is significant over-capacity and limited international demand in both satellite production and space launch, which is likely to lead to further consolidations and additional lay-offs in the near-term.

The Commission, in its Interim Report #3, requested the Secretary of Defense to task the Defense Science Board (DSB) to review and recommend overall DoD policy toward future military industrial base consolidation, including its policies toward mergers and acquisitions. In particular, as part of this review, the DSB should:

- Address the aerospace industry consolidation and workforce challenges resulting from today's diminishing number of system design programs;
- Assess approaches for aligning consolidation policies with procurement and budgeting policies;
- Consider specific measures (metrics) on the health of defense contractors, such as magnitude and longevity of a contractor's production base and product development work; and
- Assess the long-term sustainability of the nation's high-performance aircraft and solid rocket booster design and development capabilities, including the potential of increasing/initiating high payoff technology development programs and/or continuing low-rate production of strategic systems to bridge industry capabilities to a succeeding generation.

Unstable demand for air and space systems has been a major contributor to an age imbalance in both industry and government aerospace workforces. Younger workers have been laid off first and have more readily taken voluntary separations. At the same time, students do not see a bright future in the aerospace industry and seek other professions. To get out of this trap, government policy must focus on both the demand and supply sides of the aerospace labor market, particularly since defense spending could be one of the few sources of stable demand in the U.S. aerospace sector.

On the demand side, government must increase and then stabilize funding for research and development and for the prototyping, spiral development, and production of new systems. In addition, government should reduce barriers that inhibit demand for the aerospace products and services needed for national security.

The barriers that inhibit demand could be reduced by the following actions. First, as discussed in Chapter 6, government must remove unneeded government-imposed barriers on the export of defense products. Second, since the civil and military aerospace workforces are highly integrated, DoD can improve its access to trained workers by removing the remaining barriers to its use of commercial products and services and, more importantly, by buying commercial products and services on a priority basis when appropriate. Third, government should move military aerospace products into the commercial sector in areas such as air-to-air and satellite-to-air communications, where DoD has significant technology that could meet civilian needs, and integration could capitalize on international demand for modernized aerospace systems.

Prototype unmanned combat air vehicle.

> "The Wright Brothers Institute in Dayton, Ohio is building collaborative partnerships … of government, industry, and academia… to expand the base of science, technology, engineering, and design integration available for air and space applications."
>
> General Lester L. Lyles, testimony submitted to the Aerospace Commission, August 22, 2002

If stabilization of demand through increased funding for cutting edge research and development/prototyping programs is insufficient to develop a sufficient supply of talented engineering and factory workers, a program of targeted grants, loans or tax credits for apprenticeship and graduate education programs might also be considered.

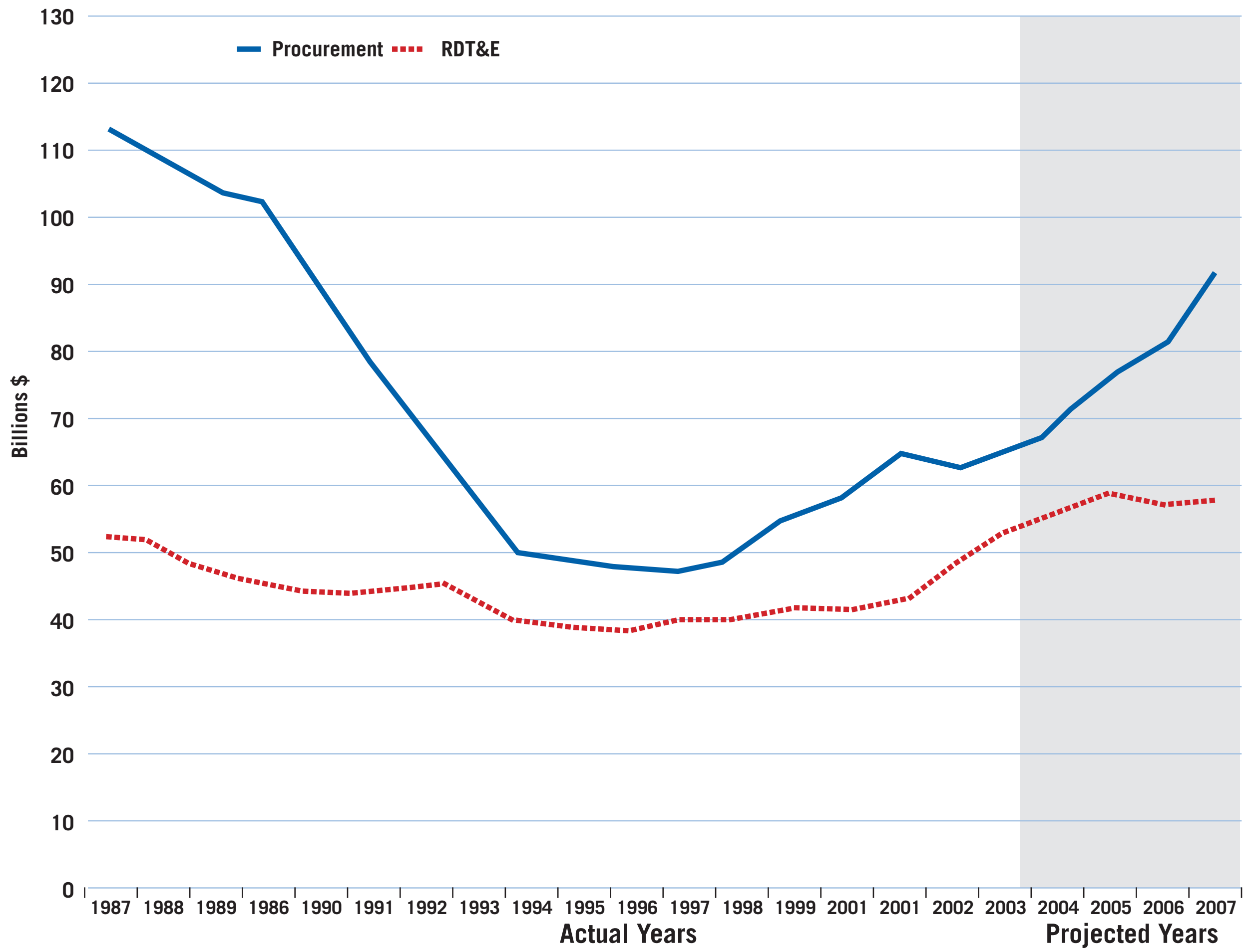
Our overall national security depends on the efforts of multiple government departments and agencies, working as partners, with stable and sufficient budget lines.

Funding. Our overall national security depends on the efforts of multiple government departments and agencies, working as partners, with stable and sufficient budget lines. However, all departments and agencies suffer from conflicting priorities and annual congressional authorization and appropriation processes, which may lead to unstable funding over time.

The inability to fund all the competing demands within the defense budget often leads to unrealistic initial cost estimates, a mismatch of program requirements and budget, service-imposed "taxes", and insufficient management reserves to address major unforeseen events. In addition, the large operations and support costs associated with legacy systems, and the need to support ongoing military operations, drain funding away from R&D, infrastructure modernization, and force transformation.

The Secretary of Defense has expressed concern about the impact of unstable funding in the defense

Figure 4-1 FY 1987 – FY 2007 DoD Budget Authority



Source: National Defense Budget Estimate for FY03, Office of the USD (Comptroller)

sector. See Figure 4-1. He has specifically recommended that defense in the 21st century be seen as one where the military forces cannot be optimized against a specific threat. Instead, he suggests that defense spending be understood to be closer to an investment that is subject to a stable fraction of national income, suggesting 3-3.5 percent per annum—about one third of the Cold War peak in 1962.[10] This could be considered a constructive alternative concept to address the subject of how "stable funding" might be achieved.

The Commission's recommendations to enhance DoD budget stability and flexibility in Interim Report #3 addressed these issues, in part. Further, the Commission supports DoD's Fiscal Year (FY) 04 Legislative Priority #9, "Streamline DoD Processes," to shorten the Planning, Programming, and Budgeting System and the acquisition cycle time.[11] Refer to Chapter 5 for actions the Congress can take to improve their authorization and appropriation process for aerospace.

Further, the Commission believes that DoD's annual science and technology (6.1-6.3) funding must be sufficient and stable to create and demonstrate the innovative technologies needed to address future national security threats. An amount no less than three percent of DoD Total Obligational Authority, "fenced" from budget cuts, would be sufficient. The use of more joint technology development and acquisition programs would also help to spread the funding burden and promote interoperability.

To help reduce the high development and production costs of advanced military systems, the U.S. must also increase the number of international joint programs, such as the Joint Strike Fighter.

Transnational Partnerships and International Sales. DoD and the U.S. aerospace industry share a long history of forming global partnerships and conducting joint operations with our allies. However, the current regulatory environment, especially in the area of export controls, provides too little security, restricts American companies from marketing their products, and prevents effective international technology collaboration. In addition to increasing international commercial trade tensions, today's regulatory environment hinders the development of national security partnerships and sales of U.S. defense equipment to our friends and allies.

The Commission believes that the federal government must remove unnecessary barriers to international sales of defense products, and implement other initiatives that strengthen global partnerships to enhance national security.

The Commission believes that the federal government must remove unnecessary barriers to international sales of defense products, and implement other initiatives that strengthen global partnerships to enhance national security. To help reduce the high development and production costs of advanced military systems, the U.S. must also increase the number of international joint programs, such as the Joint Strike Fighter, and continue to foster international interoperability of defense and commercial aerospace systems-of-systems. At the same time, we must also ensure that our truly militarily critical technologies are protected in the international marketplace, and compliance must be strictly enforced. These issues are discussed in more detail in Chapter 6.

Defense Procurement of Commercial Products and Services. DoD procurement policies must be modernized in a manner that will allow the DoD to access the full range of modern technology. Accessing this technology—most of which will originate as "commercial" technology—will allow the specialized defense industrial base to transform them into products and services that create superior military capabilities. The manner in which DoD procurement is currently structured prevents the DoD and its industrial base from doing so. As a consequence, defense technology is falling behind the pace of development in the civil sector rather than leading it.

Unfortunately, many commercial companies are electing to avoid government work due to onerous paperwork and the risk of losing intellectual property. This hinders the

application of the latest technology to military products. The government must revise policies and processes to encourage commercial vendors to provide their products and services for national defense applications. Use of commercial technology is critical to integrated national security systems of the future.

As the military transforms with new aerospace systems to meet future threats, the operational readiness and capabilities of defense platforms will need to be sustained and upgraded.

The Commission believes DoD acquisition policies should encourage greater use of commercial standards, impose government requirements by exception only, allow commercial entities to protect intellectual property, and remove other burdensome regulations that deter providers of commercial pro-ducts from doing business with the government.

Transition of Defense Technologies into Civil Applications. There are numerous other government missions that would benefit from defense technology and capabilities, such as in the areas of communications, navigation, surveillance, and reconnaissance. The Commission believes that these technologies could be adapted and transitioned into other government applications, such as those that would significantly enhance the capacity of our air traffic management system and simultaneously enhance our national defense and homeland security. These topics are also discussed in Chapters 2 and 3.

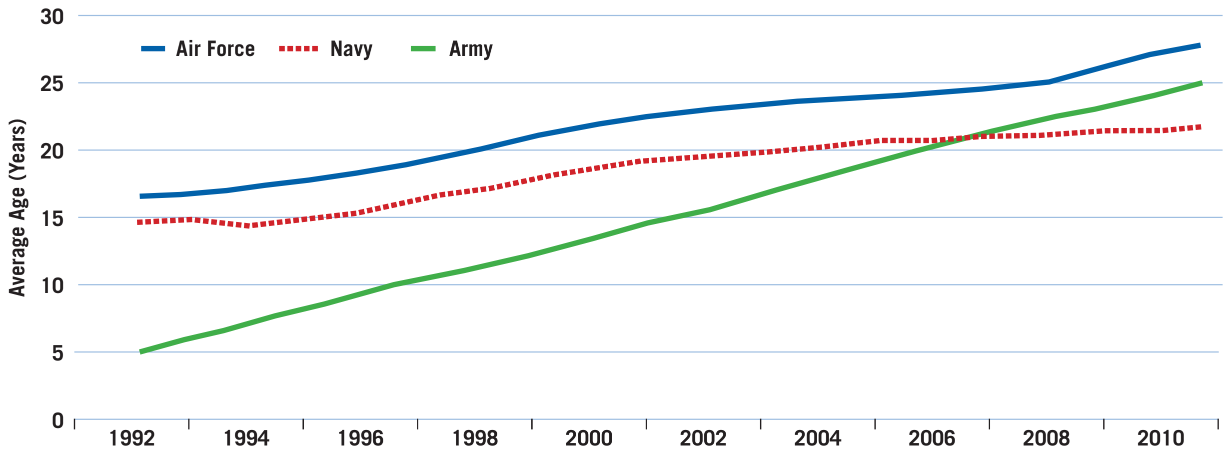
Technology Insertion and Operational Support for Defense Systems. Aging aerospace systems and infrastructure create a large and growing operations and support cost burden that adversely impacts warfighter readiness, morale and retention. Many aerospace systems, like the B-52, are on the path to an operational life of 50-75 years, though their original design life was only 20-30 years. See Figure 4-2. These aging systems face inadequate spares support, increased inspections and maintenance costs. In some cases, these aging systems pose flight safety risks.

The high cost to develop and procure new systems is one cause for legacy systems to be retained in service. New operational concepts are also causing legacy systems to be used much differently than originally intended. The high cost to retrofit legacy platforms with improvements to enhance their operational readiness and capability is equally problematic.

As the military transforms with new aerospace systems to meet future threats, the operational readiness and capabilities of defense platforms will need to be sustained and upgraded:

- Extending aircraft mission range would reduce the need to forward stage fuel and supplies, resulting

Figure 4-2 Military Aircraft Age Trend



Source: Joint Aeronautical Commanders Group

Many aerospace systems, like the B-52, are on the path to an operational life of 50-75 years though their original design life was only 20-30 years.

in potentially enormous cost and operational benefits.

- Investments to improve reliability, maintainability and safety in legacy systems would increase materiel readiness, reduce maintenance and inspections, reduce maintainer workload, and raise morale and retention.
- Reducing the noise and emissions of legacy and new high-performance military aircraft would alleviate current basing issues, community lawsuits, the need to pay for soundproofing homes, as well as potential U.S. and foreign flight-path issues in the future.
- Use of advanced information technologies, such as modeling and simulation, would reduce development, acquisition and support costs of new and legacy systems.
- Adopting commercial build standards, contractor or shared government-industry logistics support, and performance-based logistics incentives would accelerate technology insertion into new and legacy systems, reducing the cost and improving the logistics support.

Technology insertion in the defense establishment is expensive, in part, because of the procurement and budgeting systems. These systems cause the unnecessarily expensive practice of upgrading ancient computers (e.g., 80286-based microprocessors) rather than throwing them away, as is done in commercial practice. Technology insertion is highly desirable and, in principle, should emerge from evolutionary "spiral" development practices. A well-structured "spiral" development program, that is adequately funded to create and field new military capabilities, can facilitate technology insertion into legacy platforms as the threat and the availability of appropriate technology requires and/or justifies.

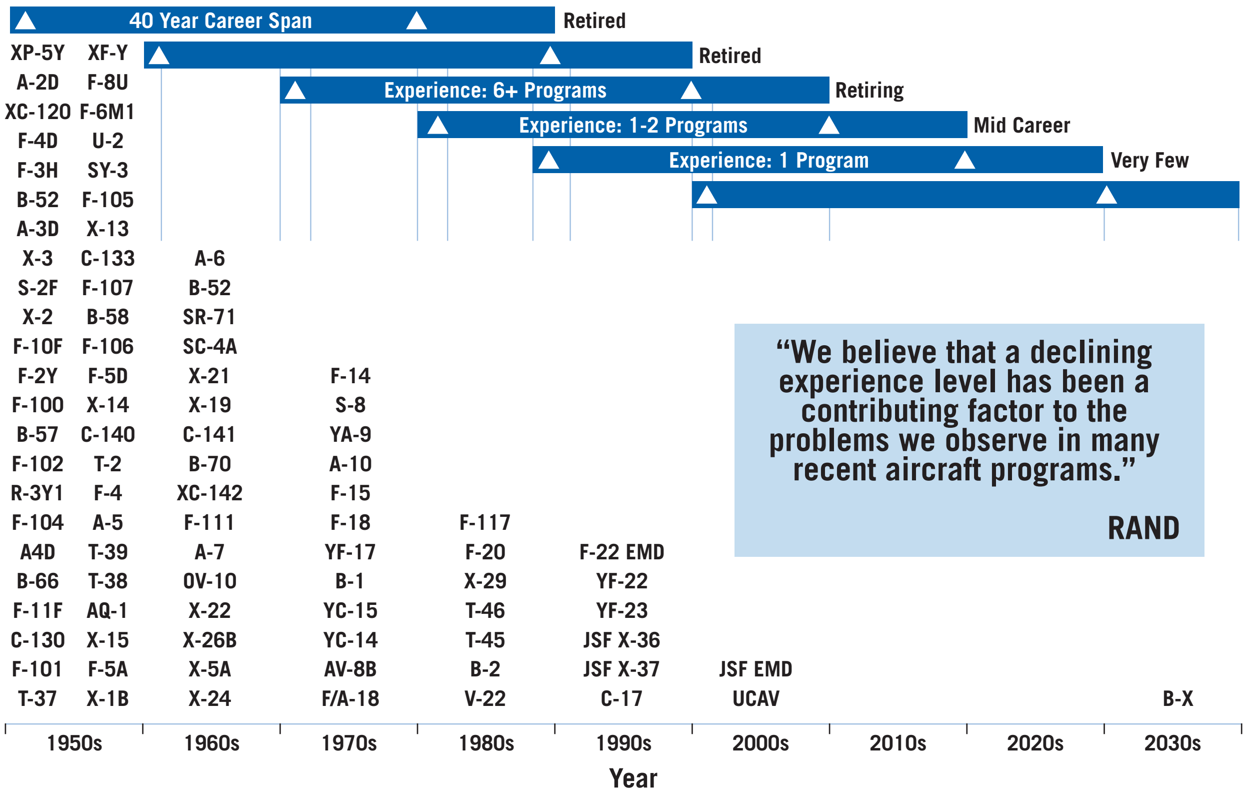
In sum, the Commission believes that the federal government and the aerospace industry must partner to sustain and enhance the operational readiness and capability of our military aerospace systems. The government should fund research and technology development programs to reduce total ownership costs and environmental impacts; implement performance-based logistics support; create a structured, timely and adequately funded technology insertion process; and reform its procurement practices as recommended in Chapter 7.

Experience in the Workforce: Few Opportunities and Limited Skills Transfer

At the end of World War II, a typical manager of a military aircraft development program had worked on the development of 15 programs. By the end of the 1990's, that number had fallen to one. See Figure 4-3. What this statistic reflects is the loss of "corporate knowledge" in our design teams, a loss with parallels in the skilled workforce that builds our aerospace systems. There is already evidence that loss of "corporate knowledge" has been costly. A 1999 study of rocket launch failures found that inadequate

The current success of the Predator program shows the military value of moving leap-ahead demonstrators into the hands of warfighters at a very early stage of development.

Figure 4-3 Declining Experience Levels in Military Aircraft Programs
(Vertical Bars: Military Aircraft Program Starts, Horizontal Bars: Typical 40 Year Career Span)



Source: RAND Study (Chart by Northrop Grumman, Aerospace Industries Association

engineering experience was a major contributing cause. More recently, the Secretary of the Air Force has pointed to the decline in systems engineering skills as a major contributor to cost overruns in military space programs.

Opportunities to Learn. To rebuild the U.S. knowledge base and to keep it “up-to-date,” a core of design and production teams must be continuously exercised, even in periods when the country does not want to fund extensive production programs. This requires DoD to continuously fund prototyping programs and, where possible, move to spiral development of major systems. Such a policy would strongly support current DoD efforts on experimentation and transformation by providing a small supply of “leap-ahead” systems for use in the field. The current success of the Predator program—itself a technology demonstrator—shows the military value of moving leap-ahead demonstrators into the hands of warfighters at a very early stage of development. At the same time, programs providing opportunities for cutting edge work should create additional incentives for the “best and brightest” to come to aerospace.

The Commission believes that the United States must continuously develop new experimental systems, with or without a requirement for production, in order to sustain the critical skills to conceive, develop, manufacture and maintain advanced systems and potentially provide expanded capability to the warfighter.

Skills Transfer to the Next Generation. The ultimate goal of government policy must be to create an extremely high quality workforce in the aerospace sector, a workforce that continuously transfers knowledge and experience from one generation to the next in all areas that may be needed by future military systems. A continuous transfer of skills is a byproduct of stabilized funding.

There is a need for a joint government and industry planning function to ensure that attention is paid to areas where skill sets would disappear if government/DoD did not support a segment of the aerospace industry. Areas like radiation-hardened computer chips and solid rocket booster motors are likely to become extinct, if DoD does not maintain them. While obsolete technologies should be allowed to disappear if no longer needed, government/DoD should have a planning process in place to ensure that skills do not disappear before the need is truly gone.

Intellectual Capital. An aerospace worker's intellectual capital includes technical knowledge, process knowledge and network knowledge—what to do, how to do it, and who can help. All of these are necessary to get the job done. With an aging workforce about to leave, the intellectual capital must be passed on to the continuing workforce to avoid losing the "corporate knowledge." A concerted effort by both industry and government must be initiated to understand the impact of this loss of knowledge and how to transfer it to the workforce of the future.

Critical National Infrastructure: In Jeopardy

Maintaining the nation's critical infrastructure is a joint responsibility between industry and government. The critical national infrastructure includes both facilities and capabilities.

Facilities. The aerospace industry lacks an adequate business case in several areas critical to national security. This includes solid rocket boosters and radiation hardening capabilities. In addition, there is inadequate funding to support and modernize aging government RDT&E infrastructure, such as existing space launch facilities and new facilities that would support the development of transformational capabilities, such as wind tunnels for new hypersonic vehicles. The aerospace industry needs these facilities to test and evaluate new systems. Compounding the funding shortfalls, political pressures also make it difficult to consolidate or realign infrastructure in ways that could eliminate inefficiencies and/or unnecessary duplication. The result is that higher operating costs are being passed to the user.

European sources in many cases offer better alternatives for testing new capabilities. For example, U.S. companies are using foreign wind tunnels for testing because they are less costly and more capable. The U.S. must retain world-class infrastructure for test and evaluation of future technologies.

The Commission believes the federal government must assume responsibility for sustaining, modernizing, and providing critical, often high-risk, defense-related technologies and infrastructure when it is in the national interest. Chapter 3 contains specific recommendations addressing our space launch infrastructure. As political circumstances permit, the government must also address the broader issue of RDT&E infrastructure as part of future facility consolidations and realignments.

Capabilities. The government uses the term "ubiquitous" to describe capabilities that are critical to the national security and economic prosperity of the United States and the world. GPS and frequency spectrum are two of these ubiquitous capabilities and, as such, must be protected as critical national infrastructure.

Global Positioning System. GPS provides global positioning, navigation and timing information for a wide range of military, commercial, and civil applications. It enables the military to place precision munitions on target. Its timing enables the financial markets, power grids, and the Internet to synchronize their operations around the world. The nation's air transportation system is becoming more dependent upon GPS for global navigation and precision landings. GPS is becoming more embedded throughout national and international infrastructures and operations.

Though it is managed by the U.S. government through an interagency process, GPS is fundamentally paid for and operated by the DoD. Its critical contributions to national security and to the global economy require that senior leadership in both the executive and legislative branches of the government be conscious of its role, take the necessary steps to ensure its continuous robust availability, and expedite its improvement. In addition, our global leadership in space-based positioning, navigation, and timing will be lost if we do not continue to focus resources and attention on this asset.

As part of the national imperative for protection of critical national infrastructure, the Commission believes the federal government should identify and protect funding that enables the DoD to accelerate the launch of the next generation of GPS satellites for the enhancement of anti-jam capabilities and creation of worldwide dedicated civil signals.

Frequency Spectrum. Rapidly changing and emerging information and communications technologies are placing significant strains on the finite radio frequency spectrum and on the management processes that control how it is allocated and used. Globally, the radio frequency spectrum is an extremely valuable resource essential to national and international security and commerce.

The Commission believes that the U.S. should create a national spectrum strategy to preserve and protect access to radio frequency bands that are dedicated to public safety and scientific applications, while enabling the U.S. to remain in the forefront of global electronic commerce.

Conclusions

The Commission concludes that aerospace capabilities and the supporting defense industrial base are fundamental to U.S. economic and national security. While the nation's defense industrial base is strong today, the nation is at risk in the future if the United States continues to proceed without a policy that supports essential aerospace capabilities.

Develop a U.S. Military Industrial Base Policy. The Department of Defense should task the Defense Science Board to develop a national policy that will invigorate and sustain the U.S. aerospace industrial base. The policy should address issues, such as mergers and acquisitions, procurement and budgeting policies, research and development investments, technology transition, international sales and workforce development.

Sustain the Defense Industrial Base. Today's national defense industrial base is robust, but without constant vigilance and investment, vital capabilities will be lost.

- DoD's annual science and technology (6.1-6.3) funding must be sufficient and stable to create and demonstrate the innovative technologies needed to address future national security threats. An amount no less than three percent of Total Obligational Authority, "fenced" from budget cuts, would be sufficient. The use of more joint technology development and acquisition programs would spread the funding burden and promote interoperability.
- The federal government must remove unnecessary barriers to international sales of defense products, and implement other initiatives that strengthen transnational partnerships to enhance national security. To help reduce the high development and production costs of advanced military systems, the United States must also increase the number of international joint programs (like the Joint Strike Fighter), and continue to foster international interoperability of defense and commercial aerospace system-of-systems.
- DoD acquisition policies should be revised to encourage greater use of commercial standards. DoD should impose government requirements by exception only, allow commercial entities to protect intellectual property, and remove other burdensome regulations that deter providers of commercial products from doing business with the government.
- There are numerous government missions that would benefit from defense technology. For example, the U.S. military has developed capabilities in the areas of communications, navigation, surveillance, and reconnaissance. These technologies could be adapted and transitioned into other

government applications that would significantly enhance the capacity of our air traffic management system and, hence, our national defense and homeland security.

- The federal government and the aerospace industry must partner to enhance the operational readiness and capability of new and legacy military aerospace systems. The government should: fund research and technology development programs to, reduce total ownership costs and environmental impacts; implement performance-based logistics support; create a structured, timely and adequately funded technology insertion process; and reform its procurement practices accordingly.

Increase Opportunities to Gain Experience in the Workforce. The U.S. must continuously develop new experimental systems, with or without a requirement for production, in order to sustain the critical skills to conceive, develop, manufacture and maintain advanced systems and potentially provide expanded capability to the warfighter. Furthermore, the federal government and industry must develop approaches to retain and transfer intellectual capital as the workforce retires in greater numbers in the next few years.

Maintain and Enhance Critical National Infrastructure. The federal government must assume responsibility for sustaining, modernizing, and providing critical, often high-risk, defense-related technologies and infrastructure when it is in the nation's interest. This includes critical design capabilities, solid rocket boosters, radiation hardening, space launch facilities, critical RDT&E infrastructure, GPS, and frequency spectrum.

RECOMMENDATION #4

The Commission recommends that the nation adopt a policy that invigorates and sustains the U.S. aerospace industrial base. This policy must include:

- Procurement policies which include prototyping, spiral development, and other techniques which allow the continuous exercise of design and production skills;
- Stable funding for core capabilities, without which the best and brightest will not enter the defense industry;
- Removing barriers to international sales of defense products;
- Removing barriers to defense procurement of commercial products and services;
- Propagating defense technology into the civil sector, particularly in communication, navigation and surveillance; and
- Sustaining critical technologies that are not likely to be sustained by the commercial sector, e.g., space launch, solid rocket boosters, etc.

RECOMMENDATION #5

The Commission recommends that the federal government establish a national aerospace policy and promote aerospace by creating a government-wide management structure. This would include a White House policy coordinating council, an aerospace management office in the Office of Management and Budget, and a joint committee in Congress. The Commission further recommends the use of an annual aerospace sectoral budget to establish presidential aerospace initiatives, assure coordinated funding for such initiatives, and replace vertical decision-making with horizontally determined decisions in both authorizations and appropriations.

Chapter 5

Government: Prioritize and Promote Aerospace

The federal government plays a key role in promoting the health of the U.S. aerospace industry. Maintaining global aerospace leadership to ensure America's military preeminence, guarantee homeland security, and assure economic growth and a superior quality of life for our citizens in the 21st century requires government activism. Aerospace provides the fastest, safest, most flexible and often the only means of travel and security. A coherent and integrated national aerospace consensus is critical to move the country forward, drive government action, and preserve U.S. global aerospace leadership.

The federal government has called on the aerospace industry in time of crisis in the past. The aerospace industry has always responded when called. Today, the U.S. aerospace industry is in jeopardy and is looking to the federal government to respond. The Commission is not asking for the federal government to create industrial policy, to pick winners and losers, or to subsidize the development of commercial aerospace products and services. But, the federal government must recognize that its interactions with industry are key to its strength and long-term survival and, ultimately, to the security and economic prosperity of America.

The health of the aerospace industry, today and in the future, is inextricably linked to the leadership of the federal government.

Objective: Government—Flexible, Responsive and Oriented Towards Decision Making

The health of the aerospace industry, today and in the future, is inextricably linked to the leadership of the federal government. Its interaction with the U.S. aerospace industry is vast, complex, and multi-dimensional. In the rapidly changing global economy, government leadership must be increasingly flexible, responsive and oriented toward decisionmaking at macro-levels. It must prioritize and promote aerospace both within the government and in its interaction's with the industry in order to realize the fullest potential of aerospace to the nation.

- As a leader, the government must provide the national policies and investments needed for the industry to be competitive, to be innovative and to serve the public good both in the short and long term.
- As a customer and operator, the government must buy, use and provide the finest aerospace products and services for the public good, such as for national defense, homeland security, air transportation and science.
- As a facilitator, the government must create a level international playing field so that the U.S. aerospace industry can compete openly and fairly around the world.
- As an enabler, the government must look to and enable the future by investing in workforce development, public infrastructure, and long-term research critical to the nation's future.

In sum, the health and future of the aerospace industry depends on the federal government performing these functions efficiently and effectively in order to preserve our national security, economic prosperity and the quality of life of all Americans.

Issues

National Aerospace Consensus: Needed

The development and implementation of federal aerospace policy is currently spread across multiple government departments and agencies, with oversight by numerous and different Congressional committees. (See Appendices F and G.) Therefore, no organization in either the executive branch or the legislative branch has an integrated view of the health and future of the aerospace sector.

The development and implementation of federal aerospace policy is currently spread across multiple government departments and agencies.

Air transportation policy is but one example of an aerospace issue that crosses many federal departments and agencies.

- The Department of Transportation (DOT) develops domestic and international aviation policy.
- The Federal Aviation Administration (FAA) regulates and certifies aircraft safety; develops, acquires and maintains the air traffic control facilities and equipment at commercial airports; and provides the air traffic controllers and operates the air traffic management system.
- The Department of Defense (DoD) acquires and maintains the air traffic systems for its airfields; trains military air controllers; and develops and operates air and space surveillance systems, secure communications and the Global Positioning System (GPS) that support its national security mission. It also conducts research and fields technologies that are used to manage its forces globally in combat, such as JTIDS/Link 16, high-bandwidth digital communications, battle management systems, and digital terrain and elevation data. Many of these technologies could be used by the civil aviation system but are not.
- The proposed Department of Homeland Security will be responsible for the security of commercial and general aviation and airports, among other

ISSUES

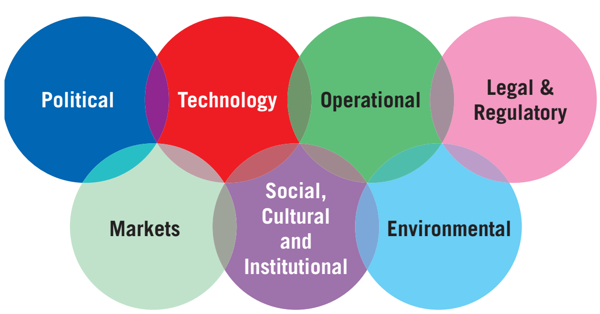
- National Aerospace Consensus
- Government Organizational Structure
- Key Government Processes
- Private-public Partnerships

things. Currently, some 22 departments and agencies share responsibility for homeland security.

- The Department of State, working with the other federal departments and agencies, deals with international treaties, agreements and standards development dealing with aviation.
- The Department of Commerce and, in particular, its National Oceanic and Atmospheric Administration (NOAA), develops and maintains the National Weather System, including the air- and space-based systems, that provides meteorological and weather forecasting data used by the nation's air transportation system.
- The Environmental Protection Agency (EPA) provides regulations for vehicle noise and emissions and environmental permits for airport and runway construction.
- The National Aeronautics and Space Administration (NASA) develops prototype algorithms for the current civil air traffic control system, new models and simulations to improve air traffic management and technology to improve safety.

The federal government does not have a process to bring the appropriate departments and agencies together to reach a consensus on national aerospace policy. Complicating matters further, there is no process that brings all of the stakeholders together to address the factors that influence the health and the future of the aerospace sector. (See Figure 5-1.)

Figure 5-1 Factors Influencing the Health and Future of the Aerospace Sector



The Commission believes that sustaining U.S. global aerospace leadership will require Presidential and Congressional leadership and a unified national team—state and local government, industry, labor, academia and non-governmental organizations—committed to sustaining a healthy U.S. aerospace sector.

Government Organizational Structure: Not Integrated and Responsive

The government is not organized to define national aerospace priorities, develop federal aerospace sector plans and budgets, manage programs that cross multiple departments and agencies, or foster a healthy aerospace sector in a global economy. As described earlier, no single federal organization is responsible for identifying the appropriate role of aerospace in the context of the nation's transportation system and other national needs, including homeland and international security, air transportation, and space exploitation and exploration. No organization is responsible for defining national aerospace priorities or addressing all of the factors that will influence national aerospace policy across all stakeholders and all dimensions—international, national and governmental.

U.S. global aerospace leadership will require Presidential and Congressional leadership and a unified national team.

The federal government is organized vertically while national aerospace challenges are becoming more horizontal in nature. Legacy structures and processes, which were effective in the past, are fundamentally incapable of addressing the system-of-systems level challenges facing the nation today. These structures and processes simply must be modified and/or replaced by integrated, crosscutting structures to achieve our goals.

The ability of the United States to compete both militarily and economically requires a government that speaks coherently, can focus its collective capabilities on national issues, such as terrorism and air transportation, and can respond quickly and flexibly to rapidly changing global trends. It requires a

Figure 5-2 A National Global System-of-Systems Architecture

government that is structured and has the appropriate incentives to provide system-of-systems solutions to problems that transcend all levels of government, industry, labor and academia and national and international boundaries.

National challenges now will increasingly require system-of-systems solutions that involve government, industry, labor, academia and non-governmental organizations and, in most cases, international involvement. The nation's air transportation system, for example, requires all stakeholders be involved in the solution to ensure that:

- The nation's air transportation system can move people and cargo safely and securely when and where they need to go domestically or abroad in peacetime and in wartime;
- Aerospace manufacturers build safe, clean and quiet aircraft that meet international standards and are appropriately equipped;
- Airplanes operate safely and have well trained pilots and crews; and,
- Airports have runways and terminals that can handle aircraft of all sizes and capabilities and have facilities that can move people and goods quickly to and from connecting modes of transportation without sacrificing safety and security.

The federal government is organized vertically while national aerospace challenges are becoming more horizontal in nature.

Without integration, national aerospace policy occurs either by default or piecemeal. Government aerospace sector resources often are not efficiently focused on national problems, such as air transportation, or new breakthrough opportunities, such as in propulsion and power.

The Commission believes that the U.S. government can only ensure U.S. aerospace global leadership by leading itself. To do this, both the executive and legislative branches need to be reoriented to better address national aerospace issues. Both branches need to provide a focus on national aerospace needs and priorities, government aerospace sector plans and budgets, and government management of national aerospace initiatives. The Commission believes that the following executive and legislative branch organizational changes are necessary.

Executive Branch

Federal Departments and Agencies—Offices of Aerospace Development. Most federal departments and agencies spend public funds to develop, operate and use aerospace-related products and services to advance public policy and to perform their missions. This includes departments and agencies typically not identified with aerospace, for example:

- The Department of Agriculture promotes the use of remote sensing for monitoring the nations agricultural, rangeland and forestry resources, and the Global Positioning System for improving farming techniques, such as precision farming.
- The Department of Health and Human Services promotes the use of space-based communications for distance medicine and for space-based research on new medicines and drugs.
- The Department of Interior uses aerospace derived geodetic information for fish and wildlife preservation, mining reclamation and enforcement, and national park surveys.
- The DOT promotes the use of space-based communications and navigation for air, highway, transit, rail and maritime applications, including law enforcement. It also licenses commercial space launches.

Appendix F provides a more comprehensive list of departments and agencies that spend public funds on aerospace-related products and/or services. The list highlights the fact that almost every federal department and agency contributes to or benefits from the aerospace industry in performing its mission.

Most federal departments and agencies, however, do not have an organization that helps them to: promote and implement national aerospace policies; define aerospace requirements in support of their mission; coordinate aerospace policies, plans and programs within their department or agency; prioritize aerospace budgets and spending; and leverage broader aerospace capabilities in the government and the private sector to achieve their mission more efficiently and effectively.

The Commission believes that each federal department and many agencies should have an Office of Aerospace Development.

The Commission believes that each federal department and many agencies should have an Office of Aerospace Development to perform these functions better. The Office should report directly to the Office of the Secretary or Agency Head and be led by a full-time senior executive.

Office of Management and Budget—Bureau of Aerospace Management. The federal government is not organized to deal with issues that are more horizontal than vertical in nature (i.e., system-of-systems issues), whether it is developing national aerospace policy, defining national priorities, or planning and budgeting aerospace resources. It does not have an organization and process that looks at government-wide plans and budgets with the health and future of the aerospace sector in mind. Further, it does not have an organization that manages initiatives that are a national priority, span multiple departments and agencies and require system-of-systems solutions. Development of a next generation air transportation system is a good example.

To manage its aerospace investments efficiently, effectively and as a sector, the federal government and the aerospace sector need a standardized set of terms and definitions in order to get a clear and accurate picture of government aerospace budgets. A standard set of terms and definitions will also help to improve communications, standardize procedures and processes, and simplify government business and administrative practices.

As the DoD has found over the last several decades, a system-of-systems level solution requires a single organization to plan, budget and manage it efficiently and effectively. As a result, DoD has created joint programs that report either directly to the Office of the Secretary, such as the Missile Defense Agency and Defense Advanced Research Projects Agency (DARPA), or to a lead service, such as the U.S. Air Force for the Joint Strike Fighter. The success of these joint programs can, in part, be attributed to the DoD's decision for a single program management structure.

The formation of the Department of Homeland Security is one of the first attempts to create an organization at the interagency level to provide focused and integrated management of programs across the federal government from a systems perspective. The Commission is not proposing the creation of a new Department of Aerospace. The executive branch, however, needs an organization that performs this function for major national aerospace initiatives that, through necessity, cross multiple federal departments and agencies.

The Commission believes the White House Office of Management and Budget (OMB) should perform this function. It should assume a new and proactive role as horizontal integrator for the government's aerospace sector plans, programs and budgets. Within its organization, OMB should create a Bureau of Aerospace Management that would translate the national aerospace policy into annual planning and budget guidance to the appropriate federal departments and agencies. It would also produce an annual assessment, plan and budget for government aerospace activities.

The Office of Management and Budget should assume a new and proactive role as horizontal integrator for the government's aerospace sector plans, programs and budgets.

The Bureau should take responsibility for those major aerospace initiatives that cross multiple departments and/or agencies and are deemed in the national interest. They should assign a lead organization to manage the interdepartmental effort. The Commission's approach of developing aerospace competency and prioritizing aerospace throughout the government will make this role even more important.

Critical national aerospace initiatives, especially those that require a system-of-systems approach (e.g., modernizing the nation's air transportation system), require focused and streamlined management, a national plan that provides a well-defined system architecture and performance measures, and program budget authority with clear lines of responsibility among participating departments and agencies. OMB seems particularly well positioned to carry out this vital management role.

White House—Aerospace Policy Coordinating Council. All federal departments and agencies need to be involved in developing and implementing national aerospace policy. Today, there is no organization or process in the executive branch that does this. Because of the importance of aerospace to national security, homeland defense and the economy, this policy function should be assigned jointly to the National Security Council and the National Economic Council. They should establish an Aerospace Policy Coordinating Council (PCC) to develop and implement an integrated means of formulating national aerospace policy. This builds on Commission deliberations that have identified a wide range of aerospace policy issues that cut across the federal government, such as spectrum availability, GPS civil frequencies, air transportation, space launch infrastructure, workforce and research priorities.

The Aerospace PCC should include the direct participation of the Office of Vice President, Domestic Policy Council, OMB, Office of Science and Technology Policy and Office of Homeland Security. A senior executive should be assigned full time to perform this function.

The Aerospace PCC should provide an annual report to the President with an assessment of the health of the aerospace sector, including the impact of government fiscal and monetary policy, U.S. statutes and regulations (e.g., export controls), international treaties and agreements, and public funding in the aerospace sector.

A prudent response from Congress would be to organize a Joint Committee on Aerospace.

Legislative Branch

Joint Committee on Aerospace. The legislative impact of our recommendation to create Offices of Aerospace Development throughout the federal government will be to extend aerospace jurisdiction to most, if not all, committees on Capitol Hill. Therefore, a prudent response from Congress should be to organize a Joint Committee on Aerospace that would have the obligation to coordinate legislatively the multi-faceted jurisdiction issues.

Like the former Joint Committee on Atomic Energy, the Joint Committee on Aerospace would be empowered to hold hearings, initiate legislation and provide overarching and integrated guidance and direction to the appropriate Congressional authorization and appropriations committees.

Key Government Processes: Neither Streamlined Nor Integrated

Government processes tend to be complex, lengthy and inefficient. As a result, aerospace products and services developed and used by the government, such as military weapon systems and civil space missions, are more costly for the taxpayer and take longer to

Figure 5-3 Notional Federal Responsibilities for Coordination and Oversight of Aerospace Matters

	Executive Branch			Legislative Branch	
	White House	Office of Management and Budget OmB	Federal Departments and Agencies	House and Senate	Congressional Budget Office
	Aerospace Policy Coordinating Council	Bureau of Aerospace Management	Offices of Aerospace Deployment	Joint Committee On Aerospace	
Policy National Vision, Goals and Priorities Financial Policy Performance-Based, Flexible laws and Regs International Treaties and Agreements Maintenance of Nation's Industrial Base	Lead	Participate	Participate	Oversight Authority	
Management and Budget Common Definitions/Currency/Policy Major Aerospace Sector Budget	Input	Lead	Participate	Oversight Authority	Analysis
Program Acquisition and Procurement Multi-Year Funding, Life-Cycle Cost/ Management Civil and Military Needs Simpler, Shorter, More Efficient Best Practices From Private Sector Incentives For Risk Taking	Input	Lead (Designate Lead)	Lead (As Assigned)	Oversight Authority	Analysis

acquire. Also, aerospace products and services developed by industry for sale in the commercial marketplace take longer and cost more because of extensive government legal and regulatory barriers, resulting in lost market share and diminished profitability.

Integrated Government Aerospace Sector Planning, Budgeting and Program Management. The Government Performance and Results Act of 1993 has mandated strategic planning and program management within individual federal departments and agencies. The DoD, for example, has a very well defined strategic management process including:

- National strategy and policy development (e.g., National Security Strategy, Quadrennial Defense Review);
- Requirements definition in the Joint Chiefs of Staff (e.g., Joint Vision 2020);
- Planning and budgeting across the Services and Defense organizations (e.g., DoD Strategic Plan, Defense Guidance); and
- Management of joint and individual service programs (e.g., Missile Defense Agency, Joint Strike Fighter, GPS, DARPA).

The Government Performance and Results Act, however, does not adequately address strategic planning, budgeting and program management **across** federal departments and agencies, especially when the issues cross military, civilian and commercial lines.

Aerospace Sector Budget. The federal government spends public funds for aerospace products and services in performing its missions. This includes: the development, procurement and operation of military weapon systems and the nation's civil air traffic control system; the conduct of long-term civil aeronautics research; and the procurement and use of aircraft for monitoring our borders and for fighting forest fires. It also invests in maintaining the nation's critical manufacturing capacity, workforce development, national aerospace infrastructure, such as space launch, and long-term research that directly and positively impact the nation's security, economy and job creation.

As the Commission noted in Interim Report #1, the federal government aerospace sector spending, however, is currently spread across multiple government agency budgets, with oversight by numerous and different Congressional committees. As a result, none of these government groups has an integrated view of our national aerospace efforts. As was stated

AEROSPACE SECTOR CATEGORIZATION

- Systems*
  - Air (e.g., aircraft (fixed, rotary wing), airships, unmanned vehicles)
  - Missiles (e.g., cruise, guided, ballistic, rockets)
  - Space (e.g., spacecraft, space transportation)
- Services
  - Air transportation
  - Telecommunications
  - Navigation
  - Earth Monitoring
  - Others
- Infrastructure (e.g., facilities and equipment)
  - Airports/airfields
  - Spaceports
  - Air traffic control
  - Research, development, test and evaluation facilities
  - Manufacturing and maintenance facilities
  - Other launch and support facilities and equipment (e.g., telemetry, tracking and control)
- Research
  - Government
  - Industry
  - Academia
- Workforce (e.g., personnel)

* Note: Subcategories include: system research, development, test and evaluation; flight systems (production); and operations (including maintenance and decommissioning).

previously, the government's organizational structure and planning and budgeting process lack the necessary overall insight and accountability to develop and implement a coherent national strategy and program. This makes it difficult, if not impossible, to provide overall national aerospace leadership and oversight.

As a result, the Commission asked the OMB to work with the Commission staff to develop an acceptable categorical definition of the aerospace sector and to prepare an aerospace sector budget breakout to be submitted with the President's annual budget request, by category. Appendix C provides the first attempt by OMB to provide an aerospace sector budget using the categorization depicted in the accompanying insert.

Ultimately, OMB and the Congressional Budget Office should agree to a categorization and provide aerospace sector budget data and analysis on an annual basis. The Commission believes that these two steps are important, if the executive and legislative branches are to have insight into the government's aerospace investments.

Since this categorization is new and much more comprehensive than what has been used by the government in the past, the Commission was not able to assess completely the adequacy, balance and trends in the government aerospace sector budgets. However, based on existing historical data, the Commission has the following observations.

- *Aeronautics Research and Development.* Based on the data contained in the annual publication of "Aeronautics and Space Report of the President" for the fiscal years 1980 to 2000, the federal aeronautics budget more than tripled between 1980 and 1993, reaching a peak of $11,359 million in 1993. From 1993 to 1999, the budgets declined by approximately 20 percent to a low of $8,997 million before heading upward again with levels now approaching those in the early 1990's. See Figure 5-4. Most of this budgetary increase has been in the DoD and DOT. Of concern, however, is the continued decrease in NASA's civil aeronautics budget. This is unacceptable given the huge opportunities to improve the nation's air transportation system as discussed in Chapter 2.

Figure 5-4 Federal Aeronautics Budget (in millions of dollars)

FY	DoD[a]	NASA[b]	DOT[c,d]	TOTAL
1993[1]	7,582	1,245	2,532	**11,359**
1994[1]	6,848	1,546	2,309	**10,703**
1995[1]	7,196	1,310	2,212	**10,718**
1996[1]	6,792	1,315	2,052	**10,159**
1997[1]	6,323	1,252	2,146	**9,721**
1998[1]	6,256	1,327	2,099	**9,682**
1999[1]	5,532	1,194	2,271	**8,997**
2000[1,2]	6,460	1,060	2,201	**9,721**
2001	6,587[3]	985	2,838[3]	**10,410**
2002	6,149[3]	997	3,203[3]	**10,349**
2003	6,808[3]	985[4]	3,107[3]	**10,900**

Notes:

[a] Research, Development, Testing, and Evaluation of Aircraft and Related Equipment.
[b] Research, Development, Construction of Facilities, Research and Program Management.
[c] Federal Aviation Administration: Research, Engineering, and Development; Facilities, Engineering, and Development.
[d] DOT's R,E&D Presidential budget for 2003 is $126 million. This does not reflect aviation security R&D that has been moved from FAA to the Transportation Security Administration (TSA).
[e] Department of Energy (DOE) has an annual budget of approximately $70 million for aircraft and systems research and development.
[1] Budget numbers are from the "Aeronautics and Space Report of the President" for years 1993-2000.
[2] The budget figures for the year 2000 are estimates.
[3] Budget numbers from Office of Management and Budget.
[4] Presidential Budget for FY 2003

- *Space.* The "Aeronautics and Space Report of the President, Fiscal Year (FY) 2000 Activities" shows that annual government budgets for civil and military space (in equivalent FY 1999 dollars) have essentially been flat at approximately $26 billion per year since 1995 after reaching a peak of $37 billion in 1989. During the period from 1989 to 1995, the DoD saw a decrease of over 50 percent from $23.8 billion in FY 1988 to $11.6 billion in FY 1995. This downward trend has now been reversed and investments are approaching the levels of the early 1990s. Over the last decade, NOAA saw its budgets increase from approximately $300 million in FY 1990 to $571 million in FY 2000.

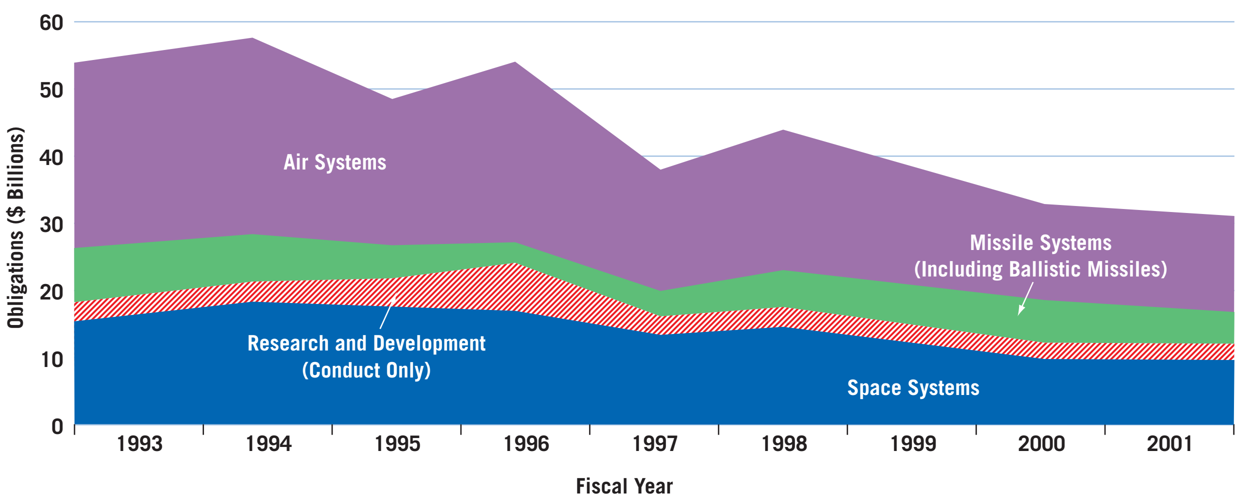
  On the other hand, from FY 1991 to FY 2000, NASA's space budget authority declined by almost 20 percent from $15.8 billion to $12.5 billion. Given the extreme importance of civil space to the nation, the Commission finds this alarming.

The federal budget only provides a partial picture of government investments in the aerospace sector.

The federal budget, however, only provides a partial picture of government investments in the aerospace sector. The federal budget is a policy document and does not explain in detail how the budget authority is spent. To understand more about specific spending, the Commission contracted with the RAND Corporation to determine federal procurement spending in the aerospace sector. Figure 5-5 provides a summary of this data from 1993 through 2001. Additional information can be found in Appendix D. The data show the following:

- *Procurement.* The direct link between the U.S. government and the nation's aerospace industry is the federal procurement system through which federal agencies purchase air, missiles and space systems and their related infrastructure from the private sector companies that comprise the aerospace industry. The past decade has witnessed a steady decline in federal procurement spending in all of these areas. Specifically, it shows that between FY 1993 and FY 2001, federal procurement spending dropped 35 percent on air systems, 50 percent on missile systems, and 46 percent on space systems in absolute dollars. At the same time that the U.S. government was buying fewer and fewer aerospace systems, federal departments and agencies were also investing fewer dollars in R&D efforts of private industry to advance and improve existing aerospace systems. The combined spending of all federal departments

Figure 5-5 Federal Aerospace Procurement and R&D Expenditures FY 1993 – FY 2001



and agencies on extramural aerospace-related R&D dropped by 46 percent in absolute dollars. In the past decade, federal support for major segments of the aerospace industry has declined significantly as evidenced by direct purchases.

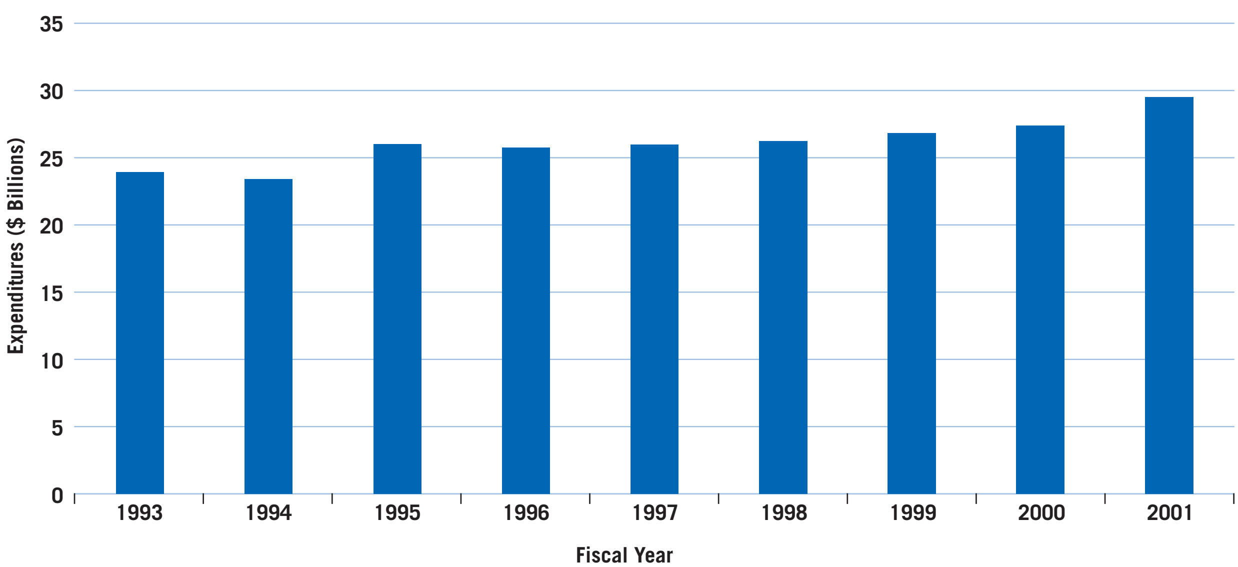
- *Personnel.* The U.S. Air Force, NASA and FAA are the three lead agencies for aerospace. Figure 5-6 shows that during the same years in which federal support to the aerospace industry was declining, U.S. Air Force, NASA and FAA spending on their own internal workforces (i.e., personnel) increased by 25 percent in absolute dollars even though overall federal support to the industry was declining. This suggests, that in the past decade, the operating costs of those three organizations began to "encroach upon" activities in other areas (i.e., procurement and R&D).

- *Government Users of Aerospace Systems.* DoD, DOT/FAA and NASA are the major federal departments and agencies involved in aerospace, accounting for over 99 percent of federal procurement spending. There are others departments and agencies that are major users of aerospace products and services and have spent more than $100 million in at least one fiscal year between 1996 and 2000. These include the General Services Administration and the Departments of Energy, State and Justice.

Even though the Commission was not able to assess completely the adequacy, balance and trends in the government aerospace sector budgets using the new aerospace sector categorization used by OMB, it was able to get some insight into important trends in government aerospace sector procurement and personnel costs. This information has not been available to decision makers in the past but needs to be in the future.

The Commission believes, therefore, that both the executive and legislative branches of government need better insight into aerospace sector budgets and procurement and personnel costs over time. To achieve this, both branches should adopt the aerospace sector categorization definition developed by the Commission with OMB. Further, OMB should prepare a budget and spending breakout, by category, as an addendum to the President's Annual Budget Request. The Department of Commerce should compile and present baseline statistics on the economic performance and investment expenditures of the aerospace sector for the purpose of comparing federal outlays. And, the Congressional Budget Office should provide an annual sectoral budget breakdown that parallels the President's Annual Budget Request, using the same aerospace sector categorization.

Figure 5-6 Air Force, NASA, and FAA Personnel Expenditures FY 1993 – FY 2001



Integrated Government Science, Technology and Acquisition Process. In the future, government must think and act on the same time scales as industry—weeks and months as opposed to years and decades. This will require a much simpler, better-integrated and more streamlined government science and technology (S&T) and acquisition process.

The government's current S&T and acquisition process is rooted in the nation's science policy that was articulated by President Roosevelt's Director of the Office of Scientific Research and Development, Vannevar Bush, in 1945. The science policy suggested that basic research leads to applied research, then to technology development and, ultimately to product development and sales. This linear model has resulted in segmentation as opposed to integration of S&T and acquisition not only within and among government organizations but also across government, industry and academia. Today, the government's S&T and acquisition process:

- Is complex, fragmented, and lengthy;
- Has a one-year planning, budgeting and execution time horizon;
- Varies from department to department and agency to agency and, hence, is a maze of different processes, practices and procedures for government customers and stakeholders to figure out and use;
- Does not use best business practices and performance-based contracting, standards and certification processes; and
- Provides few incentives for risk taking, private investment, cost sharing and cost and timesavings.

Global competition dictates that the U.S. aerospace sector must transition from the fragmented, linear and functional-oriented S&T and acquisition process to a dramatically simpler, integrated, and streamlined product-development process—a national innovation process. The sector needs a process that enables it to transform the best domestic and international ideas available into new and better products and services faster than our competitors. It needs a process that has dramatically shorter cycle times and provides a much higher rate of return on the nation's investments and natural resources.

Global competition dictates that the United States aerospace sector's product-development process be dramatically simpler, integrated, and streamlined.

To meet this challenges, the aerospace industry has started to: reengineer its major business and manufacturing processes; integrate its research and development with its manufacturing processes; create partnerships with government and industry to leverage national research investments; automate these processes using tools such as computer-aided design, development and manufacturing; and adopte international quality standards.

The federal government is under similar pressures from the public and its internal customers to deliver better products and services faster and cheaper for the taxpayer. As with industry, it also needs to integrate, streamline and speed up its product-development process.

In summary, the Commission believes that both the executive and legislative branches should work together to:

- Create a common set of terms and definitions (e.g., aerospace sector, aerospace sectoral budget categorization), currency (e.g., not different "colors" and kinds of funds) and administrative and business policies, practices and procedures across the government;
- Reengineer its strategic planning and budget process to look at government aerospace polices and investments as a sector and from a long-term perspective (e.g., multi-year funding, life-cycle costing and management);

- Create a single S&T and acquisition process—a product-development or innovation process—that is simpler, shorter and more efficient, uses private-public partnerships and addresses both civil and military needs;
- Emulate best private sector business practices, including the use of performance-based contracting and process (not product) certification; and
- Provide incentives for risk taking, capital formation, cost and risk sharing, and time and cost savings.

Public-Private Partnerships: Difficult to Build

Government, industry, labor and academia must work together—as partners—to transform the way they do business, allowing the nation to capitalize on the best ideas available and apply them rapidly to new aerospace products, processes and services. Each play different, but important, roles. They cannot perform these roles separately or in isolation. Each must understand its role and work together to create an environment that fosters innovation in aerospace sector. Collectively, they need shared goals, objectives and incentives to share the risks, costs and benefits of doing business.

- Government, at all levels, should:
  - Provide leadership and policy that prepares the nation for the future while sustaining public trust and confidence today;
  - Create a supportive legal and regulatory framework that enables rapid introduction of new products and services;
  - Encourage open and fair global competition and markets; and
  - Invest in the future—workforce development, special-purpose national infrastructure and long-term research.
- Industry should:
  - Understand customer and market needs;
  - Produce quality aerospace products and services;
  - Invest in technologies and concepts that will provide a competitive advantage;
  - Leverage government investments in long-term research; and
  - Ensure that it has the manufacturing capacity and human resources needed to produce and sell new products and services quickly and affordably.
- Labor should:
  - Represent workers and ensure that they are treated fairly by employers,
  - Engage in collective bargaining on behalf of the workforce,
  - Hold industry accountable to the workforce and the communities where work is performed,
  - Develop and enhance existing training and apprenticeship programs, and
  - Provide a voice for workers.
- Academia should:
  - Play a leadership role in developing the well-educated, scientifically literate workforce that government and industry will need in the future, and
  - Perform cutting-edge research for the nation.

To date the success of private-public partnerships are mixed, but they are improving. One potential measure of the outcome of these partnerships is the number of jobs, wages, establishments and payroll data for the U.S. aerospace and aviation industry. Appendix E provides a summary of national, regional, state and metropolitan data collected by the Commission.

The Commission believes that all of the stakeholders must work together to ensure that the government can do its mission and the commercial sector to prosper and compete successfully. They all have a stake in the outcome; and all need to work together to ensure that the outcome is in the best interest of the nation and the American people.

Conclusions

The Commission concludes that the government must ensure that the nation has a healthy aerospace industry today and in the future, an industry that can not only meet the security and economic needs of the country but also can compete successfully in the international market place. The government needs to exert leadership and prioritize and promote aerospace by managing its activities efficiently, effectively and as a sector to accomplish national objectives. It needs to create an environment that fosters innovation in the U.S. aerospace industry, ensuring its competitiveness into the 21st century.

Create a National Aerospace Consensus. The federal government does not have a national aerospace consensus that supports broader national security and economic policies, goals and objectives. This will require Presidential and Congressional leadership to develop a consensus of federal, state and local government, industry, labor, academia and non-governmental organizations to sustain a healthy U.S. aerospace sector.

Reorient Government Organizational Structures. The federal government is dysfunctional when addressing 21st century issues from a long-term, national and global perspective. Government is organized vertically while national problems are becoming more horizontal in nature requiring system-of-systems solutions. Key government processes, such as planning and budgeting, are currently spread across multiple departments and agencies, with oversight by numerous Congressional committees. As a result, none of these government groups has an integrated view of our national aerospace efforts.

The executive and legislative branches need to be reoriented to provide a focus on national aerospace needs and priorities, government aerospace plans and budgets, and government management of national aerospace initiatives.

- *Federal Departments and Agencies.* Every federal department and most federal agencies should create an Office of Aerospace Development to prioritize and promote aerospace activities within their organizations and with the public that they serve;
- *Office of Management and Budget.* OMB should establish a Bureau of Aerospace Management to develop and implement an aerospace strategic plan, establish an acceptable categorical definition of the aerospace sector, prepare an annual aerospace sector budget as an addendum to the President's Budget Request, and manage major national aerospace initiatives; and,
- *White House.* The White House should establish an aerospace policy coordinating council to develop and implement national aerospace policy consistent with national security and economic goals and objectives.
- *Congress.* In response to these executive branch changes, the Commissions encourages the legislative branch to create a Joint Committee on Aerospace to coordinate legislatively the multi-faceted jurisdictional issues.

Streamline and Integrate Key Government Processes. Government processes for policy, planning, and budgeting, and for developing and acquiring aerospace products and services are vestiges of the Cold War. As a result, they tend to be ad hoc, complex, lengthy and inefficient. The Administration and the Congress need to make a concerted effort to streamline these key government processes to reflect the new realities of a highly dynamic, competitive and global marketplace. Specifically, they should work together to create: an integrated federal planning, budgeting and program management process; an integrated government science, technology and acquisition process; and an environment that fosters rather than impedes innovation in the aerospace sector.

Promote Private-public Partnerships. Partnerships and interconnectedness are keys to competitiveness in the future. Government, industry, labor and academia play different, but important, roles in developing and deploying new aerospace products and services. They cannot perform these roles separately and in isolation. But today, cultural and institutional biases hinder their ability to partner and achieve national goals. We need to create an environment and the incentives that will foster private-public partnerships.

RECOMMENDATION #5

The Commission recommends that the federal government establish a national aerospace policy and promote aerospace by creating a government-wide management structure. This would include a White House policy coordinating council, an aerospace management office in the Office of Management and Budget, and a joint committee in Congress. The Commission further recommends the use of an annual aerospace sectoral budget to establish presidential aerospace initiatives, assure coordinated funding for such initiatives, and replace vertical decision-making with horizontally determined decisions in both authorizations and appropriations.

RECOMMENDATION #6: The Commission recommends that U.S. and multilateral regulations and policies be reformed to enable the movement of products and capital across international borders on a fully competitive basis, and establish a level playing field for U.S. industry in the global marketplace. The U.S. export control regulations must be substantially overhauled, evolving from current restrictions on technologies through the review of transactions to controls on key capabilities enforced through process controls. The U.S. government should neutralize foreign government market intervention in areas such as subsidies, tax policy, export financing, and standards, either through strengthening multilateral disciplines or providing similar support for U.S. industry as necessary.

Chapter 6

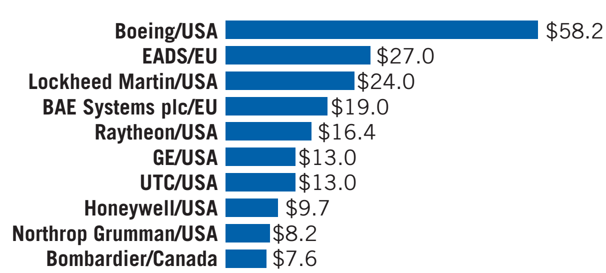
Global Markets: Open and Fair

U.S. aerospace companies currently enjoy a dominant position in the global market for civil and defense products. Seven of the world's top ten aerospace companies measured by annual aerospace-related sales are based in the United States. The success of U.S. aerospace companies has been a result of two factors: (1) government investments in long-term research and cutting-edge national infrastructure; and, (2) industry's ability to develop and integrate new technology into their products and services and achieve economies of scale in production through access to a broad global customer base.

Since the end of the Cold War, the U.S. aerospace industry has changed from an industry primarily dependent upon the defense market to one in which a significant portion of its sales are commercial. The result of this change is that for the first time in U.S. history aerospace companies must succeed commercially to remain viable. If they do not, the nation will lose its defense industrial base. As a result, the United States must maintain its global commercial leadership.

However, U.S. industry dominance of the commercial market is eroding. Some of this loss in market share is inevitable as other companies mature and improve their ability to compete. Government regulations, protectionist policies and our government's failure to invest adequately in technology innovation also are to blame. We must take action to reverse this erosion.

Figure 6-1 2001 Annual Aerospace-related Revenue (in billions) of Top Global Aerospace Companies



Source: company annual reports

The Commission wants to make it clear that we are not calling for industrial policy. Rather, we call for a policy of cooperation between the U.S. government and the U.S. aerospace industry to establish a fair and open competitive global market. Government policies and investments have a major impact on the health and future of the U.S. aerospace industry. Therefore, it is important that government and industry work together to achieve national policy objectives. For example, U.S. government investments in aerospace are viewed by some as commercial subsidies. They are not.

U.S. investments in defense provide security for America as well as for its friends and allies abroad. Likewise, U.S. government investments in long-term research and critical aerospace infrastructure benefit U.S. companies as well as companies around the world. National Aeronautics and Space Administration (NASA) investments in fly-by-wire technology, for example, were first applied to commercial aircraft designed in Europe. What concerns the Commission is that other governments are practicing industrial policy by funding the transfer of our research and theirs into commercial products and services, giving their industries a competitive advantage.

Objective: A Globally-Competitive Industry

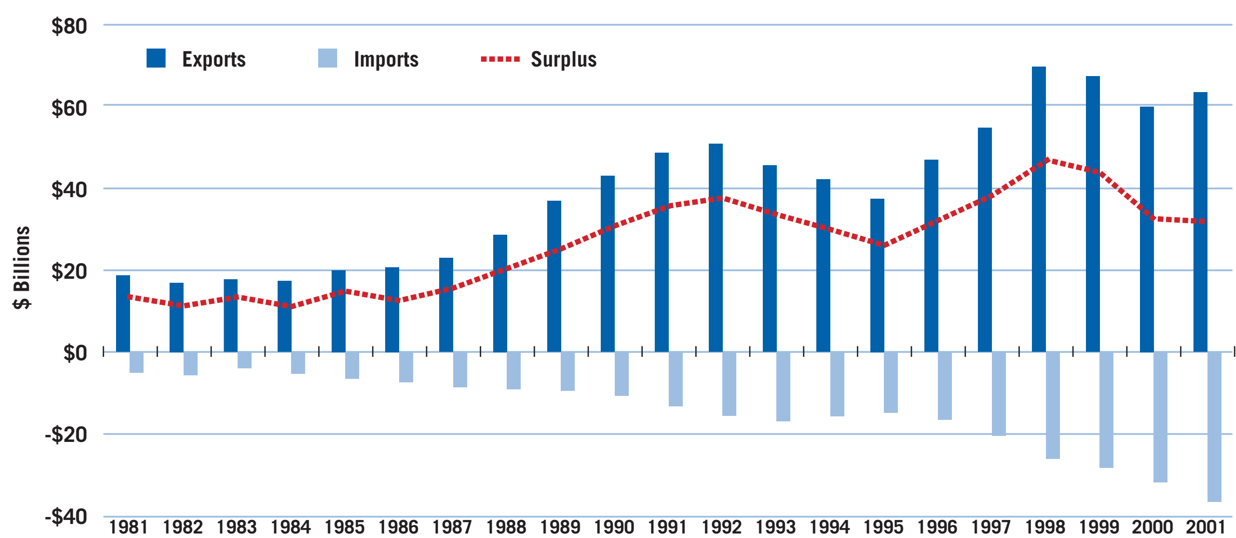
To lead an increasingly global industry, U.S. companies must remain at the forefront of technology innovation and continue to have access to global markets. This requires collaboration at the global system-of-systems level, such as in air transportation management, to establish common rules and procedures, and competition at the system level, such as aircraft, parts, components, to drive innovation, quality and efficiency.

The United States government must: (a) enable U.S. companies to retain their position at the forefront of technology innovation, (b) reduce government intervention in the market whenever possible, and (c) counteract government-generated market distortions when no alternative exists. Where other countries or coalitions of countries distort the market through policy, regulation or subsidy, the U.S. government must act to level the playing field. If successful, U.S. companies will compete in an environment characterized by:

- An export control system and military procurement policies that allow U.S. companies to

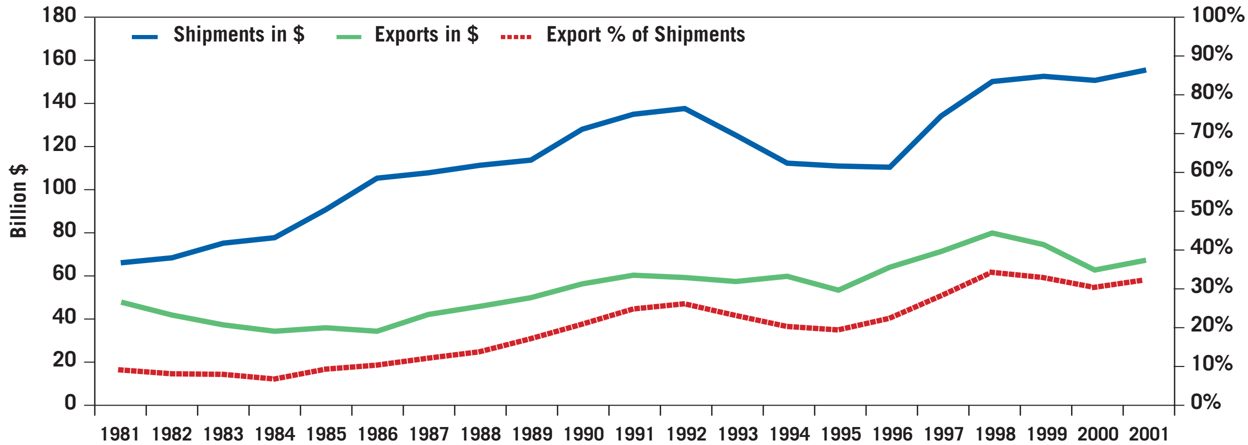
Figure 6-2 U.S. Aerospace Trade Balance*

*Includes aircraft, missiles, space vehicles and parts.



Source: Aerospace Industries Association

Figure 6-3 U.S. Aerospace Export Share of Production



Source: Aerospace Industries Association

compete and partner globally without compromising national security;

- Robust U.S. government funding for long-term research and development; and
- A global aerospace market free from distortions caused by protectionist and market distorting foreign government policies.

Issues

Open global markets are critical to the continued economic health of U.S. aerospace companies and to U.S. national security. International markets help U.S. companies to grow by providing a broad customer base. The 2001 U.S. aerospace trade surplus was nearly $32 billion, the largest surplus of any U.S. manufacturing sector. Over half of all U.S.-manufactured large civil aircraft are sold to non-U.S. customers, and foreign airlines represent the largest market growth prospects for the next 20 years.[1] Twenty-five percent of general aviation airplanes produced in the United States are sold to overseas customers.[2] Overall, exports consistently account for around one third of total U.S. aerospace production.

The Commission wants to make it clear that we are not calling for industrial policy.

Global demand for aerospace products and services increased dramatically over the last twenty years. Global airline fleets tripled as aircraft connected the world's economies with readily available and relatively affordable transportation. Governments around the world reduced tariffs and other trade barriers through multilateral and bilateral agreements, opening up new markets for airlines and for producers and reducing the cost of trade.

Revenues generated through export sales helped companies to fund development of new technology, and a broad customer base enabled U.S. companies to achieve economies of scale necessary to incorporate innovative technology into new generations of products. Open international markets enabled U.S. aerospace companies to retain production and jobs in the United States instead of forcing investment overseas to get around trade barriers.

International partners also have contributed to the economic success of U.S. companies and to our national security. These partners have contributed technology and funding to development of new civilian and military products and services. They have opened up new markets and strengthened our ties with allies. They are contributing to our national security by facilitating the increased cooperation and interoperability with allies required in emerging models of coalition and network-centric warfare.

Figure 6-4 Turbojet Aircraft in the World Airline Fleet by Country of Origin

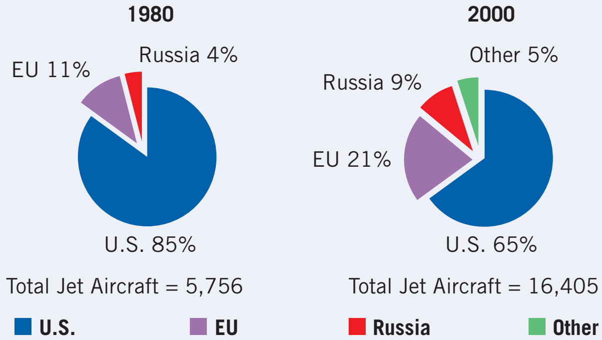


Figure 6-5 Turboprop Aircraft in the World Airline Fleet by Country of Origin

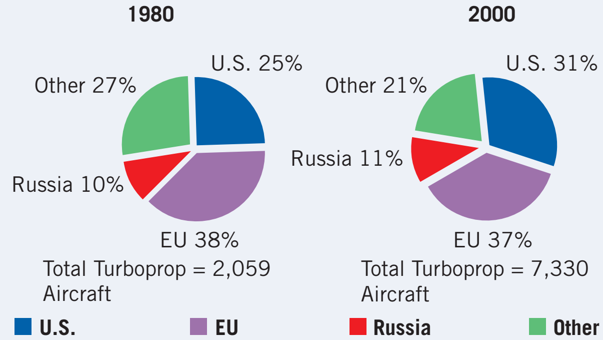


Figure 6-6 Turbine Helicopters in the World Airline Fleet by Country of Origin

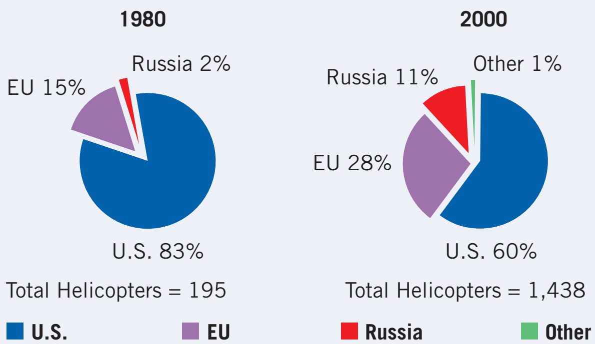


Figure 6-7 Installed Jet Engines in the World Airline Fleet by Manufacturer

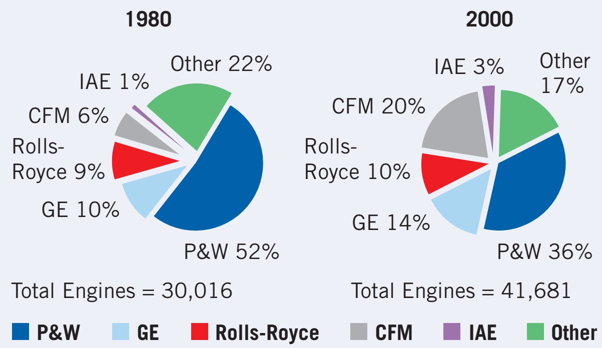


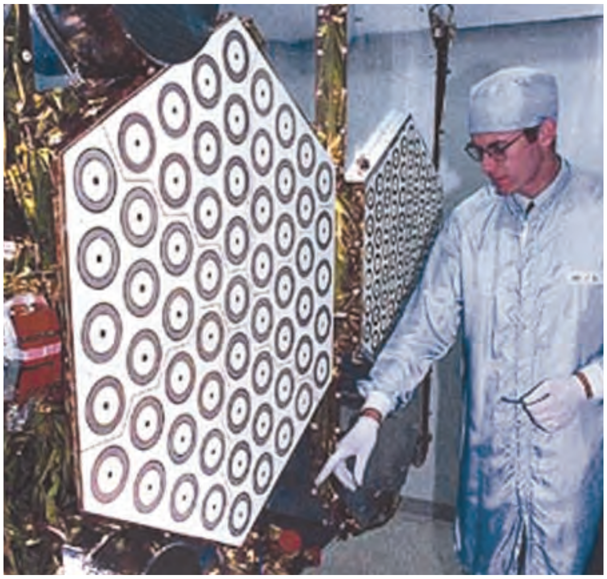
Figure 6-4 through 6-7 Source: Aerospace Industries Association

The U.S. industry share of the global market, however, has declined in key sectors over the last twenty years. We are on the brink of ceding our position as the top producer of large commercial aircraft, and are losing market share in civil helicopters and aircraft engines. We have made small gains in the commercial turboprop aircraft market, although regional jets are replacing larger turboprops in many markets.

The situation is somewhat better in space-related industries. The United States remains one of only two nations with human-rated space launch capability, and the only operator of a versatile space shuttle. Until 1999 U.S. companies led the world space launch market in terms of number of commercial and military launches, and have established a number of joint programs with Russian companies, their closest competitors.[3] U.S. companies dominate the world satellite manufacturing industry in large satellites and are very competitive in the manufacture of new smaller satellites. U.S. manufacturers continue to lead worldwide in sales and development of missile systems.[4]

We remain strongest in military aircraft markets. U.S.-origin aircraft dominate existing international fleets of military transports, tankers and helicopters.[5] Existing world fleets of Russian origin combat aircraft and non-piston engine trainers exceed those of U.S. origin, but U.S. market share is set to grow with the introduction of the Joint Strike Fighter and procurements of F-22 fighters, while sales and replacements of Russian fighter aircraft are weak at best.

Nonetheless, we have determined that continued dominance of each of these sectors is by no means assured. U.S. industry is slowly losing market share to foreign competitors.



U.S. companies dominate the world satellite manufacturing industry.

European companies present the most formidable competition to U.S. companies in global markets as the only other current producers of large civil aircraft and complete engines, and leading producers of helicopters and many elements of military hardware. Europe leads the world commercial space launch market, and European advances in satellite manufacturing capability as well as consolidation of the European missile industry may result in declining U.S. share of these markets.[6]

European companies also are our most important partners. U.S. companies collaborate more with companies from Europe than from any other country or region in the world, through partnerships on projects and systems, joint ventures and direct investment. Not surprisingly, Europe is the biggest customer of U.S. aerospace exports, as well as the largest supplier of U.S. aerospace imports.

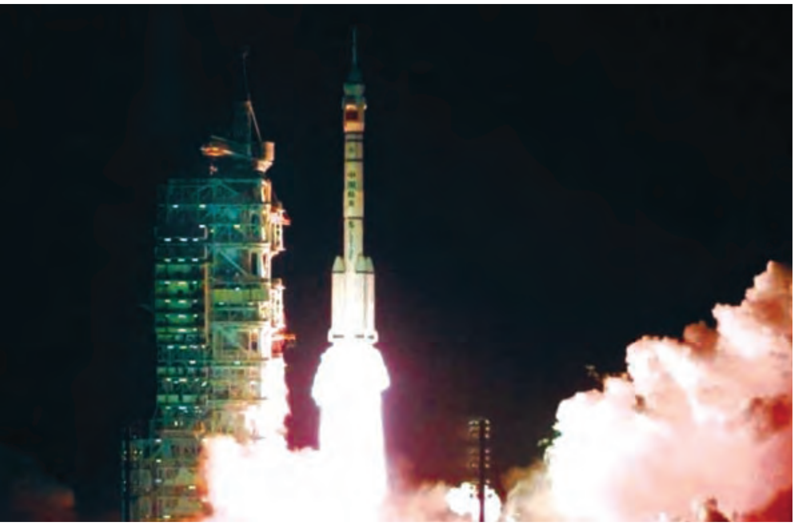
The Russian aerospace industry also is highly developed in all sectors, although most Russian aerospace manufacturing has ground to a halt under the weight of economic and political problems following the dissolution of the Soviet Union. This is turning around, in part because of the evolving relationships between U.S. companies and their Russian counterparts. However, it is unclear when and if Russian aerospace manufacturing will regain a competitive position in many sectors. Russia is an important partner in space flight and exploration, and a growing partner and competitor in commercial and military aerospace production.

Other countries with long-established aerospace industries historically have focused on producing a limited range of complete products and supplying parts and subsystems to other large manufacturers. They are now expanding their market presence with first-tier prime manufacturers.

For example, U.S. and Canadian aerospace industries have had close ties for decades with significant cross-border trade and investment. Successful sales of regional and business jet aircraft have propelled Bombardier into one of the top ten global aerospace industry companies with plans to break into the 100 seat commercial aircraft market. Japan has long been an integral supplier of small and large subsystems for a wide variety of U.S. aircraft and engine programs. Japan also produces a limited selection of indigenous civil and military aircraft and trainers. After nearly twenty years of development, Japan has just completed development of its first space launch vehicle to be offered on the global commercial market.

New partners and competitors in Asia and Latin America are further changing global market dynamics. For example, the Chinese aerospace industry has a number of civil and military aircraft programs under development. More importantly, the Chinese government has identified aerospace as one of

European companies present the most formidable competition to U.S. companies in global markets as the only other current producers of large commercial aircraft.



The Chinese government has identified aerospace as one of China's leading high-technology industries for the 21st century centered around a core government policy goal of self-reliance in the aerospace and defense sectors.

China's leading high-technology industries for the 21st century centered around a core government policy goal of self-reliance in the aerospace and defense sectors. Chinese companies seek to become world-class producers by 2012, in part via close cooperation with major international aerospace firms and enhanced supplier relationships with non-Chinese primes. Other Asian countries such as Korea and India also are establishing sophisticated aerospace industries. In South America, Brazil has emerged as a significant player in a number of areas, led by sales of regional aircraft to airlines around the world.

Competition is healthy. It drives innovation, quality and efficiency.

We are greatly concerned where the rise in foreign competition has been aided by persistent government intervention.

We are greatly concerned, however, where the rise in foreign competition has been aided by persistent government intervention. We see concerted strategies by other governments to unseat U.S. companies from their position of world leadership. Interventionist policies are being used as tools to establish and support "national champions" protecting them from market forces at the expense of U.S. industry. These policies are described in the "International Playing Field" section later in this chapter.

Many governments have well-established aerospace industrial policies because of the unique market dynamics of the industry and the blurring line between civil and military products. Aerospace is a complex, expensive and highly cyclical industry characterized by long lead times for new product development and purchase decisions. The aerospace industry also is highly susceptible to external factors such as terrorism or general economic downturn. And in spite of growing overall size of the commercial aviation market, it can support only a limited number of major aerospace manufacturers. As a result, governments often provide financial support to help their companies get into the market and to stay there.

Production choices are not made entirely according to immediate market demand and price. Manufacturers in essence "buy market share" by offering discounts to entice downstream sales of additional products, replacements, spares and repairs. Airlines tend toward equipment commonality to increase flexibility of their labor and route structure, as well as to reduce operation and maintenance costs. Military procurements often are focused on procurement of a single product to satisfy each particular requirement. In this environment, governments sometimes are able to sway procurement decisions with political pressure.

It also is difficult to separate commercial considerations from national security. Military users increasingly look to civilian aerospace products for military applications, and hence may intervene in civilian markets to protect military capability. For this reason, recent years have witnessed dramatic consolidation of the aerospace industry on a national level, but insufficient rationalization on a global level.

We have identified key areas of intervention that warrant a policy response from the U.S. government. These include:

- Restrictions on sales or transfer of technology to foreign customers through export controls;
- Restrictions on collaboration through partnerships, acquisitions, foreign investment and military procurement of foreign-sourced products;
- Significant government funding for commercial aerospace research and development, and in some cases assistance with the "launch" of new products;
- Tax law;
- Export financing for civil and military products;
- Obstacles to collaboration on commercial projects;
- Regulations and standards used by national governments to distort markets and provide their domestic firms a competitive advantage; and
- Insufficient commitment to global partnerships in air transportation systems and space activities.

Export Controls and Defense Procurement Policies: Impede Competitiveness

The preeminence of U.S. military aerospace capability is a direct result of our concerted policies to withstand and ultimately defeat international communism. In the early years of the Cold War, America and our allies were confronted by a numerically-superior opponent that threatened our European allies from secure interior lines of communication compared to our need to mobilize and project forces from the United States. To deter our opponent, we crafted a three-part strategy. First, we assembled a standing military alliance composed of democratic states committed to standing together against the threat. Second, we stationed substantial American forces in Europe and Asia on an indefinite basis and extended America's nuclear guarantee to our allies. Third, we committed ourselves to building a qualitatively superior military force to counter the numerical superiority of the Warsaw Pact.

Our qualitatively superior military force depended on substantial peacetime research and development to produce qualitatively superior weapons, and a systematic program to keep that advanced technology out of our opponents' hands.

The qualitatively superior military force depended on two subordinate strategies. First, we committed to a program of substantial peacetime research and development to insure we invented more advanced ideas and brought those ideas into production with qualitatively superior weapons. Second, we instituted a systematic program to keep that advanced technology out of the hands of our opponents through effective export controls.

ISSUES

- Export Controls and Defense Procurement Policies
  - – Restrictive Export Controls
  - – Collaboration in Defense Procurement
- International "Playing Field"
  - – Commercial Research and Development Funding
  - – Domestic Tax Policy
  - – Export Financing
  - – Commercial Mergers and Teaming
  - – Offsets
  - – Regulations and Standards
- Global Partnerships
  - – Air Traffic Management
  - – Open Global Air Transportation
  - – Cooperative Space Activities

The RAH-66 Comanche helicopter is one of the key upcoming aircraft programs that has been scaled back.

The strategy worked. The commitment to military superiority depended on those two equally important policies—strong continuing research and development and systematic export control. It should be noted that these policies never prevented the Soviet Union from stealing America's industrial secrets, or the secrets of our allies. Indeed, we were continually confronted by effective Soviet espionage that stole our military secrets. But in the main, the strategy worked because it insured that we stayed qualitatively ahead of our opponent. We won the race because we never stopped running.

The end of the Cold War brought about a shift in U.S. military research and procurement priorities, with negative consequences for the U.S. military aerospace establishment. U.S. Department of Defense (DoD) spending for aircraft research, development, testing and evaluation (RDT&E) declined dramatically in the 1990s. U.S. DoD aircraft procurements dropped by half during that period as well.

The end of the Cold War brought about a shift in U.S. military research and procurement priorities, with negative consequences for the U.S. military aerospace establishment.

The RDT&E trend appears to be reversing as the U.S. fights the war on terrorism and takes a new look at U.S. military capabilities and priorities. Hopefully this increase in spending is evidence of a long-term reorientation instead of a temporary aberration. Our defense investment is critical to provide for the security of the U.S. and the world. This increase is needed due to the lack of defense investment elsewhere in the world.

The outlook for military aircraft procurement is less clear. Although we now are committing more resources to keeping our military aircraft fleet flying, future aircraft procurement projects face an uncertain future. U.S. military planners are investigating options to fund transformational changes in our military capability to meet emerging needs. This has resulted in scaling back or canceling key upcoming aircraft programs, including the F-22 fighter, the V-22 tilt-rotor and the RAH-66 Comanche helicopter. However, air and space assets likely will continue to play a central role in any new concepts of military operations and warfare.

Restrictive Export Controls. One of the primary obstacles to the health and competitiveness of the U.S. aerospace industry is our own export control regime. Export controls have been and should be an important component of America's national security. We believe, however, current export controls are increasingly counterproductive to our national security interests in their current form and under current practices of implementation. In our judgment, export control reform is crucial to provide better security in the future and to insure the health and vitality of our aerospace industry.

As a central element of our concerted military policy, export controls took two forms. We tried to control the export of weapon systems directly through a system of export controls managed by the Department of State. We also tried to limit the export of commercial products and technology that could be applied to military purposes, the so-called “dual use” items. Dual use export controls were managed by the Department of Commerce.

Export controls largely worked because we created a consensus with our European allies to control the same things globally. All of the countries agreed to limit the export of military items. And the dual-use items were controlled through the Coordinating Committee of the North Atlantic Treaty Organization (COCOM) process.

At the end of the Cold War, several trends dramatically affected the course of export controls. First, the United States broadened the use of export controls beyond our Cold War strategy. Export controls and embargoes became a favored way to signal our disapproval of other countries and to express foreign policy objectives. Second, the consensus with our allies broke down after the end of the Warsaw Pact and the Soviet Union. The COCOM system was dissolved and replaced by a weak Waasenar process. European allies often saw our export restrictions as protectionism intended to enhance U.S. commercial competitiveness rather than national security measures. Third, the nature of advanced manufacturing and design evolved sharply as companies and consortia of companies established trans-national design teams. Just-in-time business practices evolved with international shipments of components being installed within hours of receipt at the loading dock.

Export controls, which were set up in an era of local manufacturing and slow paper-based processing, strained (unsuccessfully, we believe) to cope with the explosion of new technologies and business practices.

Over 180 individual export control licenses have been needed for export sales of C-130J military transport aircraft to the United Kingdom (UK) Royal Air Force, to support companies in the UK that are involved in the production of the aircraft. The U.S. prime manufacturer must apply for a new Technology Assistance Agreement every time the U.S. company needs to discuss technical issues for parts being manufactured by the UK partner. The UK company was selected for it's manufacturing expertise and capabilities and therefore it is difficult to see how this process is effective in protecting national security.

In the process, export controls became increasingly complex, elaborate and burdensome.

Our complaint about export controls is twofold. First, we believe export controls now provide too little security and impose enormous inefficiency. Some 40,000-export licenses are reviewed every year by the Department of State, and 99.8 percent of the licenses are approved, too often after many long months of review. The bulk of the licenses are required for prosaic items of equipment, often to our strongest allies. Ninety percent of the military export licenses are granted to companies exporting equipment and components to North Atlantic Treaty Organization (NATO) allies, for example. The current system fails to distinguish adequately between friend and foe, between cutting-edge and pedestrian technology.

Export controls largely worked in the past because we created a consensus with our European allies to control the same things globally.

Administrative hurdles and out-of-date information further exacerbate the inefficiencies of the system. Country risk surveys used to evaluate the willingness and ability of recipient nations to comply with restrictions on the unauthorized use or retransfer of U.S.-origin defense exports are woefully out of date. The absence of up-to-date information causes export-licensing authorities to depend on data that may no longer reflect current conditions in many United States defense export markets when evaluating licenses. It also puts U.S. negotiators at a disadvantage when consulting with other governments on how to strengthen compliance among the community of nations with whom the U.S. shares modern defense hardware and technology. Bad information makes for bad decisions.

More importantly, U.S. export controls are undermining one of the central goals of military planning during the past 30 years—alliance interoperability. We actively try to get allies to buy American military equipment to improve our ability to fight as an alliance, yet we bog down that process through nettlesome export controls. For example, during the Kosovo air war, allies were petitioning the DoD to intercede with the State Department to expedite license approval of weapon systems needed to arm combat aircraft flying side-by-side with American pilots.

Export controls are undermining the collaboration between companies in alliance countries on new system developments. Foreign companies have actually instructed design engineers to avoid American components because of the difficulty of acquiring license approval from the United States government.

We do think it is important to block the sale of stealth technology, for example, but see little reason to block the sale of five-ton trucks.

We believe U.S. export controls now provide too little security and impose enormous inefficiency.

The current approach to export controls is increasingly isolating the American aerospace industry from the commercial sector in an unproductive cocoon of regulation. The defense industrial base is falling farther and farther behind the commercial market place because it has to cope with excessive regulation.

The Commission is fully prepared to defend such regulation where it purchases indispensable security. But we are convinced that today's export controls do not. We do think it is important to regulate the sale of stealth technology, for example, but see little reason to block the sale of five-ton trucks. We see th need to formally decide whether to sell a combat aircraft to an ally, but we see little need to require hundreds of subsequent licenses for necessary support gear, training manuals, replacement spare parts, etc. We see the clear need to block the sale of military equipment and dual use items to irresponsible nations like Iran and Libya, but we see little justification to impose the same standards on our strongest allies.

During the Kosovo air war, allies were forced to petition the Defense Department to expedite license approval of weapon systems needed to arm combat aircraft, such as the Royal Air Force Harrier GR7, flying side-by-side with American pilots.

In sum, the current export control regime provides too little security and is choking American companies and preventing effective technology collaboration with others.

The United States export control system needs a thorough overhaul. We recommended a number of immediate reforms in Interim Report #2. However, if we are to improve the long-term competitiveness of our industry, minor tinkering on the margin is unacceptable and even counterproductive.

We call for a fundamental shift away from the existing transaction-based licensing system to process licensing.

Shift From Transaction to Process Licensing. We call for a fundamental shift away from the existing transaction-based licensing system to process licensing. Currently, we require an export license for every sale and every shipment. Instead, we should establish a process that approves a company for basic operations under predefined conditions. A useful analogy here is the way aircraft are produced. Before Boeing can sell a new design aircraft it must submit to extensive, detailed licensing approval by the Federal Aviation Administration (FAA) for that new design. It cannot be sold or delivered to a customer without that basic production approval. Once it is approved, however, Boeing does not need to subsequently test and safety-certify every subsequent aircraft that comes off the production line. The FAA certifies the design and the production methodology once for safety, and then monitors ongoing production on the basis of departures from the baseline design.

The export control system would be much more efficient if it were similarly reconfigured. Companies that wish to export would undergo a rigorous certification process to ensure they possess the internal controls that safeguard against the sale of weapons or dual use items to unacceptable parties. Once approved, the company would be free to sell and ship goods consistent with U.S. government policy. The government would monitor and audit those operations for compliance. In some instances, the government approval would require case-by-case approval of sales. For example, we believe the government would want to approve any and all individual sales of advanced technology like stealth technology, even to our strongest allies. Also, we believe the government would want case-by-case approval of any sale to countries that we judge to be serious security risks.

Additional Reforms Are Needed. This shift to a process approval licensing system will not be effective unless other elements of the U.S. export control policy are changed as well.

- Expand International Traffic in Arms Regulations (ITAR) Waiver Process to Allies With Appropriate Security Controls. Currently, the United States requires approval of exports of components even to a subsidiary of the same company that is located in a different country. Because of the integration of U.S. and Canadian production capacities, the United States entered into an agreement with Canada for license-free transactions of non-classified components between the two countries. Licenses are required if the item leaves either the United States or Canada for another country. We believe this streamlined ITAR waiver process should be expanded to other key allies. We believe that countries should be granted this waiver only after agreeing to appropriate security procedures with the United States.

- Fix the Munitions List. The current so-called "munitions list" is far too inclusive and out of date. It has not been reviewed since 1992. The list should be shortened substantially and refocused on items that meet the multilateral standards of significance, such as precursor chemicals for chemical weapons. It should no longer control commercial products and technologies that have been "modified or designed for" a military product, unless they substantially improve military performance. In particular, commercial communication satellites and related components should be removed from the "munitions list" and again be controlled as a dual-use product. The government should establish an annual review process to continually clean up the munitions list.

Just fixing the U.S. list is not enough. We must work with our allies to identify critical technology and come up with solutions on how to protect it. By and large, the United States and its allies agree on the items that should be controlled for nonproliferation reasons. However, we lack sufficient buy-in from the international community on actually getting the job done. The six major European countries that account for most European defense production have signed a Letter of Intent (LOI) to harmonize export controls for countries outside the group while facilitating defense trade and competition among the group. The United States should begin discussions with the "LOI six" to exchange ideas and to examine the possibility of a framework between the U.S., the "LOI six" and later with other industrial democracies.

- Establish an Objective Appeals Process. Currently, if the government rejects a license application, the applicant has no effective method to appeal the decision except to return to the same people who rejected it in the first place. The only other course is for companies to take up the matter at the highest levels of the government, a step that can be used rarely and with great peril. A more objective appeals process should be established. Ultimately only the secretary of a department has the authority to approve or reject a license. But the secretary should have an appeals board that can offer an alternative recommendation to the secretary if the panel decides the original decision was unwarranted. This way the secretary will have an independent perspective to consider before making a final decision. It also permits a more normal way for appeals to be made, other than through extraordinary intervention to senior officials that is largely unavailable except to the largest defense contractors.

- Extraterritorial Retransfers. One of the current great controversies in the export control system is the American insistence that no component part or technology from the United States that is used by a foreign producer can be sold to a third party without gaining permission each and every time from the United States. No matter how small the component is as a part of the entire system, the United States has asserted that it has exclusive control rights over the entire sale. This retransfer obligation should be retained for significant military equipment, such as complete end items. But for other items, the 25 percent de minimus content threshold originally developed by the Reagan Administration should be reinstated as the threshold governing extraterritorial retransfers.

- Compliance Risk Management. Decision makers must have an up-to-date and detailed understanding of the willingness and ability of recipient nations to comply with restrictions on the unauthorized use or retransfer of U.S.-origin defense exports. Updated country risk surveys are one key way of developing and maintaining this information. Moreover, up-to-date country risk surveys would provide a basis for government-to-government consultations to strengthen compliance among the community of nations with whom the U.S. shares modern defense hardware and technology.

Since the Commission's February 2002 public hearing, U.S. federal agencies have reviewed nearly half of the chapters of the U.S. Munitions List, including the chapter on aircraft. Agencies are considering removing a number of aircraft from the USML, as well as expanding the use of waivers for spare part export licenses to certain parties. As the first review of the USML in a decade, this is a step in the right direction. Nonetheless, this review will be insufficient unless it culminates in a comprehensive revision of the list.

- Administrative Streamlining. Finally, the federal government should make a major investment in streamlining the licensing administrative process. The Department of State should establish timelines and interagency dispute resolution procedures. The process outlined in the national disclosure process is appropriate. The federal government also should modernize the information technology backbone for the license approval process, and establish a totally interoperable system with all executive branch departments that have a role in the license review/approval process. Such a system ought to allow industry to file licenses and all supporting data electronically. Adequate staffing and training are fundamental to the success of any reform initiative.

Collaboration in Defense Procurement. Export controls are not the only problem—other U.S. military procurement policies also undermine our goals of alliance interoperability and U.S. competitiveness. In order to protect our position of military leadership and capability, we must re-evaluate military procurement policies that hamper collaboration with our allies.

Export controls are not the only problem—other U.S. military procurement policies also undermine our goals of alliance interoperability and U.S. competitiveness.

The United States has a number of restrictions affecting military acquisitions of foreign-manufactured products, systems and parts. U.S. legislation requires many military products to be manufactured in the United States. Even in instances where foreign procurement could be authorized, some DoD program managers have a bias against considering non-U.S. equipment.

These restrictions do not reflect the realities of a new global economy. Instead, they hamper U.S. industries' access to technology and impede their competitiveness. In some cases these restrictions limit U.S. industry and government access to superior capabilities and technology developed in other countries. In other cases it means that U.S. companies have to establish two separate production facilities for the same product to ensure that no foreign nationals are involved in producing the copy of the product going to the DoD. As commercial companies become more global, they will be less and less willing to go through the financial and administrative expense of selling to the DoD.

Existing solutions to this problem are cumbersome. Most foreign companies interested in selling to the DoD end up investing in U.S. companies or working through U.S. prime contractors. In fact, a number of leading European aerospace companies have an extensive presence in the U.S. market through "special security agreements" (SSAs) designed to prevent technology flows out of the U.S. from U.S. subsidiaries to their foreign parent companies. There certainly are benefits to this system. For example, the 1995 acquisition of the U.S. Allison Engine Company by Rolls-Royce plc of the UK has resulted in a stable, ongoing partnership that has brought benefits to companies on both sides of the Atlantic. As a result of this investment, the U.S. DoD is Rolls-Royce's largest single military engine customer. However, not only do SSAs prevent U.S. technology from leaving the country, so do they prevent U.S. subsidiaries from taking advantage of foreign technology advances.

If we do not change our procurement policies, it will become increasingly difficult to find competitive suppliers of military products as U.S. industry consolidates. We will be stuck with sole-source contracts for critical technologies, and may be forced to subsidize U.S. suppliers just to keep them operating.

Support International Collaboration and Procurement. U.S. government procurement rules should be revamped to support increased collaboration with, and in some cases procurement from, non-U.S. based companies. The resulting competition will drive innovation and efficiency, and allow the government to choose items at the best cost and performance, regardless of where it is produced. It will promote interoperability with key allies, a critical element to the success of the emerging model of coalition and network-centric warfare. It will enable U.S. industry to take advantage of the best technology available anywhere in the world, integrating it into products for the U.S. warfighter.

We are doing this in the Joint Strike Fighter program, bringing in technology from key allies, securing access to additional markets, stabilizing funding and ensuring the long-term sustainability of both U.S. and partner defense industries. This close partnership also establishes a channel of influence when dealing with these countries on defense and national security issues. We recognize that this partnership is a two-way street, providing foreign governments and suppliers some level of influence over production and maintenance of U.S. military equipment. However, if projects are correctly managed this is a manageable concern, since further integration will bring a dual dependency resulting in convergence of views.

The Bush Administration is taking positive steps in promoting international collaboration on other key defense programs as well. For example, the DoD is investigating the possibility of including international partners in development of its new ballistic missile defense system. In July 2002 at the Farnborough Air Show, Boeing and the European Aeronautic Defense and Space company (EADS) announced plans to work together on missile defense in response to the DoD's policy. EADS already is a major subcontractor to Integrated Coast Guard Systems (ICGS) recently selected by the U.S. Coast Guard to work on the Deepwater Capability Replacement Program ("Deepwater"). As a major subcontractor to ICGS, EADS will refurbish and supply helicopters and surveillance aircraft.

We need to reform DoD procurement regulations to permit integration of commercial components into military products even if they are provided by non-U.S. companies or worked on by foreign nationals. For example, if a commercial aircraft is to be upgraded with military hardware, the company should not have to set up a separate assembly facility to ensure that particular aircraft are not worked on by foreign nationals.

We are not calling for unilateral opening of our defense market. Key allies must offer reciprocal access to U.S. companies bidding in foreign procurement competitions. Increased U.S. procurement of foreign products can only work if our companies have access to their markets as well.

We need to reform DoD procurement regulations to permit integration of commercial components into military products even if they are provided by non-U.S. companies or worked on by foreign nationals.

Countries seeking access to our defense market also must reconsider their investment priorities. These allies should invest their limited development budgets in creation of new capabilities instead of seeking to displace sales of existing U.S. products. Such targeted investment will bring bigger returns and advance the overall capabilities of all parties. This partnership has established a strong foundation for cooperation with our allies in NATO and elsewhere in the past that must not be weakened in an effort by some parties to simply broaden the product range of domestic champions.

International partners have contributed technology and funding to the multinational Joint Strike Fighter program.

The U.S. government should protect the strength and viability of the U.S. industrial base in certain areas of critical technology and capability. This includes continuing to procure the most critical equipment from U.S. prime contractors, and careful consideration of partnership/teaming requests. The United States government should remain committed to continued foreign investment in the United States with the appropriate safeguards for U.S. technology. The U.S. government also should continue to monitor closely the transfer and use of sensitive technology to ensure that it stays in the control of our partners. Most importantly, policies on procurement and teaming must be clear and consistent, enabling companies to make judicious decisions on new projects and acquisitions.

NASA rotorcraft research was eliminated entirely in Fiscal Year 2002, bringing an end to rotorcraft wind tunnel testing at the Ames Research Center.

International "Playing Field": Out of Balance

Commercial Research and Development Funding. Although we are ahead of other countries in investment in military technology and capability, we are on the edge of dropping out of the race in the civil sector. Instead of continuing to invest, our government has increasingly pulled back from the civil aerospace market and left it up to U.S. companies to compete against competitors subsidized by governments that have "not stopped running."

The U.S. government historically has limited civil aerospace technology-related funding to basic research, creating enabling technologies and sharing the results with U.S. and non-U.S. companies. We have left it up to the companies to integrate these technologies into commercial products.

NASA spending for aerospace research has declined in recent years, resulting in fewer and less robust programs.

NASA spending for aerospace research has declined in recent years, resulting in fewer and less robust programs. NASA rotorcraft research was eliminated entirely in Fiscal Year 2002. In those projects that remain, the U.S. government is cutting off funding at earlier stages of technology development as a cost-saving measure. FAA R&D funding has remained flat in recent years in the midst of plans to completely overhaul our air traffic control system. These budgets are likely to decline in the near future as FAA diverts funding from all areas to aviation security.

Starved of funds, the U.S. government research and development infrastructure is deteriorating as well. Some NASA research facilities have closed, while others are saddled with an aging infrastructure and declining number of programs. In fact, the percentage of the budget NASA must spend on maintaining aging infrastructure has increased over the last ten years, displacing money intended to be spent on other aspects of the research programs.

Instead of increasing private funding for basic R&D, U.S. industry spending has fallen off too. Because companies contribute money and resources when they participate in government-funded R&D

Langley Research Center's 16-foot Transonic Tunnel, which has been making major contributions to the aerospace community for nearly 50 years, will be mothballed in 2003 due to budget cuts.

projects, a reduction in federal funding is matched by a corresponding decrease in industry funding. Companies have little incentive to fund basic research on their own because capital markets and stockholders shy away from risky investments with indeterminate returns.

Chapters 5 and 9 addresses in more detail the need to reverse this decline in federal civil aeronautic R&D funding. Although there are many reasons to take action in this area, declining international competitiveness is near, if not at, the top of the list.

Other countries do not share the United States' philosophy regarding civil aerospace research and development funding. Many take their funding beyond basic technology development, choosing to fund product development and even bringing the product to the market (also known as product launch). These governments seek to establish and support aerospace producers, even if their products are not fully commercially viable. In their view, the benefits of employment in a high-value and high-tech industry, establishment of a national aerospace industrial base and even national pride outweigh the costs of market distortions. This has become one of the most politically charged forms of government intervention requiring U.S. government attention.

Foreign government subsidies directly affect the competitiveness of our companies. Subsidized prime manufacturers as well as suppliers are able to undercut prices offered by their U.S. competitors, and are better able to weather market downturns. Subsidized companies are able to secure cheaper commercial financing since their governments share the risk associated with bringing new products to market. Subsidized production skews the market itself by flooding it with products that are not commercially viable. Governments providing the subsidies also apply political pressure on customers in an effort to facilitate a positive return on the governments' "investments". In many cases, these government subsidies stifle competition and often slow the introduction of new technology into the market.

European funding has had the most dramatic impact on U.S. competitiveness because European products directly compete with U.S. products in most sectors. This problem will be compounded as other governments fund new competitors that will seek to enter an already saturated market. If we maintain the status quo, U.S. industry will be left to compete against companies that don't play by the same rules.

European and U.S. companies benefit from similar types of government funding in many respects. European governments fund military R&D and buy aerospace products, albeit at lower levels than the United States. Accordingly, European Union (EU) aerospace companies benefit from enhanced technology capability and a strengthened aerospace industrial base in the same manner as U.S. firms benefit from U.S. military spending. However, some EU officials have indicated that in the absence of sufficient defense contracts, they seek to establish and sustain their aerospace industrial base through commercial aerospace subsidies. European industry and some NATO officials have called for increasing European military procurement and improving capabilities, although such changes are likely to come about slowly. More importantly, there has been no corresponding call for reducing funding for commercial aerospace products in light of increased military investment.

Like the U.S., individual European governments provide funding for basic civil aerospace research in many areas such as materials, aerodynamics, safety, propulsion, systems and manufacturing processes. This has led to a number of basic technology advances ranging from composites to greater fuel efficiency. Participation in these programs, and access to the research results, is limited to European firms.

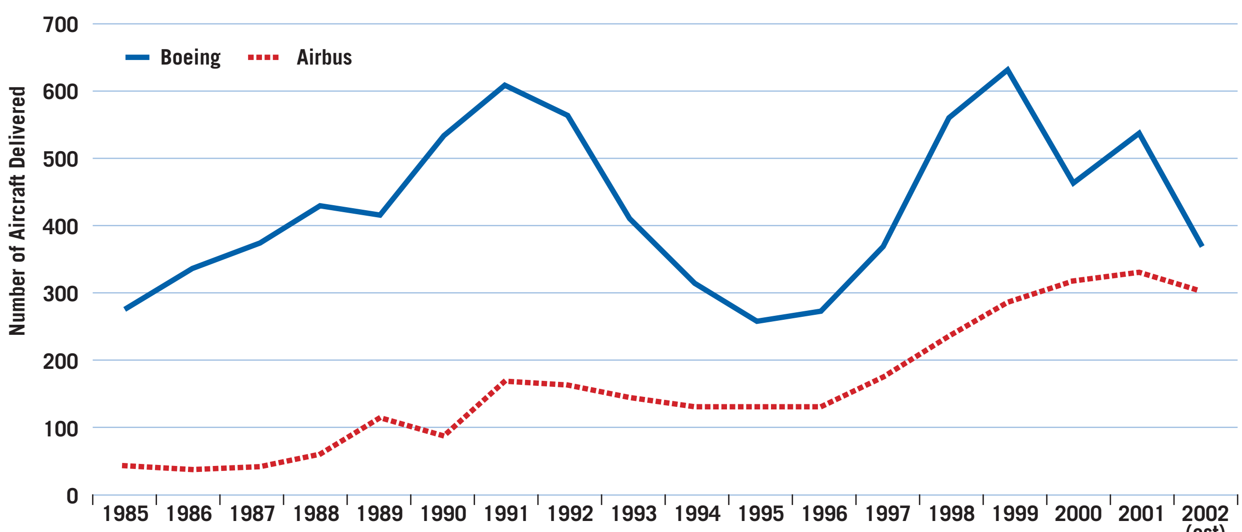
The EU supplements its member state basic R&D funds via European Commission (EC) "framework programs" (FPs). In contrast to declining NASA and FAA funding, FP funding has increased dramatically since 1987. The first EU four-year FP (1987 – 1991) consisted of $35 million in R&D assistance to the aerospace industry. This figure jumped to nearly $1 billion in the sixth EU FP (2002 – 2006).[7] According to the EC, Sixth Framework funding goals are to enhance the competitiveness of European commercial aerospace manufacturers, improve EU air traffic management and other safety issues, reduce emissions and aircraft noise and enhance the space industry. An advisory committee was established in 2001 to create EU-wide aerospace research goals and coordinate EU member state activities in an effort to improve the effectiveness of European basic research.

European and U.S. government approaches diverge on the issue of project "launch aid" (financially supporting the introduction of commercial aerospace products in the market). The U.S. has never supplied "launch aid" for commercial products. In contrast, "launch aid" funded development of almost every large commercial aircraft and aircraft engine model produced by European companies. As one example, over 75 percent of total development costs for Airbus commercial aircraft, totaling over $30 billion at current market value, were paid by European governments to help Airbus establish a competitive product line. Thus far, Airbus has repaid an estimated 25 percent of these total development costs according to the U.S. Commerce Department.

As another example, UK engine company Rolls-Royce plc has received nearly $2.2 billion since 1975 in government "launch aid" for the RB-211 and successor Trent engine programs that constitute the bulk of their engine offerings for Airbus and Boeing large commercial aircraft. According to government and private sector sources, an estimated $300 million of that launch aid has been repaid, with the majority of this debt erased from the slate at privatization in 1987 and during subsequent royalty repayment loan forgiveness by the UK government. Beyond this support, multiple European aerospace companies have received equity infusions (sometimes concurrent with privatization) to cover losses.

Figure 6-8 Boeing vs. Airbus Deliveries*

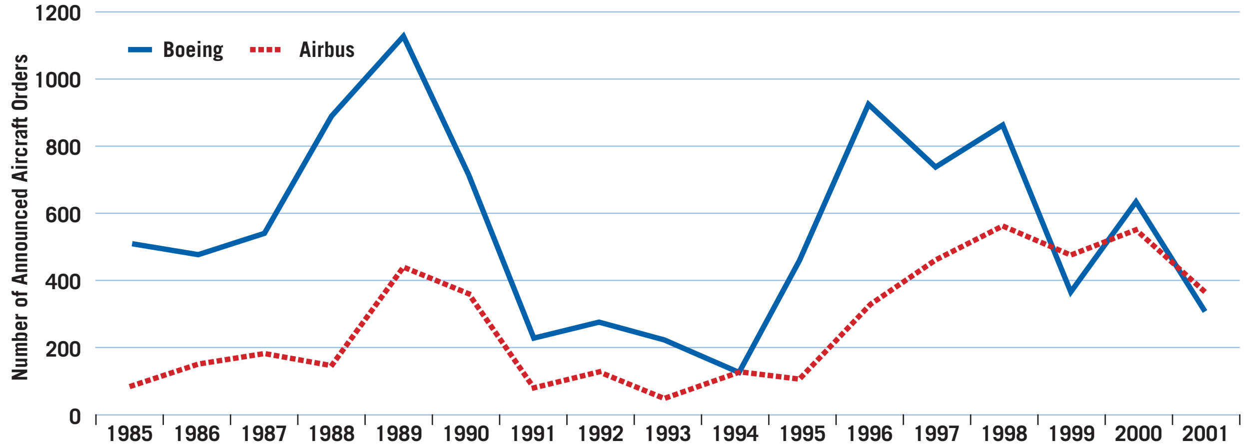
*Number of large civil jet transport aircraft produced; Boeing figures before 1997 include aircraft models manufactured by McDonnell Douglas



Source: U.S. Department of Commerce

Figure 6-9 Boeing vs. Airbus Announced Orders*

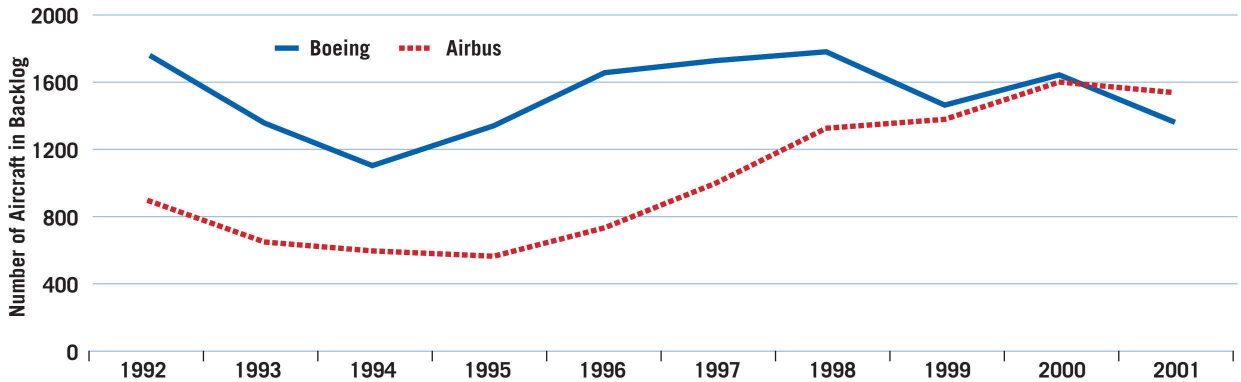
*number of new large civil jet transport aircraft orders announced by each manufacturer, not adjusted for unannounced order cancellations; Boeing figures before 1997 include aircraft models manufactured by McDonnell Douglas.



Source: U.S. Department of Commerce

Figure 6-10 Boeing vs. Airbus Backlog*

*Backlog of large civil jet transport aircraft to be manufactured; Boeing figures before 1997 include aircraft models manufactured by McDonnell Douglas.



Source: Aerospace Industries Association

Often European subsidies are targeted specifically to replace U.S. suppliers with European companies. The EC subsidy to Sextant to develop the avionics suite for the A340 provides a clear example. In its approval of this subsidy, the French government cited the goal of displacing the U.S. supplier of avionics for earlier models of that aircraft.[8]

European funding for the "launch" of new commercial products is continuing. Nearly $4 billion in government public funds have been allocated for development of the Airbus A380,[9] and nearly $385 million have been allocated by the UK government for new Rolls Royce engine derivative projects.[10] In both cases, funding is being provided in the form of royalty-based loans that don't have to be fully paid back unless the projects are a complete commercial success.

To the Europeans' credit, their funding strategy has been very successful. EU companies have developed robust commercial product lines that are slowly displacing U.S.-produced commercial aircraft and helicopters, aircraft engines and components. Government subsidies have aided in this rise of European industry competitiveness.

The recently unveiled EU aerospace policy strategy calls for an increase in subsidies to continue building market share, largely at the expense of U.S. companies.

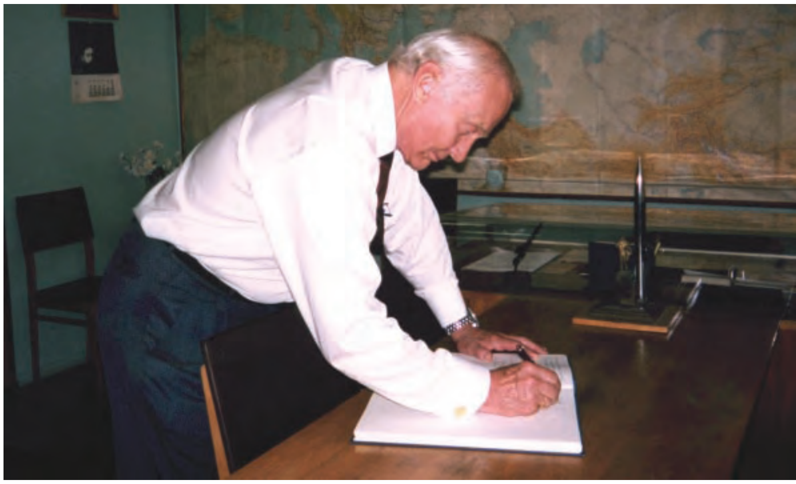
European subsidies to Airbus had a direct impact on the exit of McDonnell-Douglas from the market as an independent large civil aircraft (LCA) manufacturer and its subsequent merger with Boeing. European government and industry officials repeatedly have cited the goal of Airbus achieving a fifty percent share of the global LCA market. With Airbus surpassing Boeing in terms of orders and backlog in 2001 and possibly poised to exceed Boeing in deliveries in 2003, it appears that the Europeans are achieving their goal.

Unfortunately, it appears that European officials intend to continue directly subsidizing EU companies. The recently unveiled EU aerospace policy strategy calls for an increase in subsidies to continue building market share, largely at the expense of U.S. companies. If trends continue, European companies may soon gain market leadership in other products and technologies as well. This fundamental mismatch of declining U.S. government R&D funding for basic research and increasing European government funding for both basic research and product development is reaching crisis proportions for U.S. industry. This challenge cannot go unanswered.

Disputes over subsidies are likely to be exacerbated in the coming years as other governments look to Europe as a role model and support their indigenous manufacturers in an attempt to establish or gain market share. Countries such as China have well-established plans to foster their domestic aerospace manufacturing capability for military and civil aircraft. Production by Russian aerospace manufacturers has fallen off greatly since the dissolution of the Soviet Union, and the Russian government has implemented a number of protectionist policies in an attempt to rebuild their industry.

Stop Direct Commercial Product Subsidies. In order for the playing field to be level, foreign companies need to be subject to the same market forces as their U.S. competitors when seeking funding for the introduction of new products to the market. We should support the further privatization and increased transparency of European companies so they become more responsive to company shareholders than to government planners. Establishment of EADS as a private company is an important step in this direction. Another positive trend is European companies reportedly seeking other risk-sharing partners to cover nearly a third of the development costs for the two newest commercial aircraft-related programs, namely the Airbus A380 and the Rolls-Royce Trent 900 program to power the A380. Increasing availability of commercial financing may reduce European industry dependence on government subsidies.

In reality, European companies are unlikely to stop taking government money if European governments keep offering it. Therefore we should make every effort to work bilaterally with EU governments to get them out of the business of "product launch". This will be very difficult. European officials offer grossly exaggerated claims of U.S. subsidies to commercial aircraft programs through funding of military research and procurement as justification for their continuing subsidies. U.S. efforts to clear up these misconceptions thus far have fallen on deaf



Former Apollo astronaut and Commissioner Buzz Aldrin signs Yuri Gagarin's Tribute Book at Star City Russia.

ears, but we should continue to press our case. We are skeptical that bilateral efforts with European governments or other market newcomers will be sufficient.

Any truly workable solution must therefore be multilateral in nature. International trade agreements have significantly liberalized trade of civil aerospace products and reduced government intervention in the civil aerospace market, starting in 1979 with the negotiation of the General Agreement on Tariffs and Trade (GATT) Agreement on Trade in Civil Aircraft. This agreement has successfully eliminated import tariffs on aircraft, engines and parts by signatories, and had some impact on reducing government intervention in procurement decisions.

Under the pressure of a possible U.S. challenge of European subsidies to Airbus in the GATT, U.S. and European negotiators went to the table to draft the 1992 Agreement U.S.–EU Agreement Concerning the Application of the GATT Agreement on Trade in Civil Aircraft on Trade in Large Civil Aircraft (the "1992 Aircraft Agreement"). This agreement further clarified the type and extent of financial and political support U.S. and European governments could provide to large aircraft manufacturers.

Our response must be to fix the World Trade Organization instead of abandoning it.

The 1994 Marrakech Agreement establishing the World Trade Organization (WTO) contained further disciplines on market-distorting subsidies through the Agreement on Subsidies and Countervailing Measures (ASCM). Together, these three trade agreements provide relatively robust disciplines that theoretically establish a level playing field for global aerospace producers.

Although WTO provisions are established to ensure there is fair and open trading between signatory nations, the system breaks down when one party chooses to violate the agreement. Application of remedies becomes difficult when addressing actions by nations in support of global companies with global customers and partners. Governments may be reluctant to pursue trade cases in the WTO for fear of starting a devastating trade war. Globally-focused companies may be reluctant to press for action against their subsidized competitors for fear of losing access to foreign suppliers or customers because of counter-retaliation or political pressure.

Failure to enforce WTO provisions, however, results in distorted competition where the subsidized company gains market share at the expense of unsubsidized companies. The only option left is to subsidize in kind. Once one country steps out of line, the rest follow. We find ourselves in a "race to the bottom", where both parties would find it in their best interests to withhold subsidies but instead find themselves pressured to take the exact opposite course.

The ongoing dispute between Brazil and Canada over violations of the ASCM by both parties in support of regional aircraft sales shows both the strength and the weakness of WTO provisions in addressing aerospace subsidies. A WTO Dispute Panel conducted an objective study of both countries' subsidy programs and found them to be in violation of the ASCM. A successful resolution to this dispute has been far more elusive, as neither party has been willing thus far to eliminate the market distorting effects identified by the panel.

Our response must be to fix the system instead of abandoning it. The U.S. government should work to strengthen the existing WTO provisions restricting the use of subsidies to distort the market. This could be a combination of new and/or more stringent subsidy disciplines applicable to aerospace companies to be negotiated in the WTO Doha round of negotiations. This will be a difficult challenge as previous attempts have been only partially successful, perhaps due to a failure of all parties to commit to finding a workable solution. In any event, existing provisions must not be weakened.

The U.S. government also should work with other WTO members to adopt more effective trade remedies to address distortions that do occur. These remedies must be usable and effective in a market characterized by increased globalization. We cannot let the WTO become a forum where member governments seek to divide up markets and production work shares. Instead, WTO members must commit to work together to eliminate market distortions to enable competition between companies, not between countries.

Despite the deficiencies of the existing system, the U.S. government should not shy away from challenging illegal subsidies under applicable WTO provisions. All parties have negotiated these provisions in good faith and willingly agreed to them. Accordingly, the U.S. government should require that European and other governments live up to their obligations. This includes obligations in the 1992 U.S.–EU Aircraft Agreement as well as the WTO.

We also believe there is a compelling case to help our companies get back in the technology race by revising our policies on investment in basic research and development. The U.S. government should not provide "product launch" funding for new programs. However, we should increase funding for investigation of revolutionary enabling technologies and processes such as propulsion, materials, communications, air traffic management and security. In areas where we conduct basic research, the government should bring technology to a more advanced level of technology readiness than is current practice to assist with technology diffusion among the industry. Without such investments, our companies will only fall farther behind.

Domestic Tax Policy. Like subsidies, tax policies impact the prices companies are able to offer in international sales. Accordingly, tax policy is the source of another long-standing dispute between the U.S. and the EU. EU countries rely heavily on a value-added tax (VAT) for revenue. The VAT tax is imposed on imports and rebated at the border for exports. EU countries also tend to tax their companies more leniently on overseas earnings than on domestic profits. Similar benefits are not traditionally available to U.S. companies under domestic U.S. tax law.

To create a more level playing field, over thirty years ago the United States government established a provision in U.S. tax law that permitted U.S. companies to reduce domestic taxes on a share of profits derived from exports. This regime, called the DISC (Domestic International Sales Corporations), was intended to offset the competitive advantage offered to European companies via the VAT system. Europe challenged the DISC program under multilateral rules (the GATT) as an unfair advantage to U.S. companies, and the U.S. challenged the VAT system in response. Following negotiations with the Europeans, in 1984 the U.S. government established the U.S. Foreign Sales Corporation (FSC) tax regime, replacing the DISC with a more restrictive regime that still leveled the playing field.

Fifteen years later, Europe once again challenged U.S. tax law under multilateral rules, even though WTO negotiators had refrained from establishing explicit WTO rules on domestic taxation. Although the FSC system directly offset tax benefits available to European competitors, the WTO determined that the FSC regime was an illegal export subsidy inconsistent with WTO rules. In an effort to become WTO compliant, the United States repealed FSC and enacted the "FSC Repeal and Extra-territorial Income Exclusion Act of 2000" (ETI) regime in November 2000. The WTO subsequently ruled that ETI also was not in compliance.

We highlighted in Interim Report #2 the need for the United States to work closely with the EU to find a mutually agreeable solution to this dispute in order to avoid the up to $4 billion in trade sanctions against the United States threatened by the EU. Retaliation of this magnitude would be devastating to U.S.–EU trade relations. However, U.S. companies will face a significant competitive disadvantage if a replacement U.S. tax regime is adopted that does not counter the export-related benefits to European companies of their VAT system. Loss of the ETI tax incentive would result in declining sales as U.S.

manufacturers have to raise prices to compensate for the increased tax burden, and may result in the loss of U.S. employment as companies move jobs to off-shore facilities that enjoy favorable tax treatment by foreign governments.

The U.S.–EU dispute over FSC/ETI will have a particular impact on U.S. aerospace companies. Because they generate a significant portion of their revenue from export sales and their primary competitors are European companies who receive VAT benefits, many U.S. aerospace companies are active users of the FSC program.

Negotiate Permanent Solution to Tax Disputes. In the near term we must seek to delay European sanctions while both parties negotiate a solution. We urge the President and Congress to authorize changes to U.S. tax law that are WTO compliant but that continue to offset the advantage enjoyed by European companies. The Commission highlights some favorable proposals for such changes in Chapter 7, namely an enhanced national security R&D credit and proposals offered by the National Foreign Trade Council related to wage credits and changes in accordance with WTO rules (including "Footnote 59" of the WTO ASCM). The Commission urges the Administration to work with industry and Congress to develop an equitable resolution to this dispute.

In the longer term, the Administration should initiate changes in the WTO rules to remove the current inequity in the treatment of direct and indirect taxes that caused the dispute in the first place. We are not advocating the global harmonization of tax law, rather we wish to ensure that WTO rules create a level playing field.

Export Financing. The U.S. government also has sought to eliminate unfair pricing practices and to level the playing field in the area of government-supported export financing.

Financing plays a critical role in the ability of customers to procure military and commercial aircraft. International agreements, such as the Organization for Economic Cooperation and Development (OECD) Arrangement on Officially Supported Export Credits, establish ground rules for governments seeking to support commercial export financing by absorbing some of the risk of loan default by customers. These financing arrangements, known as export credit agency (ECA) programs, facilitate the purchase of aircraft by customers who would not otherwise have sufficient access to commercial financing.

The U.S. Export Import Bank (Ex-Im Bank) supports financing for sales of commercial aircraft as the U.S. ECA. Ex-Im Bank loan guarantee applications are rigorously reviewed for commercial viability and risk before they are approved, resulting in an excellent history of repayment. Nonetheless, Ex-Im Bank has congressionally appropriated funds to cover losses from high-risk projects that exceed program fees.

Ex-Im Bank funding programs for exports of commercial aircraft are an essential tool to counter discounted or otherwise preferential financing terms offered by foreign manufacturers with the assistance of their governments. Continued support from Ex-Im Bank is particularly important in light of a recent agreement among European ECAs to expand their export credit support for European aircraft and engines.

Ex-Im Bank financing also enables airlines from poorer countries or with credit problems to access financing they need to keep operating and to integrate safer and more environmentally friendly aircraft into their fleets. Airlines struggling to survive the current downturn in global traffic will become more reliant upon these programs in the near future.

Continue Commercial Aircraft Official Export Financing. Continued funding for Ex-Im Bank is important to the U.S. aerospace industry. The U.S. government also should support efforts to reduce international reliance on ECAs for export financing assistance, such as through ratification of the "Cape Town convention" (The International Institute for the Unification of Private Law Mobile Equipment Convention and Aircraft Protocol). This convention

The House Armed Services Committee has proposed expanding the list of countries eligible for DELG assistance in an effort to make the program more usable. We supported inclusion of this provision in the FY 2003 Defense Authorization legislation, and encourage further revisions to the program.

and protocol sets rules that determine the order in which creditors will get paid if an airline defaults on mortgage payments. The certainty provided by these rules helps airlines to access cheaper financing and helps creditors to make wise loan decisions.

The U.S. government falls short in providing necessary financing for military aircraft exports. The Defense Export Loan Guarantee (DELG) program established by Congress in 1996 provides a framework for such financing, but the shortfalls in the program are evidenced by its limited use. The DELG program shares most of the characteristics of the Ex-Im Bank loan guarantee program for civil sector exports with an important exception—the defense loan guarantees are not subsidized with funds appropriated to the DoD. Because of statutory constraints and regulatory and administrative practices, this program has proven to be unattractive to potential foreign customers—only one small transaction has been executed in more than five years of operation. As a result, the United States is the only significant exporter of defense-related equipment without an effective military-related exports credit mechanism.

Modernize the DELG. The DELG program needs to be modernized to permit the DoD to create an effective export credit organization that will facilitate the financing of defense exports to U.S. allies and friendly nations abroad. Modernization of the DELG should remove dysfunctional statutory and regulatory constraints that frustrate implementation of the DELG statute. A number of legislative and policy changes would make this program more effective. For example, customers should be permitted to finance their exposure fees, the lists of countries eligible for DELG financing should be expanded, and administrative costs should be reduced. These reforms are highlighted in more detail in the Commission's Interim Report #2.

In addition to DELG reforms, Export Import Bank funding could be extended to military equipment purchases and the Foreign Military Sales (FMS) program could be updated.

Commercial Mergers and Teaming. International collaboration between companies and much needed rationalization of the global aerospace industry are impeded by a number of foreign government policies on foreign investment and mergers and acquisitions in the commercial sector. Oftentimes countries impose restrictions in these areas to protect their "national champions" from national or international competition.

Because of the increasing global nature of production and customers, foreign governments have increasing jurisdiction over mergers or teaming plans of U.S. companies. This becomes a competitiveness issue when foreign governments make decisions based on different criteria than the U.S., or based on concerns about the market share of their own "national champion".

This issue has been most prominent in Europe. United States and European officials appear to have different philosophies on consolidation and partnerships. U.S. regulators tend to investigate the impact of a merger on the consumer and the ultimate monopoly power of the company in the overall market. EU policy makers seek to preserve stability of the internal European market and to protect market share of European companies competing with U.S. companies.

The EU imposed a number of conditions upon the 1997 merger between the Boeing Company and McDonnell Douglas in an attempt to prevent any competitive advantage of the new company over their own Airbus Industrie. More recently, concerns about the competitive impact on EU based manufacturers apparently contributed to the EU rejection of the General Electric-Honeywell merger in spite of U.S. anti-trust approval.

All countries, including the United States, have some level of restriction on foreign investment in sensitive industries to preserve national security. However, we are concerned about instances where countries such as Russia restrict foreign investment in their commercial aerospace industries to foster their national champions. In fact, these restrictions can be counterproductive when they isolate companies from international markets and much-needed sources of capital investment.

For example, U.S. aerospace companies have invested extensively in Russia over the last ten years, providing much needed financial support and access to global markets for Russian products and capability. Multiple partnerships between U.S. and Russian companies in the space launch industry have had a significant impact on the global launch market. U.S. and Russian civil aerospace manufacturers also have worked extensively together to develop Russian aircraft with U.S. parts, systems and even engines and to secure FAA safety certification. However, domestic political pressure on the Russian government has led to restrictions on foreign investment in Russian aerospace companies, potentially resulting in divestment by U.S. companies in their Russian partners and depriving them of the myriad benefits of international collaboration.

EU policy makers seek to preserve stability of the internal European market and to protect market share of European companies competing with U.S. companies.

Remove Obstacles to Commercial Mergers and Teaming. The U.S. government should remove policy and regulatory obstacles to increased commercial mergers and teaming within the U.S. and with international partners. Examples of the benefits of this business model abound. Most commercial aircraft engine programs today are characterized by extensive international collaboration, where U.S. and foreign partners combine their technology and investment capital to bring new engines to the market. U.S. prime producers of large civil aircraft and helicopters also rely heavily on foreign suppliers and partners to provide critical elements, components and expertise.

U.S. suppliers benefit from this business model as well, as evidenced by the regional jet industry. The global market for regional jets is only big enough for a limited number of manufacturers, but until recently was plagued by oversupply. The manufacturing base has undergone some consolidation/rationalization in recent years with the exit of Fokker and BAE from regional aircraft production. Following the impending departure of Fairchild-Dornier from this market segment, Embraer (Brazil) and Bombardier (Canada) will be the remaining regional jet manufacturers in business today.

U.S. prime manufacturers have not directly pursued the regional jet market. However, U.S. suppliers have significant content on both the Embraer and the Bombardier aircraft models. In fact, U.S. companies provide nearly 70 percent of the hardware to Embraer for assembly, from engines to electronics to structural components.[11] In turn, Embraer is a key supplier of structural components to Boeing for other aircraft. U.S. suppliers benefit from an increased market for their products, and U.S. customers win as some of the largest customers of these Brazilian and Canadian regional jets.

The U.S. government should assist in developing and policing international anti-trust treaties relating to mergers/teaming between commercial entities. Such multilateral agreements could minimize divergence of requirements and the methods of assessment, presumably making reviews more objective. The U.S. government also must continue to work bilaterally with key countries to remove barriers to foreign investment.

OFFSETS. "Offsets" are a form of market distortion in global aerospace trade that can take on the form of forced collaboration. Offsets are conditions that a foreign government negotiates with a company seeking to export a major defense or commercial system to its country. Under an offset agreement, the exporting company agrees to either shift some production of the system and/or parts to the procuring country, or to offer some other technological or economic benefit. Procuring governments usually seek to negotiate the best offset package possible from all competing bidders, e.g., U.S. and foreign aerospace companies.

Offsets are most prevalent in defense procurements because governments negotiate the terms of the sales. According to figures gathered by the U.S. Department of Commerce and the Office of Management and Budget, the dollar value of defense offset agreements negotiated with U.S. companies as a percentage of the export sales with which they are associated has ranged from 34 percent to 98 percent over 1980 – 1998. U.S. exporters of defense systems complete approximately $3 billion per year in defense offset transactions with other nations. The dollar value of defense offset agreements relative to defense exports has remained stable over time; however, ancedotal evidence provided to the Offsets Commission suggests that offset demands may have grown qualitatively as the receiving countries increasingly require specific results rather than best efforts from the U.S. exporters and seek greater technology transfer.[12] These figures in most cases exceed the actual dollar value of offsets provided, since procuring governments usually will associate higher values to offsets that are more important to them and hence use a "multiplier" to equate the actual offset and the negotiated percentage.

Offsets also can be involved in exports of commercial aerospace products and systems where governments own or have influence over the buyer, such as state-owned or controlled airlines. There is little data on the prevalence of commercial aerospace offset requirements since the government does not have any effective or comprehensive reporting requirements for offsets in the commercial industry. Industry surveys indicate that countries require offsets on a relatively small percentage of commercial export sales.

The full impact of offsets is difficult to determine. Such agreements can reduce the U.S. content in the product or system being exported, and can shift some production or technological capability to the procuring country. This may result in a shift of U.S. jobs to foreign suppliers. However, if an offset agreement enables a U.S. company to make an export sale that would not have occurred without the offset, the effect is to create additional work and jobs in the United States. Offsets also can provide U.S. industry access to new markets and technology. We highlight concerns about the impact of offsets on the U.S. workforce in Chapter 8.

Reactivate Offsets Commission. To minimize any negative impact of government-mandated offsets on the U.S. aerospace industry and employment, the United States should maintain its policy of discouraging such offset requirements by foreign governments. Unilateral restrictions that prevent U.S. producers from participating in offset agreements likely would shift demand to other countries, reducing business for a wide range of U.S. prime contractors and subcontractors. Therefore the U.S. government should pursue a multilateral solution to curtail offset demands.

The National Commission on Offsets in International Trade established in 2000 to examine the use of offsets has not undertaken further study following the publication of an interim report in January 2001. Reactivating that Commission may be the best alternative for developing policy recommendations on this issue.

REGULATIONS AND STANDARDS. Global standards and regulations are critical to the efficient operation of the global aviation system and international markets. They provide predictability and stability that companies and customers alike need to make wise investment choices. They are the avenue through which governments ensure the safety and security of air travel. They also facilitate the free movement of goods and people by creating transparency of policies and compatibility of products and systems. Governments use standards and regulations to pursue other goals in the public interest as well, such as reducing the environmental impact of aviation.

To minimize any negative impact of government-mandated offsets on the U.S. aerospace industry and employment, the United States should maintain its policy of discouraging such offset requirements by foreign governments.

The decline of traditional trade barriers has led to an increasing impact of standards and regulations on the competitive position of U.S. companies. To gain competitive advantage, some countries have established domestic standards or regulations that do not fully reflect or, in some cases, ignore global aerospace standards and practices.

Since the signing of the Chicago Convention in 1944, the International Civil Aviation Organization (ICAO)—a specialized agency of the United Nations (UN)—has served as the forum for establishment of international civil aviation standards and recommended practices that have enabled development of the aerospace industry as we know it today. As a consensus organization made up of representatives from almost every nation of the world, ICAO has been and remains the right place for aviation standards and practices to be developed and policed.

In view of the increasing international competition, the U.S. has not kept pace by devoting adequate resources to the development of global standards. As of the end of 2001, U.S. citizens occupied only 11 of the 27 staff positions the United States is entitled to hold in ICAO. Our involvement in ICAO often is further hampered by general U.S. government policy regarding the UN, such as the zero nominal growth policy for UN budgets. Even though we want and need ICAO to do more to support global aviation, we are prevented from providing the resources necessary to do so. Lack of resources and reduced involvement in ICAO and other international cooperative efforts erode the image of the U.S. FAA as a global leader. The U.S. is losing its position as the de facto standard setter.

In contrast, European governments actively are seeking global leadership in this area, often at odds with U.S. and other country interests. They have devoted increasing resources to international standards-setting bodies such as ICAO in an effort to shape global standards and regulations. The EU also is active in providing technical assistance to third-country regulators in an effort to influence their regulatory decisions. When they are not satisfied with the process or outcome of international deliberations, the EU has chosen to establish unilateral regulations to force their position.

The unilateral European "hushkit" regulation (European Council Regulation-EC No. 925/1999) established in 1999 by the EU clearly illustrates the need for internationally agreed-upon standards. The stated goal of the hushkit regulation was to provide European citizens relief from aircraft noise, but the regulation was constructed in a way that it had a disproportionate impact on U.S. products and airlines. U.S. industry-estimated economic damage caused by the European hushkit regulation approached $2 billion in lost sales of aircraft engines and hushkits and reduced asset value of U.S. airline fleets.[13]

This dispute has been partially resolved by ICAO adoption in October 2001 of a new aircraft noise standard and related policy guidelines. U.S. political leadership and technical expertise was instrumental in developing this global consensus on aircraft noise. It is exactly this sort of effort from the U.S. government that must be sustained, as well as expanded in other areas. Future unilateral regulations, especially environmental regulations related to aircraft noise and emissions, constitute a serious threat to fair and open trade.

Another example of regulation being used to further EU competitiveness goals relates to aircraft safety certification. European authorities appear to have used delays or denial of certification of U.S. aircraft to be operated in Europe for competitiveness reasons instead of safety or objective technical reasons. There are numerous examples where additional certification testing or procedures were required or where the certification process was unjustifiably prolonged for particular U.S. manufactured aircraft models. The resulting delays caused by European regulators worked to the benefit of European manufacturers.

Reinforce Commitment to Leadership in Global Standards. In most cases, a multilateral solution is the best remedy for regulatory trade barriers. Global standards would reduce the burden on manufacturers, provide clarity and constancy of requirements and ensure the playing field is level.

The U.S. government needs to devote adequate leadership and resources to the development of global standards in ICAO and via other forums. The United States has been a leading voice and influence in ICAO since its inception, although that influence is waning. We are not critical of increasing European involvement in ICAO—in fact, we welcome an increasing reliance on international standards. The U.S. government must follow suit and commit sufficient funding and staff resources to ensure U.S. views are integral to ICAO discussions and decisions. Particular attention should be paid to the development of global environmental standards and recommended practices through ICAO, based on objective analysis and common metrics.

An increased commitment to ICAO includes an expanded U.S. presence at ICAO. We must proactively support the placement of U.S. citizens in leadership and staff positions in the ICAO organization. This means devoting more attention to recruitment for ICAO positions and actively supporting FAA employees who make working for ICAO a career objective. There is no better way of ensuring U.S. views are well represented than having U.S. citizens working at ICAO.

U.S. officials must have sufficient funding to participate in ICAO meetings and to cover operational expenses too. Industry has spent significant money and resources to facilitate the development of ICAO standards and procedures. This partnership with industry is critical to the successful establishment of standards, but the burden should not fall solely on their shoulders. The United States cannot afford to be left behind as a result of not devoting adequate resources to protect our interests.

The U.S. government also needs to do a better job of coordinating U.S. policy positions before bringing them to international forums. In spite of best efforts, the existing interagency coordination process is not always effective in giving equitable weight to the views of each agency or in avoiding unclear or conflicting U.S. positions in international negotiations. The government structure reforms outlined in Chapter 3 would facilitate this coordination.

Although ICAO is in essence a consensus organization, numbers still matter. Therefore, we take issue with one element of increasing European involvement in ICAO—the European voting block. The U.S. is disadvantaged in ICAO discussions by the European voting block of fifteen European votes to one U.S. vote when there is a disagreement. The United States government should oppose adding a voice in ICAO for the EC unless it will replace individual EU member state votes instead of complementing them.

Our cooperation should not be limited to activities in ICAO—some issues such as requirements for safety certification may be best addressed bilaterally. The United States should continue to devote resources to harmonizing U.S. and foreign safety certification requirements to ensure the highest level of safety while reducing the burden of meeting multiple requirements in different countries. Harmonizing aircraft safety certification also would reduce the ability of foreign authorities to unfairly restrict U.S. industry access to their markets. This will require a commitment to international exchanges of technical experts and policy makers as well as a concerted effort to develop support of all the necessary constituents affected by such a harmonization.

Global Partnerships: Lack of Commitment

The importance of global standards and cooperation extends beyond avoidance of regulatory barriers to trade. International partnerships are essential to the creation of system-of-systems solutions to global challenges.

Air Traffic Management System. In order to move people and goods anywhere around the world, anytime, we need a global air traffic management system. In Chapter 2 we discuss the need to transform our management of U.S. airspace through the use of advanced technologies and improved procedures. We also need to ensure that there continues to be a seamless transition for aircraft entering or leaving U.S. airspace. Therefore, the transformation will be successful only if the United States acts in concert with other governments around the world in a number of areas.

Fundamentally, the overall architecture of the new system we envision must be compatible with that of neighboring airspace, requiring cooperation on near-term upgrades as well as long-term development plans. We are encouraged that long-term development plans issued by Eurocontrol and other foreign authorities appear similar to the new system we are proposing. The FAA must continue to consult with their foreign counterparts to ensure that these development plans are coordinated.

Common operational procedures and standard protocols are critical elements of compatibility. Through ICAO, aviation experts have established recommended practices to guide the operations of pilots and air traffic controllers. Pilots and controllers will rely on each other and share information in new ways in the proposed new system. As a result, the United States should lead development of new operational guidelines through ICAO, as well as promote opportunities for training of pilots and controllers in the new procedures.

Interoperable technology is another critical element of compatibility. ICAO now is developing standards and recommended practices for global navigation satellite services, one element of the new system we propose. The United States should lead ICAO efforts to accelerate work in this area, bringing together existing technology and expertise gained from American GPS and Russian GLONASS systems and new systems of the future. We also must start work now in ICAO to identify additional areas where introduction of new ATM technology will require common standards and procedures, and commit technical and policy resources to assist in their development. A failure of the United States to commit sufficient resources and attention to ICAO work in these areas could have disastrous implications for our efforts to field a new system.

We also must ensure that deployment of a satellite-based navigation and ATM system is not thwarted

by disputes over radio spectrum allocation. The United States must work cooperatively with other countries via the World Radio Conference and other multilateral forums to ensure that the necessary frequencies are available around the world. For us to be effective, U.S. government officials must coordinate policies among our own government agencies as well as commit the resources needed for active participation in international negotiations.

U.S. government officials must coordinate policies among our own government agencies as well as commit the resources needed for active participation in international negotiations.

European plans to establish the "Galileo" satellite constellation system could either help or harm efforts to establish a new global ATM system. Galileo is intended to provide the same type of service as the existing Global Positioning System (GPS) constellation owned and operated by the United States government and available to all users for free. GPS and other satellite services would serve as the foundation of our proposed new ATM system, providing better navigation and positioning information to pilots and to controllers around the world.

The impact of Galileo on the global air traffic system and on U.S. industry depends largely on how European policy makers choose to develop and operate their system. In the best-case scenario, Galileo would offer enhanced capability as well as redundancy to users of the satellite navigation system, although we are skeptical that establishment of a completely redundant system is necessary or even a wise investment of limited budgets. To be compatible, Galileo and GPS must use common protocols and not interfere with each others' signals.

In the worst-case scenario, Galileo signals would be incompatible or even interfere with GPS signals. We are concerned that current European government proposals for funding development, deployment and operation of Galileo could lead to just such a conflict. European governments do not intend to fully fund Galileo as the U.S. government funds and operates the GPS constellation. Instead, the EU intends to rely on commercial revenues from the sale of access to Galileo signals. We are unclear how the EU intends to generate demand for a fee-based system that offers the same service as a free system, unless EU regulators mandate the use of Galileo transponders and services by European companies or within the borders of the EU. We strongly oppose any such mandate. It would be very harmful to U.S. and all other non-European industry and create artificial barriers to the integration of European and neighboring airspace. Such a scenario surely would be grossly detrimental to the global aviation community.

U.S. government officials must work bilaterally and multilaterally to ensure GPS and Galileo are compatible and complementary in the event that Galileo becomes a reality. There have been some positive steps taken by U.S. and EU officials over the last year toward this goal, and we urge those officials to continue their discussions. We also must collaborate with others in the global aviation community to develop common standards and procedures in support of a truly seamless system of worldwide capability.

Open Global Air Transportation. A safe, efficient global transportation infrastructure provides little benefit if airlines are not able to use it. We therefore call for increased liberalization of air transport services. Growing demand for air traffic will translate into the need for more planes and equipment, benefiting passengers, airlines and manufacturers around the world. Therefore, continued liberalization of the air transport market is another critical prerequisite to the continued growth and competitiveness of the U.S. aerospace industry.

Restricted access to airports is a problem. The United States government should continue to negotiate "open skies" agreements that allow domestic and foreign airlines to use airports and airspace more productively by reducing overcapacity and enabling more point-to-point travel. This will avoid reliance upon congested hubs and reduce the cost and time of travel for the passenger, an issue of particular importance given the increased prevalence of security-related delays.

Cooperative Space Activities. Our cooperation should not be limited to terrestrial-based systems. We discuss in detail recommendations related to space in Chapter 3, but would be remiss if we failed to mention some key points related to the global nature of space exploration and planetary defense.

Space Exploration. The success or failure of our future efforts in space exploration is linked to our ability to work effectively with international partners. The magnitude of establishing a permanent presence in space and exploring new systems is too great to undertake alone—nor would we want to. Beginning with the first Apollo-Soyuz mission in 1975, we have learned that collaboration in space exploration benefits all parties as we set aside differences and pool our resources to achieve common goals.

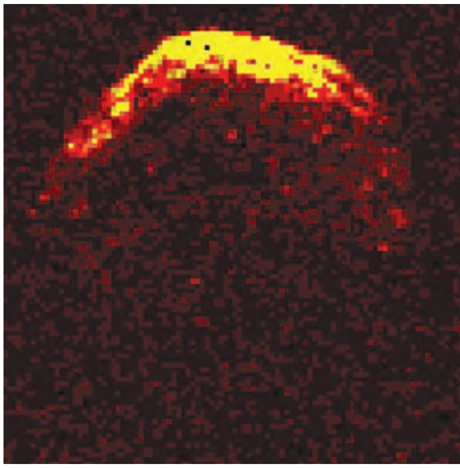
Although we are responsible for managing and operating the International Space Station (ISS), U.S. government decision makers must remember that U.S. funding and policy decisions directly affect the ability and willingness of international partners to participate in the ISS program. We want and need the ISS to be an international endeavor. ISS partners contribute expertise and resources fundamental to the operation of the station.

The success or failure of our future efforts in space exploration is linked to our ability to work effectively with partners on projects such as the International Space Station.

NASA must consider carefully the impact on international partners of decisions to restructure or reorient U.S. space exploration priorities. This includes decisions on a crew return vehicle needed to boost ISS staffing to a level beyond basic operation of the station. ISS partners have invested significant resources and expertise in developing and producing research modules and other ISS components that simply won't be used unless there is sufficient staffing on board.

Planetary Defense. Cooperative space efforts also should include planetary defense against Near Earth Objects (NEOs) ranging from asteroids to comets that come near (or impact) the earth. NEOs pose a potentially serious threat for the planet and for human kind. Scientists point to evidence of NEOs striking the earth millions of years ago, dramatically altering the climate and life on earth. The 1908 "Tunguska event" in Siberia, estimated to have had an impact equivalent to a 40 megaton bomb, was a more contemporary warning that this threat is real. Recent press reports have highlighted a series of near-misses on a planetary scale where NEOs the size of small cities came dangerously close to striking the earth.

NEOs represent a truly global problem in need of a truly global solution. The U.S. government must work with other countries through the UN and other organizations on efforts to integrate a planetary surveillance, identification and defense system.



Radar image of Asteroid 1950 DA, which may have a close encounter with Earth in 800 years.

Conclusions

Open global markets are critical to the continued economic health of U.S. aerospace companies and to U.S. national security. In order to remain global leaders, U.S. companies must remain at the forefront of technology development. They must also have access to global customers, suppliers and partners in order to achieve economies of scale in production needed to integrate that technology into their products and services.

Government intervention continues to distort global markets, from subsidies to anti-competitive restrictions on partnerships and collaboration to biased standards and regulations. U.S. companies frequently find themselves competing against foreign competitors supported directly or indirectly by their governments. We need to move to a different model of business characterized by competition between companies instead of between countries.

Open global markets are critical to the continued economic health of U.S. aerospace companies and to U.S. national security.

Reform Export Controls and Defense Procurement Policies. U.S. national security and procurement policies represent some of the most burdensome restrictions affecting U.S. industry competitiveness.

We call for a fundamental shift away from the existing transaction-based export-licensing regime to process-based licensing. Under this new system, the government would rely on companies to safeguard against the sale of controlled technologies to unacceptable parties through internal company controls certified by the government. The government then would monitor and audit those company operations for compliance. Such a process-based licensing regime would improve security, reduce licensing costs and enable our companies to collaborate with international partners and sell to global customers.

Additional reforms, including those outlined in Interim Report #2, are necessary to make this new system effective. As quickly as possible, the government should revise the U.S. Munitions List, remove barriers to global project licenses, expand waivers for trading with friendly nations, and update country risk surveys to facilitate better policy decisions.

U.S. procurement regulations currently are too restrictive and must be modified to be supportive of a global industrial base to meet military requirements, while maintaining U.S. industrial capacity in critical technologies and capabilities. We need to reform DoD procurement regulations to permit integration of commercial components into military products even if they are provided by non-U.S. companies or worked on by foreign nationals.

Establish a Level International "Playing Field". U.S. companies have lost market share to foreign companies supported by protectionist and market distorting policies. The U.S. government must take immediate action to neutralize these distortions and enable fair and open competition.

We must continue to meet our responsibilities of setting national goals and priorities for basic research, reverse declines in basic R&D funding and expand efforts to fund technology diffusion through U.S. industry.

We also must work bilaterally and multilaterally to get foreign governments out of the business of commercial "product launch." In spite of inadequacies of the current WTO system, the U.S. government should work in the WTO Doha round of negotiations to strengthen the existing WTO provisions restricting the use of subsidies to distort the market. The U.S. government also should work with other WTO members to adopt more effective trade remedies that are usable and effective in a market characterized by increased globalization. When countries do violate existing provisions, we should not shy away from taking action.

We must ensure that U.S. companies are not disadvantaged by differences between U.S. and foreign tax policies as exemplified in the current WTO dispute over U.S. FSC/ETI regulations. In the near term we must seek to delay European trade sanctions while both parties negotiate a solution to this dispute. We urge the Administration and Congress to authorize changes to U.S. tax law that are WTO compliant but that continue to offset the advantage enjoyed by European companies. In the longer term, the Administration should initiate changes in the WTO rules to remove the current inequity in the treatment of direct and indirect taxes that caused the dispute in the first place.

Official export credit support for commercial and military products is an essential tool to facilitate U.S. aerospace exports. In addition to continued funding for U.S. Ex-Im Bank programs, we should seek to reduce international reliance on official export credits for export financing assistance, such as through ratification of the "Cape Town convention." For military exports, the DELG should be modernized to permit the DoD to create an effective unsubsidized export credit organization to facilitate the financing of defense exports to U.S. allies and friendly nations abroad.

The U.S. government should remove policy and regulatory obstacles to increased commercial mergers and teaming within the U.S. and with international partners. The U.S. government should assist in developing and policing international anti-trust treaties relating to mergers and teaming between commercial entities to minimize divergence of requirements and the methods of assessment in anti-trust reviews, presumably making reviews more objective. The U.S. government also must continue to work bilaterally with key countries to remove barriers to foreign investment.

Global standards and regulations are critical to the efficient operation of the global aviation system and international markets. The U.S. government needs to step up its commitment to the development of global standards in ICAO and via other forums. This will help to mitigate the efforts of other countries seeking to provide a competitive advantage for their companies through biased domestic standards or regulations.

Commit to Global Partnerships. International partnerships are essential to the creation of system-of-systems solutions to global challenges.

In order to meet our goal of transforming the way we use airspace through the use of advanced technology and improved procedures, we must act in concert with other countries around the world. We must commit to developing common standards and recommended practices for satellite navigation in ICAO, and ensure that global cooperative efforts are not thwarted by disputes over radio spectrum allocation. We strongly urge U.S. officials to work bilaterally and multilaterally to ensure that U.S. GPS and European Galileo systems are compatible and complementary in the event that Galileo becomes a reality.

U.S. policy makers should work toward global standards for safety certification as a way to prevent the use of safety certification by some governments to enhance their domestic competitiveness. We also call for increased liberalization of air transport services through negotiation of open skies agreements in order to expand the demand for all countries' air transport services and alleviate undue congestion at the largest airports.

The success or failure of our future activities in space is fundamentally linked to our ability to work effectively with international partners. It is in our country's best interest to work cooperatively with partner nations in space exploration and protection of our planet from the threat of NEOs.

RECOMMENDATION #6: The Commission recommends that U.S. and multilateral regulations and policies be reformed to enable the movement of products and capital across international borders on a fully competitive basis, and establish a level playing field for U.S. industry in the global marketplace. The U.S. export control regulations must be substantially overhauled, evolving from current restrictions on technologies through the review of transactions to controls on key capabilities enforced through process controls. The U.S. government should neutralize foreign government market intervention in areas such as subsidies, tax policy, export financing, and standards, either through strengthening multilateral disciplines or providing similar support for U.S. industry as necessary.

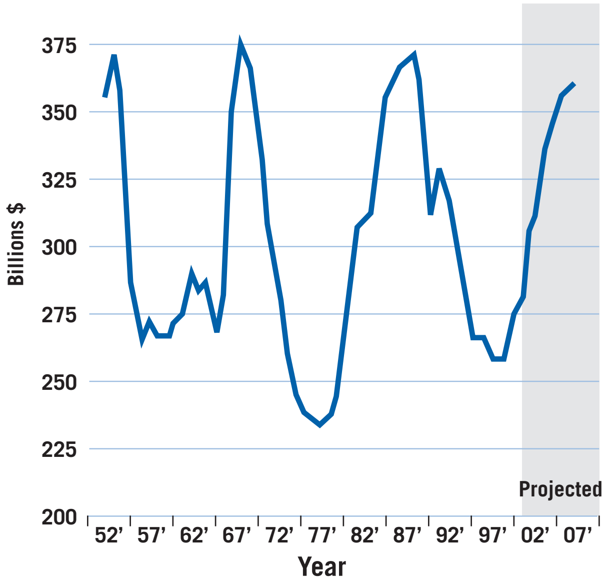
RECOMMENDATION #7: The Commission recommends a new business model designed to promote a healthy and growing U.S. aerospace industry. This model is driven by increased and sustained government investment and the adoption of innovative government and industry policies that stimulate the flow of capital into new and established public and private companies.

Chapter 7

Business: A New Model for the Aerospace Sector

To retain its vitality, the aerospace industry must be able to attract private investment in the highly competitive global capital markets. The investment community values companies with predictable revenue flows, sustainable growth in sales and earnings, strong positive cash flows, healthy profitability, innovative capabilities, and a vibrant workforce.

Figure 7-1 Defense Outlays from 1952-2007 in constant FY 1996 dollars



Source: FY03 Budget of the U.S. Government, Historical Tables

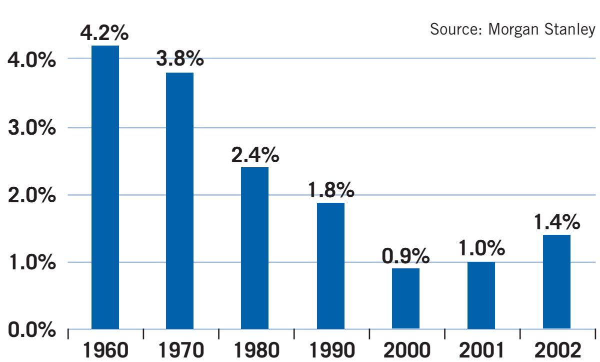
For the past half-century, the U.S. aerospace and defense industry has been inextricably linked to a defense budget characterized by a "10 years up, 10 years down" cycle. A vibrant, productive, enduring enterprise is not consistent with this "boom-and-bust" cycle, and aerospace companies must be vibrant, productive, and enduring. Our armed forces rely on advanced technology for awareness, protection, and instruments of action. Our government must provide for the many needs of our society, so value for money efficiently spent on security must be demonstrated. Our aerospace systems are designed to perform for decades, with some extending through a half century of service, and companies must be in a position to support customers through their evolving and demanding missions.

Historically, investors have characterized the aerospace industry, including the commercial business, as a low-growth sector, chronically hampered by high cyclicality, low margins, revenue instability, and inadequate returns on investment, amplified by the uncertainty in the government budgeting and acquisition process.

As a result, the relative importance of the aerospace sector in the global marketplace for capital has significantly diminished over the last two decades as evidenced by the decline in sector market capitalization. In 1980, the aerospace sector had a market capitalization of $13 billion, equivalent to 2.4 percent of the total Standard and Poors (S&P) 500. In 1990, the sector dropped to 1.8 percent of the market, and declined further to 0.9 percent in 2000. Today, even with the largest proposed defense budget in history and the longest bear market since World War II, aerospace comprises 1.4 percent of the S&P 500—well below the sector's comparative value just prior to the Reagan defense buildup. See Figure 7-2.

The most compelling determinant in an investors' decision-making process is their expected risk-adjusted return on investment. By this standard, the aerospace sector is unattractive. From 1997-2002, the returns on investors' capital from aerospace investment lagged behind even the risk-free rate of return on Treasury securities. See Figure 7-3.

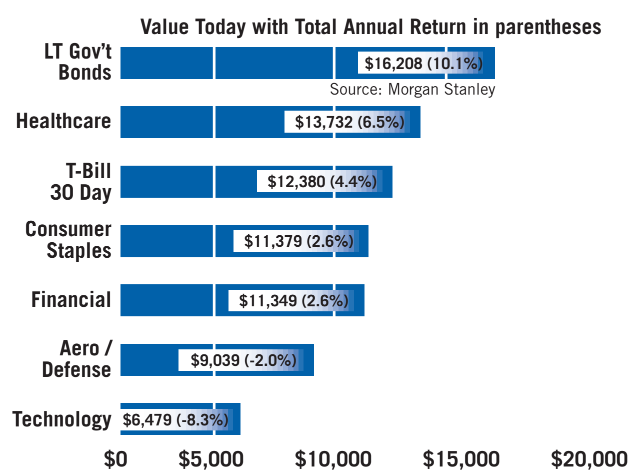
Figure 7-2 Aerospace/Defense Sector as a Percentage of the S&P 500 Market Cap



During the last "bust" cycle that impacted the industry during the 1990s, more than 50 companies were compelled to consolidate into today's "Big 5": Boeing, General Dynamics, Lockheed Martin, Northrop Grumman, and Raytheon. See Figure 7-4. While successful efforts to consolidate capacity within the framework of current government regulations are clearly evident, significant over-capacity remains. To fuel the consolidation process, the use of debt was significantly expanded across the sector, reducing financial flexibility, increasing leverage, straining coverage and liquidity, lowering credit quality, and increasing capital costs. Furthermore, the industry lost more than 600,000 scientific and technical jobs in the past 13 years significantly depleting intellectual capital and experience and increasing the average age of today's workforce (see Chapter 8). In important and enduring aspects, the industry has been weakened.

Some observers of the current equity markets note that selected aerospace firms with little commercial market exposure appear to be doing comparatively well with regard to other stocks given the renewed interest in defense spending. The Commission notes that this perceived strength in the sector is transient, as the industry is for the moment enjoying the improved funds flow of the "boom" portion of the defense cycle while the rest of the economy is in

Figure 7-3 Total Five-Year Return on Investment by Sector (1997-2002)—Value today of $10,000 investment made in 1997.
Source: Morgan Stanley



recession. History suggests that the sector will decline as the broader economy recovers. Where history will fail, however, is in support of the assumption that a call to action may be unnecessary—that industry will endure and recover as it has through past cyclical declines without immediate and substantial attention—because history does not accurately reflect the current weakened state of the industry throughout its entire supply chain.

Without significant change to the business model upon which the sector relies, the industry will be unable to survive the next downturn in either the commercial or military aerospace cycle. The Commission has identified several elements of U.S. government policy as well as industry practice that, if implemented, would significantly improve the industry's position in the capital markets.

The future economic vitality and national security of the United States depends on a strong, vibrant, and flexible aerospace industry.

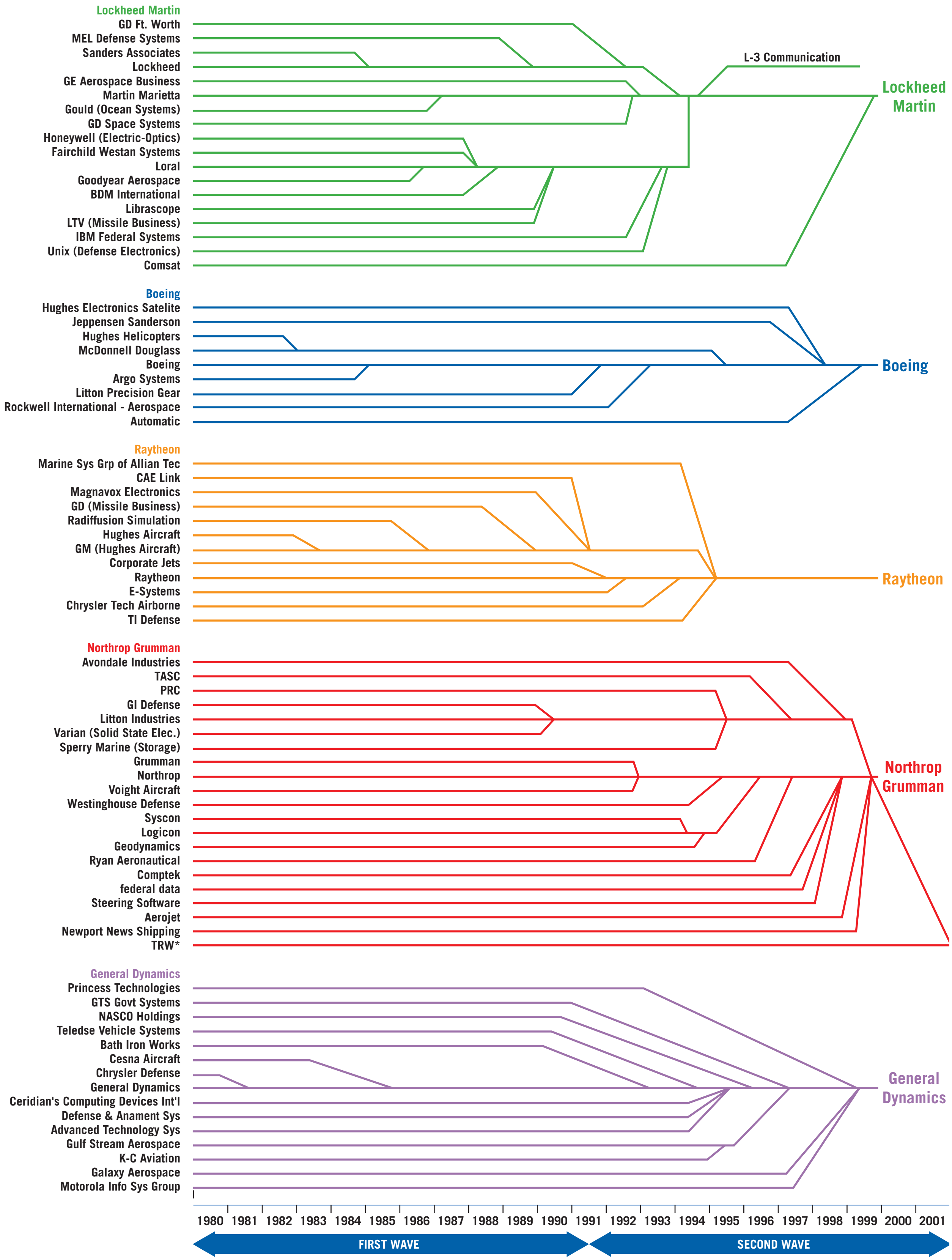
Objective: Aerospace Industry Attractive to Investors

Innovative industry-government initiatives are required now to sustain the preeminence of the American aerospace industry, ensuring industry health and producing sustained contributions to both the economic performance and national security of the United States. The U.S. government must initiate measures to establish and maintain a stable and predictable budget for aerospace investment and remove government constraints to reasonable profitability, thereby reducing risk and improving returns such that the industry can better attract capital. A government focus on essential core competencies will stimulate long-term investment in both facilities and the best and the brightest talent, ultimately spawning new cycles of exciting technology development.

Innovative partnerships among global suppliers of advanced technology are needed to assure the interoperability of systems while fostering the pursuit of new opportunities through assured open market access. Efficiency within the industry can be stimulated by a further revolution in business affairs that transforms all processes and practices to a single, integrated industry-government model that employs the maximum use of commercial business practices and innovations. A solid framework of balanced export and tax policies will safeguard vital national security information and protect intellectual property while allowing successful industry competition in the global economy.

The future economic vitality and national security of the United States depends on a strong, vibrant, and flexible aerospace industry. The Commission views these initiatives as essential steps necessary to establish a successful and enduring government-industry partnership.

Figure 7-4 20 Years of Industry Consolidation



* Merger Pending Approval

Issues

The U.S. government budgeting and procurement system is extraordinarily complex and inefficient, driving up the cost of needed national security systems while delaying the introduction of new capabilities. This observation is hardly new. Since shortly after the end of World War II, about a dozen major studies and literally thousands of lesser assessments have cited this finding. Furthermore, sound government acquisition reform initiatives have been proposed and debated for more than 40 years, but only marginally implemented. Because we have failed to sustain the will necessary to secure lasting change, we are today spending more for national security and getting less.

To the casual observer, this proposition may seem dramatically counterintuitive—do we not have the finest, best equipped military on earth? The direct answer is "yes", but it was purchased decades ago under conditions that do not exist today. Many of the systems in use now are a result of the Reagan defense build up of the 1980's when defense spending was approximately 5 percent to 8 percent of Gross Domestic Product (GDP). Today that spending is about 3 percent.[1]

A greater proportion of total spending then was devoted to "investment funds", i.e., Research and Development and Procurement, which expanded scientific frontiers, engineered leading edge solutions, attracted talent to the industry, stimulated interest by the capital markets, and fielded capabilities that won the Cold War and performed superbly well in Operation Desert Storm. Today more funds flow to Operations and Maintenance, the fastest growing segment of the defense budget, the bulk of which pays for health care, military training, support of aging systems, equipment maintenance, and other support activities.

The overall budget, therefore, remains insufficient to maintain existing capabilities, meet operational tempo needs, fulfill our commitments to military personnel, protect our homeland, and assure transformational capabilities are fielded in a timely manner to meet 21st century threats across a broadening and increasingly complex spectrum. Funding sources must be adequate, reliable, and stable. Acquisition and program management practices require simplification and reform. Trade and tax policies need to be streamlined and harmonized.

ISSUES

- Budgeting and Funding
  - Investment funding
  - Financial Flexibility
  - Program Management
- High-Tech Partners and Suppliers
  - Contract Reform
  - Privatization, Competitive Sourcing, and Public-Private Partnerships
  - Commercial Acquisition Practices
- Domestic and International Business Climate
  - Foreign Sales Corporation (FSC)/Extra Territorial Income (ETI) Resolution
  - Research & Experimentation Tax Credit
  - Percent of Completion Tax Accounting
  - Export Control
  - Airline Bankruptcy and User Fees
- Long-Term Growth and Financial Health
  - Personnel Training
  - Global Mergers and Acquisitions

The Commission has strong and unanimous conviction that without immediate initiatives to address the long-term health of this indispensable industry, the U.S. aerospace sector will lag in the capital markets, lose global market share, provide a reduced contribution to the U.S. balance of trade and the U.S. economy, atrophy its essential core competencies, and lose high-tech and high-paying jobs to overseas competition. The Commission believes this downward drift and dissipation of potential, no matter how difficult to discern on a day-to-day basis, is nonetheless occurring and constitutes an unacceptable risk to the U.S. economy and national security.

Budgeting and Funding: Unpredictable and Unstable

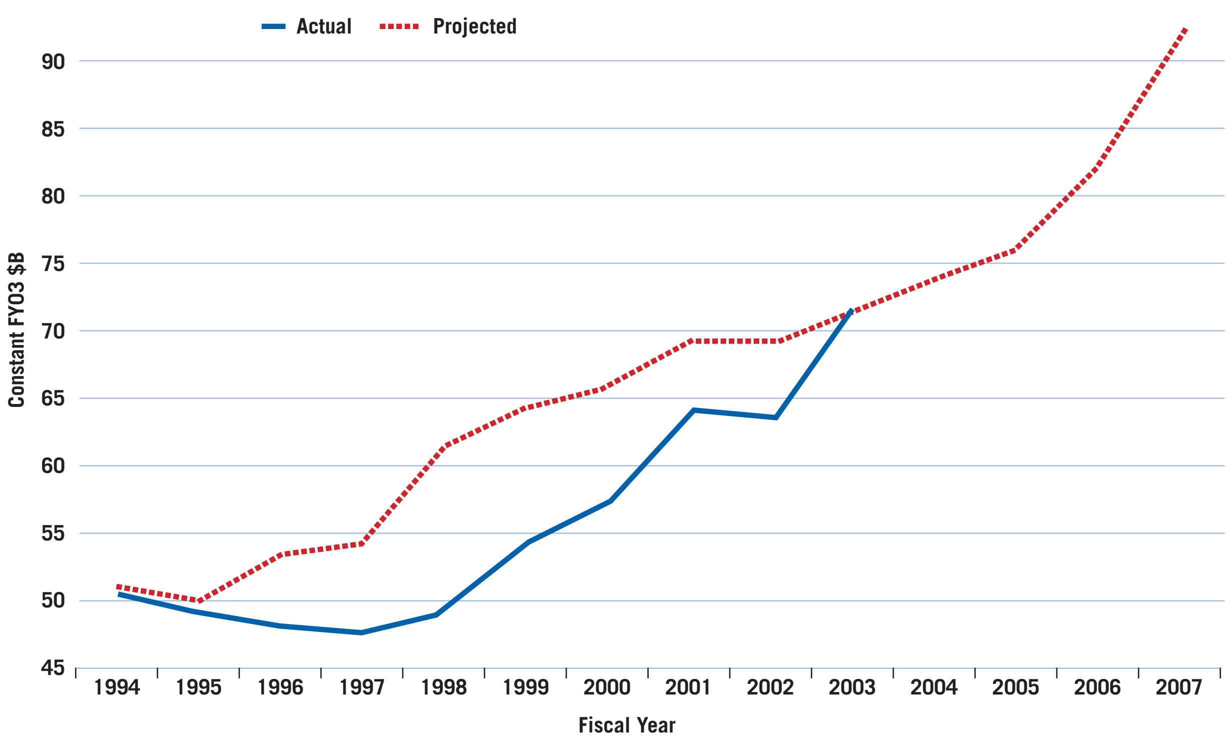
The overall defense budget has two broad provisions: one for near-term personnel, operations maintenance costs, and one for investments to fulfill our long-term need for technological advancement through research and development (R&D) and procurement. Despite budget increases over the last decade, growth in investment funding remains relatively small, especially as a share of the federal budget.

In the past, the Department of Defense's (DoD) promised growth in investment funding has not materialized adding to the complexity of capacity planning and labor force management while diminishing overall efficiency. At the same time, system costs continue to be underestimated by both the government and industry due to the pressure to adopt the optimistic scenarios necessary to accommodate limited funding, the progressively aggressive bidding behavior that results as companies with excess capacity resist being marginalized in the competition for a diminishing number of new program opportunities, and the desire to incorporate ever increasing program capability requirements. Within this unpredictable framework, many programs are also changed annually through the Congressional authorization and appropriation process or reprogrammings. See Figure 7-5.

Government-unique acquisition processes and procedures are cumbersome and unnecessarily complex, adding time and expense to systems development, and are not complementary to healthy commercial practices. Finally, any failure to perform on contract, at times induced by program and budget instability, exacerbates the tensions between government and industry and heightens the tendency to impose even more oversight and financial penalties on contractors. These factors create a cycle that contributes to the diminished return on the government's investment in national security capabilities and serves as an impediment to long-term industry excellence.

Figure 7-5 Actual Procurement Spending has Consistently Fallen Below Projections

Source: Morgan Stanley



The government must stabilize program requirements and protect adequate long-term investment funding, enact reforms that increase the financial flexibility of companies and the government, and improve program management stability and continuity. Industry must focus on performance and execution and deliver on contract commitments. These changes will help provide the resources necessary to drive competition, incentivize research and development, and enhance industry's performance on contract and in the investment markets.

Protect Investment Funding. As discussed in Interim Report #2, a stable long-term investment budget is critical to the modernization and transformation goals of the Armed Services. However, the bulk of recent DoD funding increases has been consumed by costs associated with operations, fuel, pay raises, and health-care. To protect investment funding, the Commission reiterates its recommendations contained in the interim report, that government establish and maintain a stable investment budget in the Future Years Defense Program (FYDP), protected from reductions to cover unbudgeted operations and support (O&S) and other support and personnel costs. In addition, the Commission suggests that DoD study the management of O&S costs, with the goal of better estimating and annually budgeting for these costs, rather than continuing to tap the investment accounts to pay unanticipated, unbudgeted "must pay" O&S bills.

The Commission also reiterates its recommendation in the interim report that DoD require industry and the military Services to develop realistic cost estimates and fully budget for those program costs in the FYDP. The Commission believes this action is necessary to reduce the current tendency to understate program costs in order to include unaffordable programs within the FYDP, and will also preclude contractor and DoD investment in programs that cannot be realistically completed.

Increase Financial Flexibility. The Commission believes that both the government and contractors must do a better job of realistically estimating program costs. The Commission also believes the current financial system is overly restrictive in that it allows only very limited financial flexibility, once the budget is formalized, to address unanticipated costs or requirements as individual programs progress through execution. The "color of money" and inadequacy of program reserves preclude program managers from making common-sense adjustments within a program, and decades-old reprogramming limitations preclude the government from effectively managing its budget to reflect changes in program priorities or performance.

Reprogramming thresholds for all accounts should, as a minimum, be doubled to account for 20 years of inflation since their last adjustment.

The Commission advocates increasing the government's financial flexibility to make funding adjustments among and within programs. Program managers should have the authority to move funds from procurement to R&D to cover unanticipated development and sustainment costs, or to apply unused R&D funds to procuring the weapon system. Reprogramming thresholds for all accounts should, as a minimum, be doubled to account for 20 years of inflation since their last adjustment. Such action will provide government with the needed flexibility to meet higher priority requirements as they arise, make the best use of cost savings in any program phase, and resolve problems earlier.

Streamlining cost principles, the elimination of statutory cost principles, and the use of Generally Accepted Accounting Principles will benefit the sector by eliminating unnecessary and duplicative requirements and allow government contractors who also have significant commercial business to use a single accounting system across the enterprise. The Commission concludes that the government should develop a proposal to implement cost principles and accounting standards that are more commercially oriented.

Realignment of the Defense Working Capital Fund (DWCF) will provide DoD managers with accurate and reliable cost information to manage their operations, while improving weapon system readiness and the total cost of ownership. The fund had been designed to provide an effective mechanism for financing, budgeting, accounting for, and controlling the costs of goods and services. In practice, the DWCF is structured to support and maintain logistics stovepipes in terms of supply management, maintenance, and transportation, thus limiting the ability to meet DoD customers' new product support challenges. The Commission urges ongoing General Accounting Office (GAO) management review of the DWCF, as well as an allowance for restructured costs and a shift to performance or price-based acquisition structures.

REVISE PROGRAM MANAGEMENT. As discussed in the Commission's Third Interim Report, the Commission believes the use of multi-year funding and contracting for both procurement and R&D programs will not only improve program stability and performance, but produce needed cost savings. The Commission reiterates its recommendations from Interim Report #3 for expanded use of multi-year procurement contracts and milestone-to-milestone budgeting for development programs, including the incorporation of spiral development and evolutionary acquisition principles into these long-term contracts.

In addition, the Commission supports the immediate repeal of the June 2002 DoD Financial Management Regulation that establishes an artificial and unnecessary ceiling on unfunded cancellation costs in multi-year contracts. The Commission believes the prudent use of multi-year contracting, applied to stable programs that are performing well, makes unnecessary the establishment of financing limitations that will stifle innovative acquisition strategies.

The ability of the government to become a "world class" buyer of research, products and services is an essential element of acquisition excellence. A Commission-sponsored study on the application of Smart Price-Based Acquisition reviews the current cost-based and price-based approaches to government procurement and recommends a progressive and evolutionary roadmap for implementing changes to more fully capitalize on the price-based acquisition of goods and services.

The report cites the wide variance in federal department and agency contracting that is in need of review, and recommends moving to price-based, rather than cost-based acquisition under certain conditions. First, the government must be able to clearly and adequately define its requirements for the product or service. Second, there must be a commercial market for the product or service, or the government through past or ongoing government unique efforts must have a sufficient basis of price comparison.

The report correctly states that, while the utility of price-based acquisition for government procurements is evident, it is not meant to be viewed as an across the board solution for all government procurements. For example, research and development initiatives where requirements cannot be clearly and adequately defined due to dynamic situational analysis and/or there is high risk in the potential utilization of technologies, must remain cost-based. The report also cites the reluctance of the DoD to leverage its buying power and the power of electronic commerce by utilizing the General Services Administration's (GSA) Federal Supply Schedule and Federal Technology Services for certain procurements, as permitted by current law. While some agencies are required to purchase items through GSA schedules, the DoD—through the Defense Federal Acquisition Regulations—does not mandate the use of GSA schedules and continues to issue their own contracts for GSA-available items.

The report cautions that, if the requirements of smart price-based acquisition are to be met, the government must have a procurement workforce that understands market prices and the capabilities of the market. In order to create an appropriately trained procurement workforce, the organizational structure for federal procurement must be redesigned to focus on development and maintenance of market knowledge. The ability of the government to leverage its buying power and centralize "smart buying" functions will enable better performance management of its many providers.

The Commission views the recommendations in this report as one of many possible approaches to streamlined acquisition of products and services, especially when procured as part of a stable program involving low-risk technology and clear requirements. As a general rule, the Commission does not endorse greater use of fixed-price contracting for programs that do not meet these criteria. The Commission further believes that the report supports the existing Federal Acquisition Regulations (FAR), concerning price-based acquisitions. Neither does the Commission view the report as advocating such an approach across-the-board. Instead, the Commission reads the report as recommending an option for a streamlined acquisition process that could produce not only a more efficient and less burdensome contracting process, but could also produce savings in personnel costs and time that could be allocated to higher-priority national security requirements.

Other reforms to be considered include:

- Implementation of a requirements process that is supportive of evolutionary acquisition and spiral development.
- Development of an acquisition approach for system-of-systems efforts, rather than a component-based approach.
- Provide adequate profit on R&D contracts so contractors do not wait until production contracts to recoup lost profits.
- Separately funding R&D on key components and sub-systems that are not integral parts of major systems.
- Facilitating incorporation of commercial technology in current weapons systems by expanding use of the FAR (Part 12, commercial buying) for R&D.
- Expanding the potential for contractors to earn higher profit margins and providing other incentives to drive and reward positive performance.

The following table summarizes recommended reforms, the specific participants responsible for each reform, and the near and long-term actions necessary to achieve the objectives earlier described.

Reforms	Actors	18-month Enabling Actions	Long-term Actions
Budget Reform	**OMB DoD NASA Congress**	•Establish/maintain stable top-line for DoD investment in the FYDP (see June 26, 2002 interim report) •Fully fund programs within the FYDP (see June 26, 2002 interim report)	•Study and develop methods for centralized management of non-program specific O&S costs.
Financial Reform	**OMB DoD Congress Industry**	•Enact proposals to increase DoD financial flexibility (see June 26, 2002 interim report) •Realign Defense Working Capital Fund	•Streamline cost principles, and eliminate statutory cost principles. •Revise cost accounting standards to move toward GAAP.
Program Strategy Reform	**DoD NASA Congress**	•Expand the use of multiyear procurement contracting, and implement multiyear milestone budgeting for development programs. •Repeal the June 2002 Financial Management Regulation establishing a 20% ceiling on unfunded liability costs in multiyear contracts. •Expand use of performance-based acquisition. •Allow contractors to earn higher profit •Develop and implement a new system-of-systems acquisition approach. •Provide adequate profits on R&D contracts	•Develop and implement an evolutionary/spiral requirements process. •Expand FAR Part 12 commercial buying for R&D. •Separate R&D funding for components that are not integral parts of major systems.

High-Tech Partners and Suppliers: Difficult to Attract and Retain

While it is sometimes convenient to refer to the aerospace industry through the short hand of the "Big 5" referring to the five largest aerospace systems companies, it is important to note that the government and commercial "industry" for aerospace products and services in fact extends through a network of purchasers, subcontractors, suppliers, and partners, sometimes referred to as the supply chain. Each of the participants in the sector is intrinsically tied to the factors affecting the industry. Encouraging a climate that is attractive to new entrants while stable enough for current players will promote competition and innovation, add to efficiencies, and lower costs. In addition, steps must be taken to establish a stable and predictable business climate (see section entitled "Long-term Growth and Financial Health: In Jeopardy" for additional information).

Contract Reform Must Focus on Simplification and Innovation. Successful implementation of acquisition reform is a profound challenge that involves two distinct and interdependent elements. The first, culture change, involves evolving the behavior of acquisition personnel from the traditional "buying of resources under a design specification" to the "buying of results under a performance specification". Today, an extraordinary amount of government talent, time, and resources are devoted to the process of refining and detailing comprehensive design specifications. Despite good intentions and considerable effort, this practice yields questionable value added and should be discontinued. Contemporary acquisition management practice demands a shift away from the emphasis on purchasing assets to a focus on the delivery of capabilities. Second, the implementation of new contracting rules will foster understanding of the conceptual and pragmatic nature governing the buyer-seller relationship.

Building on the Commission's earlier findings concerning expanded use of multi-year contracting, the Commission calls for the consideration of multi-year leasing arrangements as well as multi-year contracts for the procurement of goods and services. Developing stable baselines and establishing and protecting current and future year funding for programs not only provides cost savings, but allows for the use of innovative procurement strategies such as buy-to-budget in which quantities procured are limited only by available funding. Long-term excellence in this area is further enabled by near-term reforms, such as utilization of "other transaction authority" and implementation of efficiency savings and share-in-saving strategies that recognizes the benefits of productivity improvements and right-sizing of workforce and facilities, that can improve, streamline and strengthen technology access, encourage open-market competition and implement technology-driven prototyping.

The Commission notes that certain changes to DoD's "shared savings" initiative since the Commission's endorsement of that effort in its March 20, 2002 interim report have caused the Commission to reconsider its recommendations. The Commission is concerned that these changes to the efficiency savings initiative will so limit its applicability and utility as to make the effort almost negligible and ineffective in incentivizing contractor investment in right-sizing and productivity improvements. The Commission urges DoD to reevaluate this initiative and consider once again including program-specific initiatives to provide the greatest possible incentives and broadest application of the policy.

Finally, a vital element of effective contract reform is directly related to reforming regulations regarding returns on government contracts. The Commission asks that DoD strongly consider proposing and implementing changes to permit: increased award fees, carryover of unearned award fees into the next rating period, elimination of fixed price development contracts, elimination of profit take backs and withholds on Cost Plus Fixed Fee (CPFF) contracts far in excess of requirements to protect the government, and revised profit guidelines for fee bearing Independent Research & Development (IR&D).

Other reforms that should be considered include:

- Create a liability limitation for sales to all government agencies, as well as state, local, and commercial entities, to facilitate incorporation of homeland security technologies across America.
- Repeal/reform Civil False Claims Act to increase the number of high technology suppliers to government.
- Allow prime contractors to waive flow-down to lower-tier suppliers of unnecessary and costly terms and conditions.
- Minimize reliance on cost data.
- Facilitate the use of common subcontracting processes.
- Investigate leasing as an acquisition tool.

PRIVATIZATION, COMPETITIVE SOURCING, AND PUBLIC-PRIVATE PARTNERSHIPS. Widespread business practice overwhelmingly supports the economic and performance benefits that result when enterprises focus on the essential core competencies through which it fulfills its mission and creates value. Indeed the goal of every contemporary organization includes an intense focus on defining and cultivating the core while realigning roles and responsibilities accordingly. The Commission believes that there are many opportunities for redefinition and prioritization of routine non-core governmental activities currently performed by government agencies. Private sector providers specializing in military base maintenance, facility firefighting services, payroll and accounting, and human resources management can perform such services. The Commission calls for a government-wide review of functions and services to identify those functions that are not "core" to the effective execution of the mission and which could best be performed by the private sector.

Widespread business practice overwhelmingly supports the economic and performance benefits that result when enterprises focus on the essential core competencies through which it fulfills its mission and creates value.

The Commission has significant philosophical reservations regarding public-private competition, and believes such competitions under current regulations disadvantage all parties.

Office of Management and Budget (OMB) Circular No. A-76, "Performance of Commercial Activities," establishes federal policy for the performance of recurring commercial activities, and provides guidance and procedures for determining whether recurring commercial activities should be operated under contract with commercial sources, in-house using government facilities and personnel, or through inter-service support agreements (ISSAs). In principle, Circular A-76 is not designed to simply contract out. Rather, it is designed to: (1) balance the interests of the parties to a make or buy cost comparison, (2) provide a level playing field between public and private offerors to a competition, and (3) encourage competition and choice in the management and performance of commercial activities.

The A-76 process was established in an era where cost was the principal award determinant for all competitions. Reliable cost and past performance information is crucial to the effective management of government operations and to the conduct of competitions between public or private sector offerors. Unfortunately, this information has not been generally available and/or has often been found to be unreliable. In today's era of best value procurements, which recognize that cost is but one of many important factors that assure taxpayer interests are most appropriately served, the old "cost-based" decision tree is no longer valid.

The Commission believes that it is vital for government agency competition with private offerors of goods or services to be conducted on the basis of truly comparable cost accounting practices, past performance and best value. In addition, the process should be kept as high-level and streamlined as possible, avoiding the excessively detailed, overly mechanistic, aspects of the current A-76 procedure. The Commission supports reform of A-76 procedures to achieve these goals.

As changes to outsourcing competitions are developed and implemented, the Commission believes that defense and aerospace industry must work with government organizations to develop effective partnering relationships. To the maximum extent possible, these public-private partnerships should be founded on best business practices and should focus on enabling both government and industry to provide the products and services best suited to their organizational characteristics. Public-private partnerships will be required to integrate best provider government organizations, satisfy statutory requirements, and provide access to unique facilities, infrastructure and technical expertise. These partnerships will also foster a more business-like relationship, reduce administrative and life-cycle costs and reallocate risks, and assist in the evolution of government and industry roles and responsibilities. Recent changes to Title 10 U.S. Code regarding "hold harmless" will facilitate the use of conventional contractual arrangements and partnerships between industry and government. The Commission recommends that both industry and government vigorously pursue such partnerships, and supports changes in law or regulation that would facilitate increased use of public-private partnerships.

As changes to outsourcing competitions are developed and implemented, the Commission believes that defense and aerospace industry must work with government organizations to develop effective partnering relationships.

Commercial Acquisition Practices. One of the goals of acquisition reform is streamlining and simplifying the procurement process in order to reduce development and production cycle times and life cycle program costs, and to strengthen the technology and industrial base through increased access to, and use of, advanced commercial items. The FAR developed a broad range of "unique" controls and requirements for its contractors and subcontractors over the past 50 years. The government is now attempting to realign these purchasing processes to lower costs and gain access to new technology by eliminating, or at least lowering, barriers that make government business inefficient and unattractive to commercial firms and inhibit greater integration of commercial and military production lines. The Commission supports these efforts, but recognizes that the government must make this transformation while maintaining good faith and stewardship of the public dollar.

The Commission supports these enabling actions:

- Eliminate government unique contract requirements.
- Expand use of commercial like terms and conditions.
- Establish a presumption that products and services purchased from predominantly commercial companies are commercial vs. government enabling commercial contracting processes.
- Eliminate FAR cost principles that are administratively burdensome and discouraging to typical non-government contractors.
- Broaden available contract types under FAR (Part 12) to include standard commercial-type contract vehicles.
- Accelerate implementation of e-business environment.
- Streamline all payments with electronic processing and payments.

Reforms	Actors	18-month Enabling Actions	Long-term Actions
Contract Reform	**OMB DoD Congress Industry**	•Develop and enact laws and regulations limiting contractor liability for homeland security sales to all government agencies, as well as state, local, and commercial entities. •Minimize use of certified cost or pricing data. •Facilitate use of common subcontracting processes. •Expand use of "other transaction authority". •Reevaluate changes in DOD Shared Savings initiative. •Revise government profit policy to permit increased award fees, unearned award fee carryover, higher profit guidelines for fee-bearing IR&D. •Eliminate fixed price development contracts, profit takebacks, and withholds on CPFF contracts in excess of requirements to protect the government. •Formulate effective share-in-savings policies; reevaluate changes in efficiency savings initiative	•Study the use of leasing as an acquisition tool. •Repeal/reform Civil False Claims Act. •Authorize prime contractors to waive flow down to lower-tier suppliers of unnecessary and costly terms and conditions. •Expand multiyear contracting to leasing and procurement of goods and services. •Develop and implement proposals to allow "buy to budget".
Competitive Sourcing	**OMB DoD Congress Industry**	•Conduct a government-wide study of activities and services performed by government civilian and military personnel, and develop recommendations for privatization of non-core functions and services. •Reform OMB Circular A-76 to provide for more equitable and effective public-private competitions •Incentivize and expand the use of public-private partnerships	•Enact proposals to privatize non-core functions and services.
Commercial Acquisition Practices	**OMB DoD Congress Industry**	•Eliminate government unique contract requirements. •Continue the implementation of e-business environment. •Implement electronic processing and payments for all transactions. •Expand use of commercial practices. •Revise FAR part 12 to include standard commercial-type contract vehicles. •Eliminate burdensome FAR cost-based principles. •Expand commercial item definition to include all products and services purchased from commercial companies	•Fully implement e-business practices.

Domestic and International Business Climate: Burdensome

Certain U.S. tax and trade laws and regulations that affect a wide variety of industries weigh particularly heavily on defense and aerospace, both in competition with domestic commercial entities as well as in the international markets.

The complex U.S. Tax Code does little to reward or incentivize private investment in maintaining and enhancing our nation's technological edge.

The complex U.S. Tax Code does little to reward or incentivize private investment in maintaining and enhancing our nation's technological edge, either military or commercial. The Tax Code also fails to recognize the unique nature of defense development and production. In addition, a proposed resolution to a long-standing trade dispute with the European Union threatens to place military and aerospace exporters at a distinct disadvantage in the global marketplace.

Outdated and restrictive U.S. export control laws and regulations do little to protect vital national security technologies and, at the same time, adversely affect the ability of defense firms to export military products to our allies and friends, and negatively impact the ability of the government to pursue vigorously efforts to improve the military readiness and interoperability of our allies. Finally, high-tech companies are discouraged from doing business with the U.S. government, and current contractors are unfairly penalized, by the laws and regulations governing rights to inventions and technology developed under government contract.

The Commission believes the government should act promptly to replace these burdensome tax laws and outdated trade laws, as necessary, with laws and regulations that remove unnecessary administrative burdens from industry and recognize the unique contribution of defense and aerospace companies to our nation's defense and economic security. Enacting or implementing the proposals outlined below would remove some of the clearest impediments to defense/aerospace industry health.

Ensure FSC/ETI Resolution Maintains Industry Benefit. As discussed in the Commission's Second Interim report, U.S exporters face possible sanctions totaling up to $4 billion per year in tariffs on the sale of U.S. goods if the Foreign Sales Corporation (FSC) Repeal and Extra Territorial Income (ETI) Exclusion Act of 2000 (FSC/ETI), which was ruled an illegal export subsidy by the World Trade Organization (WTO), is not repealed.

In Interim Report #2, the Commission recommended that the U.S. Trade Representative seek a delay in imposition of any sanctions on U.S. exports to allow government and industry the time to develop a resolution of the FSC/ETI issue. The Commission is concerned that, while sanctions may not be imposed in the near term, the threat of significant sanctions will negatively impact the U.S. economy and other trade issues with our European allies. The Commission also reaffirms its belief that loss of the FSC/ETI benefit would have a serious adverse impact on the ability of U.S. defense and aerospace companies to compete in the global marketplace.

The Commission therefore strongly concludes that the Administration, Congress, and industry engage in serious discussions to develop an equitable resolution of this issue that maintains the current level of benefits for defense and aerospace companies. The Commission considered several proposals that could benefit defense and aerospace companies, while meeting the test of WTO compliance. The proposals favored by the Commission are an enhanced National Security R&D credit, the National Foreign Trade Council (NFTC) wage credit proposal, and the NFTC Footnote 59 changes.

Enhance the Effectiveness of the Research and Experimentation (R&E) Credit. The Commission emphasizes the recommendations contained in its Second Interim report for improving the utility of the current research and experimentation tax credit for defense and aerospace companies. Expanding on its earlier recommendations to make the R&E credit permanent and increase the rates for the current Alternative Incremental Research Credit, the Commission sees value in an additional alternative credit that would allow defense and aerospace companies to enjoy the same level of benefit as other industries—currently a 6 percent average credit. The Commission believes there should be a new alternative tax credit of 12 percent of the excess of current-year qualified research expenditures (QRE) over 50 percent of the average QRE for the prior three years, or 6 percent of current-year QRE for start-up taxpayers.

Repeal Percent of Completion (POC) Tax Accounting Method. One area of particular complexity in the U.S. Tax Code is the Percentage-of-Completion method under Section 460 of the Internal Revenue Code (the "POC method") that was enacted in 1986 when the "Competed Contract method" was repealed. Under the POC method, taxpayers are required to perform a complicated set of calculations involving estimated costs, price, and revenues to derive a percentage that is used to determine the amount of annual tax due on each contract. Many defense and aerospace contracts must be handled under the POC method, either because they are long-term contracts (requiring more than 12 months to complete) or because the items being produced are "unique" items not normally carried in inventory.

Section 460 imposes an unfair burden on defense and aerospace companies, as well as certain other industries, by requiring them to pay tax before profit is earned. In addition, complicated look-back and other requirements impose a compliance burden on taxpayers and a correspondingly large administrative burden on the Internal Revenue Service to monitor and enforce compliance, for relatively little revenue gain.

The Commission welcomes the Administration's expression of interest in reviewing Section 460 of the Tax Code. The Commission concludes that the POC method should be repealed, allowing defense contractors to be treated similarly to all other businesses. At the very least, the method should apply only to contracts involving items that take a very long time to manufacture, i.e., three years vice the current one-year limit in law.

Left unchecked, the airline industry crisis will have a serious negative impact on the entire American economy.

Export Control Reform. Export controls have a real and direct impact on the defense and aerospace industry's ability to establish and maintain international partnerships, meet market demand and stay competitive, and address the requirements of existing overseas partners and customers. Current export licensing policies and procedures are complicated and inefficient, and erode the competitive position of U.S. companies in the global marketplace.

The Commission believes that protection of our national security and technological edge in key capabilities must continue to be the principal focus of our export control laws. However, without a fundamental restructuring of the current system, American companies will lose out to foreign competition and our nations own industrial and high technology base will be significantly undermined. Refer to Chapter 6, Global Markets for a detailed consideration of the Commission's recommendations on this critical topic.

Airline Industry Bankruptcy and User Fees. The Commission also considered the plight of the U.S. airline industry, which is in the midst of a financial crisis. If left unchecked, this crisis will have a serious negative impact on the entire American economy. The impact could become more serious very quickly if more airlines are forced to declare bankruptcy leading to payment delays or defaults on debts owed to labor, manufacturers, and service providers. U.S. airlines lost $7.1 billion in 2001, and, according to the Air Transport Association, will lose an estimated $9.0 billion in 2002. The airline loss of revenue has been exacerbated by the combined effects of the terrorist

Figure 7-7 Increases in Taxes and Fees Over Time Have Reduced Airline Profits

Tax/Fee	1972	1992	2002	R/T***
Passenger Ticket Tax*	8.0%	10.0%	7.5%	**7.5%**
Passenger Flight Segment Tax*	-	-	$3.00	**$12.00**
Passenger Security Surcharge	-	-	$2.50	**$10.00**
Passenger Facility Charge	-	$3.00**	$4.500**	**$18.00****
Passenger Facility Charge	$3.00	$6.00	$13.00	**$13.20**
International Arrival Tax	-	-	$13.20	**$13.20**
INS User Fee	-	$5.00	$7.0	**$7.00**
Customs User Fee	-	$5.00	$5.0	**$5.00**
APHIS Passenger Fee	-	$2.00	$3.10	**$3.10**
Cargo Waybill Tax*	5.00%	6.25%	6.25%	**6.25%**
Frequent Flyer Tax	-	-	7.5%	**7.5%**
APHIS Aircraft Fee	-	$76.75	$65.25	**$65.25**
Jet Fuel Tax*	-	-	4.3¢/gal	**4.3¢/gal**
LUST Fuel Tax*	-	0.1¢/ga	0.1¢/gal	**0.1¢/gal**
Air Carrier Security Fee	-	-	TBD	**TBD**

***Tax Applies Only to Domestic Transportation **Legislative Maximum ***Single-Connection Rountrip With $4.50 Passenger Facility Charge**

Source: U.S. Tax Code via www.airlines.org

Reforms	Actors	18-month Enabling Actions	Long-term Actions
FSC / ETI	USTR Treasury Congress Industry	•Convene working group of Administration/Congress/Industry negotiations to develop resolution that maintains benefit for defense/aerospace industry by enacting one of four suggested alternatives.	•Negotiate a change in inequitable WTO rules regarding treatment of direct and indirect taxes that put U.S. exporters at a competitive disadvantage.
R & E Credit	Treasury Congress	•Propose and enact legislation making the R&E credit permanent, increasing the AIRC rates, and creating a new alternative credit of 12% of taxpayers' excess QRE over 50% of the average QRE for the prior three years, or 6% for start-up taxpayers.	•Periodically evaluate the effectiveness and equity of the R&E credit in incentivizing private sector investment in new technology.
Section 460 Repeal / Reform	Treasury Congress	•Conduct a review and hearings on Section 460 of the Tax Code. •Propose and enact legislation to repeal or substantially reform Section 460.	
Airline Reform	Industry Congress Commerce FAA	•Conduct study of airline user fees impact on commercial aviation. •Urge early Congressional action on terrorism re-insurance	•Develop U.S. policy regarding airline debt payments to foreign creditors.

attacks of September 2001, the current economic slump and chronically high internal cost structure. On the manufacturing side, the surplus of commercial aircraft is at a record level and worldwide production continues to exceed demand. The Commission has been told by experts that they expect demand to pick up with an eventual rebound in the economy. Most believe evolving market forces will eventually lead to a major restructuring of the airline and aviation servicing industries.

The Commission finds that one cause of the current financial condition of the industry relates to the federal government's over-taxation of the industry, principally in the form of aviation and security-related user fees. Testimony before the Commission indicated that for a $100 airline ticket, approximately 40 percent of that cost is the result of government imposed fees. See Figure 7-7. The Commission believes that the Administration and Congress should review and consider reducing these user fees on the airlines and their customers. The government should also look at how to mitigate problems caused by the scheduling cost and lack of availability of terrorism insurance.

Today's aerospace industry demands a dynamic, results oriented workforce with the talents, multidisciplinary knowledge, and up-to-date skills to enhance an organization's value.

The Commission is aware of concerns that, in future bankruptcies, airlines may be pressured to give foreign creditors preferential treatment over domestic creditors. The Commission urges the government to ensure that all creditors are fairly and equitably treated.

Long-Term Growth and Financial Health: In Jeopardy

In order to create a stable and predictable business climate that enables growth and fosters the long-term financial health of the industry, government and industry must first recognize that the global marketplace itself drives this very dynamic, complex, and innovative business environment. Challenges can no longer be simply viewed as issues between the U.S. government and American business. We must consider whether governing policies and regulations support or weaken good business practices, and whether these same rules support or weaken the technological capabilities of the aerospace industrial base. A healthy, competitive, and innovative industry meeting defense and aerospace needs must be closely integrated with the global commercial marketplace. Reduction in the uncertainty of ongoing business and future aerospace markets enables government and industry to make the necessary investments in people, technology, and facilities, to continue to ensure “world class” aerospace products today and for the future.

Major challenges to this desired climate include the need for dramatic personnel and training reform—how will we attract and retain necessary intellectual capital, sustain a robust workforce for the future, and attract highly and specifically qualified individuals to government service; and merger and acquisition policy reform—a global perspective and approach to mergers and acquisitions for a globally driven industrial base.

The Commission concludes that investors and the technology industry will continue to direct their focus toward the global commercial marketplace if specific reforms are not implemented in the near term, thus depriving the government and the aerospace industry of the best and brightest personnel, innovative ideas and technologies, and capital investments. The Commission has outlined a desired end-state within each of these areas and has provided a specific framework for long-term excellence.

Government and industry should work together to develop and implement training and exchange programs that would educate and expose their workforces to their respective challenges and responsibilities.

Personnel and Training—The Engine for Change. Today’s most successful organizations are defining in very specific terms what they want to accomplish and what kind of structures are necessary for success. They are also defining a shared vision for the future, focusing on core values, goals, and strategies and communicating this shared vision clearly, constantly, and consistently. Top organizations then choose the best strategies for integrating their organizational structures, activities, core processes, and resources to support mission accomplishments.

Aerospace-oriented organizations in both the public and private sectors recognize that people are an organization's key asset. Today’s aerospace industry demands a dynamic, results-oriented workforce with the talents, multidisciplinary knowledge, and up-to-date skills to enhance an organization's value to its customers and to ensure that it is equipped to achieve its mission. Because mission requirements, customer demands, technologies, and other environmental influences change rapidly, a performance-based organization must continually monitor its talent needs. It must also be alert to the changing characteristics of the global (not just U.S.) labor market and identify the best strategies for filling its talent needs through recruiting and hiring, and follow up with the appropriate investments to develop and retain the best possible workforce.

The Commission believes that a primary barrier to accomplishing many of the other recommendations in this report is the lack of understanding by the government and industry workforces about the roles, responsibilities, and challenges facing their counterparts. The Commission is also concerned about reported instances of government acquisition personnel failing to recognize business realities, such as the need for adequate profit margins.

Government and industry should work together to develop and implement training and exchange programs that would educate and expose their workforces to their respective challenges and responsibilities. These programs should include internship and fellowship programs, cooperative training programs, and personnel exchanges to provide firsthand experience for both workforces in the others’ day-to-day activities.

The Commission also concludes that government acquisition personnel should be required to be knowledgeable about the characteristics of the integrated civil contracting model, and that industry acquisition personnel be fully trained in the complexities of the government acquisition system. The Commission also believes that all government officials with budget and program acquisition, management, or review responsibilities, both appointed and elected, should have either a business or financial background or be provided access to expert advice in these areas. The Commission urges each new President to take these criteria into account when making selections for relevant positions. Both the executive and legislative branches are encouraged to create training programs so that personnel in relevant positions are fully knowledgeable about business practices and financial issues.

The Commission also believes that investments in new, contemporary learning systems should be immediately established to respond to the backlog of new policies and regulations that urgently need greater cultural understanding and further skill development. System focus should include: emphasis on the "how to" practical aspects of applying new rules and techniques, clear treatment of both culture change and new process, maximum use of technology based learning tools, mechanisms for validating learning tools and measuring the effectiveness of the learning process, and incorporation of joint buyer-seller learning scenarios in selected critical areas. Additionally, judicious use of outsourcing to access private sector education and training capability, aggressive use of government-industry exchange mechanisms to best leverage each side's knowledge, and finally, skills and sustained management attention and accountability including requirement for business and financial backgrounds and training for all government personnel responsible for program acquisition and financial management should be implemented.

A Global Approach to Merger and Acquisition Policy. Just as the global marketplace drives our business environment, a global approach to mergers and acquisitions is fundamental. Today's economy is comprised of multi-national corporations, operating across all time zones and financial markets. No one country or corporation has a corner on technology, innovation, or management processes. Access to global best practices and markets is an absolute necessity in today's environment.

The Commission believes the government must develop and implement a policy regarding international cooperation in defense and aerospace that recognizes the global industrial base. The Commission urges the Administration to undertake a review of the current policy regarding both domestic and international business combinations, based on an analysis of the U.S. defense industrial base, including the supplier industrial base.

Reforms	Actors	18-month Enabling Actions	Long-term Actions
Personnel & Training Reform	**DoD Industry OMB Congress**	• Implement government/industry internship, fellowship, and exchange programs for acquisition personnel. • Require training for government acquisition personnel in integrated civil contracting, and require training for industry personnel in government acquisition processes and systems. • Require all government officials with budget or program acquisition, management, or review responsibilities to have a business or financial background or training.	• Develop and implement contemporary learning systems to rapidly disseminate information about new policies and regulations
Merger & Acquisition Policy Reform	**Admin. DoD State Commerce**	• Initiate/update/complete studies on U.S. defense industrial base. • Initiate/update/complete studies on U.S. supplier base. • Conduct study of U.S. policy on domestic and international mergers and acquisitions.	• Develop U.S. policy regarding global mergers and acquisitions.

Conclusions

The Commission concludes that for our aerospace industry to be globally preeminent, now and in the future, it must be able to attract vitally needed capital at a reasonable cost. We further conclude that the defense and aerospace sector is viewed as a low growth industry with low margins, unstable revenue and a capricious major customer, the government. Without a significant change in the business model, the future of the aerospace industry, so critical to our national economic and homeland security, is uncertain and at risk.

PROVIDE INVESTMENT OPPORTUNITIES. Predictability, stability and performance are critical to the health and growth of a robust aerospace industry. The government must stabilize program requirements and protect adequate long-term investment funding, enact reforms that increase the financial flexibility of industry and the government, and improve program management stability.

ENABLE INDUSTRY TO ATTRACT AND RETAIN HIGH-TECH PARTNERS AND SUPPLIERS. The future of the aerospace industry is intrinsically tied to the ability of the sector to attract and retain high-tech partners and suppliers throughout the supply chain. The government should pursue near-term reforms to realign purchasing processes to lower costs and gain access to new technology by eliminating, or at least lowering, barriers that make government business inefficient and unattractive to commercial firms. DoD should implement changes to permit greater profitability and financial flexibility of industry working on government efforts. A government-wide review of functions and services should be conducted to identify those functions that are not “core” to the effective operation of government and those functions that could best be performed by the private sector.

CREATE A FAVORABLE DOMESTIC AND INTERNATIONAL BUSINESS CLIMATE. Certain U.S. tax and trade laws and regulations that affect a wide variety of industries weigh particularly heavily on defense and aerospace, both in competition with domestic commercial entities as well as in the international markets. The government should act promptly to replace burdensome tax laws and outdated trade laws with laws and regulations that remove unnecessary administrative burdens from industry and recognize the unique contribution of defense and aerospace companies to our nation’s defense and economic security. In addition, the Administration and Congress should review and consider reducing user fees on airlines and their customers.

ENSURE LONG-TERM GROWTH AND FINANCIAL HEALTH. Government and industry must recognize that a healthy, competitive, and innovative industry meeting security and aerospace needs must be closely integrated with the global commercial marketplace. Major challenges to this desired climate include the need for dramatic personnel and training reform and recognition of the dynamic interrelated global environment. Government and industry should work together to develop and implement training and exchange programs that would educate and expose their workforces to those challenges and responsibilities. All government officials with budget and program acquisition, management, or review responsibilities, both appointed and elected, should be required to have a business or financial background or training. Finally, government must develop and implement a policy regarding international cooperation in defense and aerospace that recognizes the global industrial base. The Administration is urged to undertake a review of the current policy regarding both domestic and international business combinations, based on an analysis of the U.S. defense industrial base, including the supplier industrial base.

RECOMMENDATION #7

The Commission recommends a new business model designed to promote a healthy and growing U.S. aerospace industry. This model is driven by increased and sustained government investment and the adoption of innovative government and industry policies that stimulate the flow of capital into new and established public and private companies.

RECOMMENDATION #8: The Commission recommends the nation immediately reverse the decline in, and promote the growth of, a scientifically and technologically trained U.S. aerospace workforce. In addition, the nation must address the failure of the math, science and technology education of Americans. The breakdown of America's intellectual and industrial capacity is a threat to national security and our capability to continue as a world leader. Congress and the Administration must therefore:

- Create an interagency task force that develops a national strategy on the aerospace workforce to attract public attention to the importance and opportunities within the aerospace industry;
- Establish lifelong learning and individualized instruction as key elements of educational reform; and
- Make long-term investments in education and training with major emphasis in math and science so that the aerospace industry has access to a scientifically and technologically trained workforce.

Chapter 8

Workforce: Launch the Future

The Commission believes the intellectual preparation of the American workforce is the cornerstone for the industry's future and the nation's economic well-being. The aerospace industry greatly enhances the vitality of the national economy by providing hundreds of thousands of high-skilled, well-compensated manufacturing jobs and by constantly developing sophisticated new technologies that benefit the entire economy, increase productivity and enhance national security. It is clear, therefore, that in the 21st century, the U.S. must continue to have a highly skilled, stable, secure, and growing aerospace workforce and a citizenry that is well prepared in mathematics and science.

Our policymakers need to acknowledge that the nation's apathy toward developing a scientifically and technologically trained workforce is the equivalent of intellectual and industrial disarmament, and is a direct threat to our nation's capability to continue as a world leader.

Government, industry, labor, and academia must work together to identify and develop needed skills at all levels and create programs and strategies to keep the aerospace workforce "pipeline" filled. This will ensure a world-class workforce ready to lead in a global economy.

Objective: Well Educated, Scientifically Literate and Globally Competitive Workforce

Aerospace workers will continue to be the most knowledgeable and the most productive in the world. U.S. students will be the world's best in mathematics, science and technology. The U.S. will have a vibrant aerospace industry that will once again be attractive to future workers.

Issues

Today's Aerospace Workforce: In Jeopardy

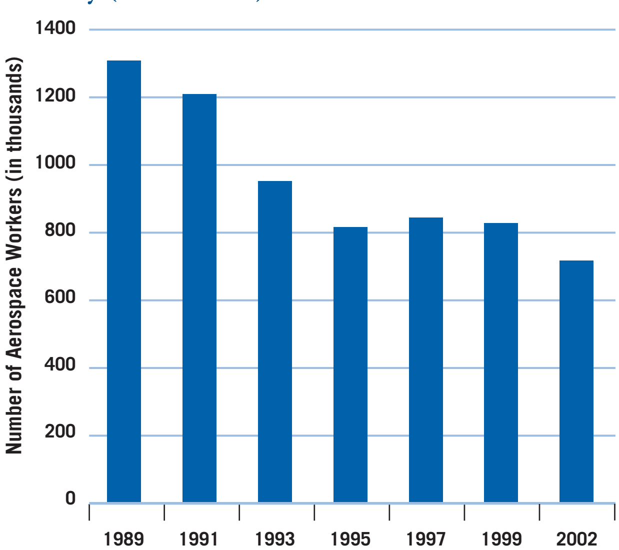
Clearly, there is a major workforce crisis in the aerospace industry. Our nation has lost over 600,000 scientific and technical aerospace jobs in the past 13 years.[1] These layoffs initially began as a result of reduced defense spending following the end of the Cold War. But subsequent contraction of the industry through mergers and acquisitions and the events of September 11 have made the situation worse. A consequence of this environment has been an overall aging of the aerospace workforce, which risks the loss of intellectual capital. In addition, the industry has shifted from one reliant upon defense sales to one in which a significant portion of sales are commercial, making U.S. aerospace industries vulnerable to foreign competition. All of this has placed our workforce in jeopardy.

ISSUES

- Today's Aerospace Workforce
  - Cyclical Nature of the Industry
  - Global Competition
  - Offsets
  - The Aging Workforce
  - Failure to Attract and Retain Workers
- Tomorrow's Aerospace Workforce
  - Failure of Mathematics and Science Education in the K-12 System
  - Higher Education in Aerospace Disciplines

Cyclical Nature of the Industry. The aerospace industry has historically been cyclical and strongly driven by defense spending, with increases corresponding to national conflicts and the military build-up in the Reagan-Bush years. Sales within the commercial industry have been cyclical as well, as has been government spending on space science and exploration.

Figure 8-1 Total Employment in the Aerospace Industry (1989 – 2002)



Source: Aerospace Industries Association*

* Chart uses AIA definition of aerospace workers that includes all occupations under manufacturing SIC codes.

Aerospace procurement by the military (expressed in constant dollars), for example, fell nearly 53 percent from 1987 to 2000.[2] The Department of Defense (DoD) also reduced its overall investment in research, development, testing, and evaluation by nearly 20 percent from 1987 to 1999.[3]

These reductions dramatically decreased the relative contribution of DoD to the aerospace industry, and contributed heavily to manpower losses in both the commercial and military sectors. However, aerospace procurements by DoD have recently begun to rebound, with an estimated 8.5 percent increase from 2000 to 2002.[4]

In addition to the reduced aerospace spending by the federal government, the aerospace industry itself cut investment in developing new technologies. Industry-funded aerospace research and development fell by 37 percent from \$8.1 billion in 1986 to \$5.1 billion in 1999 (in inflation adjusted dollars).[5]

In response to decreased government spending, the aerospace industry started consolidating in the mid-1990s through company mergers and buy-outs, further contributing to job losses. The number of major U.S. aerospace prime contractors shrank from more than 50 to just five: Boeing, General Dynamics, Raytheon, Lockheed Martin, and Northrop Grumman. Aerospace firms continue to consolidate to maximize resources, eliminate excess capacity, and access new market segments. Parts suppliers have also undergone contraction and consolidation.

This consolidation has eroded the U.S. industry's technology base and competitiveness. With fewer aerospace employers, many skilled engineers and technical experts have left the industry, resulting in a loss of intellectual capital. The most senior workers retired, while the most junior workers were laid off and migrated to other more promising industries.

The attacks of September 11, 2001 deepened the industry's economic downturn. Airlines have cancelled plane orders and two have filed for bankruptcy. Aerospace industry representatives noted that the total announced layoffs since September 11 have exceeded 100,000 workers across the industry.[6]

A CASE STUDY OF AEROSPACE WORKFORCE BARRIERS

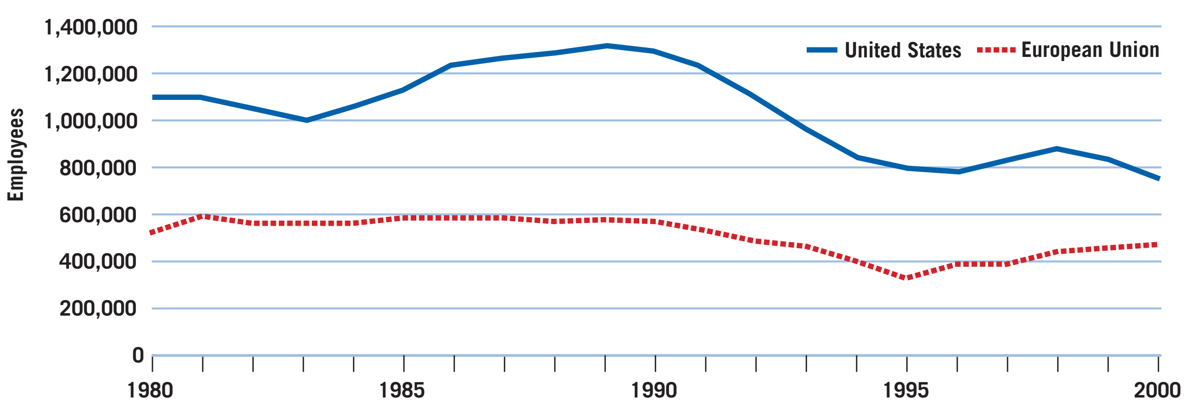
The story of Sandra Goins, a Boeing employee from 1989 to 2001, illustrates how the aerospace industry's instability contributes to its workforce difficulties.

After eight years in Boeing's copy center, Ms. Goins entered a labor-management sponsored technical apprenticeship program, seeking more valuable skills, interesting work, and a secure future. In the next four years, Ms. Goins completed 8,000 hours of apprenticeship training and a college degree and passed Boeing's initial assessment for entry-level management jobs.

But in December 2001, soon after completing her apprenticeship, Ms. Goins joined the 30,000 Boeing employees laid off due to 9/11. Now pursuing a teaching career, she says people will avoid the aerospace industry until its jobs are secure.

GLOBAL COMPETITION. Global competition has risen rapidly since 1989, most notably from Europe, and is likely to grow in the future. According to the European Association of Aerospace Industries, the U.S. share of world aerospace markets as measured by annual revenue fell from over 70 percent in the mid-1980s to below 50 percent in 2000.[7] In 2001, Airbus, the European consortium, commanded 38 percent of large commercial aircraft market deliveries. Since mid-1997, market share, as measured by order backlog, has shifted from Boeing to Airbus. At the end of 2001, Airbus had a backlog of 1,575 orders versus 1,357 for Boeing.[8] European Union (EU) increases in research and development investment may well challenge the U.S. lead in commercial aircraft. This competition has resulted in consolidation and rationalization in both countries.

Figure 8-2 U.S. and EU Aerospace Employment (1980 – 2001)



Source: MIT / LARA

Canada and Brazil, both with steadily growing aerospace workforces, have taken a leadership role in producing regional jets. This indicates that the future global aerospace industry is likely to have a growing number of niche products tied to particular nations or regions. Japan has long had such a niche status, centered on avionics. And while employment data from the Commonwealth of Independent States (CIS, the former Soviet Union) and China are not readily available, it is clear that they have major aerospace industries. In short, the aerospace industry now has four major clusters—U.S., Europe, CIS, and China—along with several regional centers, including Canada, Japan, Brazil, and others.

ISLANDS OF EXCELLENCE

BOEING / IAM QUALITY THROUGH TRAINING PROGRAM

In 1989, the International Association of Machinists and Aerospace Workers (IAM) and the Boeing Corporation created a joint training program through their collective bargaining agreement to train the workforce in new technology through apprenticeship programs and other training venues. The program, financed by a fund that collects 4 cents per payroll hour from all bargaining unit employees, had a $25 million training budget in 1999.

Offsets. Offset agreements represent a very complicated aspect of global competition in the aerospace industry. Such agreements, many of which shift production of aircraft parts to nations that buy finished U.S. aircraft, are a key ingredient in many foreign sales agreements. Manufacturers argue that offsets are a cost of doing business internationally. Labor unions contend that offsets are a major cause of job loss, compromise national security, and hurt our ability to remain dominant in aerospace by giving other nations the technology to produce aircraft and weapons.

"If the aerospace industry cannot attract and retain the best and the brightest, then the industry doesn't have a future."
Commissioner Tillie Fowler

Subcontractors and suppliers are concerned with offsets because foreign outsourcing means fewer sales for American producers and lead to overcapacity in the market. By one estimate, 11 percent of the U.S. aerospace jobs lost from 1989 to 1997 were traceable to increased imports.[9]

While the offset issue is controversial, it must be noted that since the 1970s, no large U.S. commercial aircraft or jet engine has been developed without major participation by foreign firms in technology development, manufacturing, or marketing.[10] Offsets are likely to grow in the future, due to global trends in the commercial aircraft market, and it is expected that "newly emerging markets" (developing nations) will soon order more aircraft than industrialized nations, enabling them to impose heavier offset requirements.[11] For additional details on the subject of offsets, see Chapter 6.

The Aging Aerospace Workforce. Statistics from a variety of sources indicate that the aerospace workforce is "aging" and that 26-27 percent of aerospace workers are eligible to retire by 2008. The average age of production workers is 44 in the commercial sector, 53 in defense[12] and 51 at the National Aeronautics and Space Administration (NASA).[13] In addition, the proportion of workers age 30 or younger dropped by almost two-thirds, from 18 percent in 1987 to 6.4 percent in 1999.[14]

These statistics reflect a legitimate concern about the loss of intellectual capital in the aerospace industry. Intellectual capital may be the most important factor determining the competitive success of aerospace and other industries. Tangible aspects of intellectual capital include a firm's investments, such as patents, proprietary processes, and training. Intellectual capital also includes knowledge created through collaborative work, relationships with suppliers, individual workers' expertise, and the firm's reputation. New employees may have the credentials to do the work, but the knowledge and relationships built through years of experience are difficult to replace. The pending retirements of so many aerospace scientists, engineers, and production workers pose a real threat to an industry already fraught with widespread layoffs and few new hires.

Further compounding the challenges around intellectual capital are longer product life cycles, a declining number of new platforms being developed, and reduced overall spending on research and development. These factors also diminish the ability of the industry to attract the best candidates to aerospace.

Failure to Attract and Retain Workers. The U.S. aerospace sector, once the employer of choice for the "best and brightest" technically trained workers, now finds it presents a negative image to potential employees. Surveys indicate a feeling of disillusionment about the aerospace industry among its personnel, whether they are production/technical workers, scientists or engineers. The majority of newly dislocated workers say they will not return to aerospace. In a recent survey of nearly 500 U.S. aerospace engineers, managers, production workers, and technical specialists, 80 percent of respondents said they would not recommend aerospace careers to their children.[15]

Engineering students also gave the aerospace industry low ratings for its physical work facilities, exciting and meaningful tasks, opportunities for professional development and growth, and supportive and encouraging management.[16] Consequently, U.S. students have migrated to other technical fields.

> "NASA has three times as many technicians over the age of sixty as under the age of thirty."
>
> Sean O'Keefe
> NASA Administrator

ISLANDS OF EXCELLENCE

ROCKWELL COLLINS KNOWLEDGE MANAGEMENT

Rockwell Collins has a company-wide initiative underway to record and document hard-to-replace competencies and skills. The initiative includes a computer-based training system that gives employees 24/7 access to training and information; skills assessment software that enables salaried employees to track the skills within their department and diagnose their own individual training needs; and Quick Learns, a CD-ROM based lesson series of video segments taught by actual hourly employees demonstrating how they perform elements of their work. Aerospace companies are also setting up communities of practice, executive succession planning, and mechanisms to capture workers' knowledge before they retire.

SPACE CAMP

In Alabama, children ages 9 and up can experience shuttle missions and space stations at five-day programs. Campers build a lunar colony and fly their own rocket. They learn about the history of space flight, shuttle and space station basics, and they experience lunar gravity. These stimulating activities educate young people about the space program and aviation, instilling an interest at an early age about the exciting careers in space that they may want to pursue when they are adults.

While there are no immediate solutions to the aerospace employment concerns, the Commission believes additional study of workforce issues is warranted. As the Commission recommended in Interim Report #3, steps are needed to help stabilize the aerospace workforce. We need to consider the impact on U.S. aerospace employment of domestic and international policies and reaffirm the goal of stabilizing and increasing the number of good and decent jobs in the industry. The Commission also recommended the establishment of an interagency task force on workforce issues in the aerospace industry. The task force should be comprised of representatives from the U.S. Departments of Labor, Defense, Commerce, Transportation, Education, and Energy, NASA, National Science Foundation (NSF) and other departments and agencies as appropriate. Additionally, we believe the government should develop a national strategy to attract public attention to the importance and opportunities within the aerospace industry.

Tomorrow's Aerospace Workforce: Unprepared

Failure of Mathematics and Science Education in the K-12 System. Written 20 years apart, two prestigious national Commission reports cited below highlight the continuing problems in the U.S. in developing a solid base of competence in mathematics and science required for a quality workforce and needed for general public support of research and development across the economy. One aspect of this crisis is low student achievement. In 1995, the Third International Math and Science Study found that U.S. students scored above the international average in 4th grade, slightly above it in 8th grade, but near the bottom in 12th grade.[17]

These data and numerous other national and state reports lead one to conclude that our K-12 system is doing an abysmal job of educating our children and that our nation, 20 years after "A Nation at Risk," is still at risk.

"If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war… We have, in effect, been committing an act of unthinking, unilateral educational disarmament."

A Nation at Risk, 1981

"The harsh fact is that the U.S. need for the highest quality human capital in science, mathematics and engineering is not being met… Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next century."

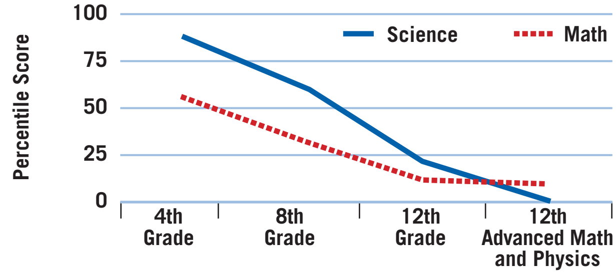
Road Map for National Security, 2001

There are multiple reasons for this failure:

- Differential funding in the 50 states and the nearly 15,000 separate school districts in the U.S.;
- Shortages of math and science teachers and the large number of uncertified teachers in the classrooms;
- Lack of competitive salaries for math and science teachers who have increasing job opportunities outside the classroom;
- Difficult work environments in many schools;
- Lack of respect for those who chose to teach; and
- Complex, decentralized management/delivery system for federal aid in math, science, and technology education systems that lacks sufficient funding, a comprehensive overview and a sense of mission.

Substantive research indicates that the most consistent predictors of student math and science achievement (and college success) are a teacher's full certification and a major in the subject they teach. Yet in U.S. high schools, more than one in four math teachers and one in five science teachers lack even a minor in their teaching field.[18]

Figure 8-3 U.S. Students Science & Math Performance Relative to Other Countries

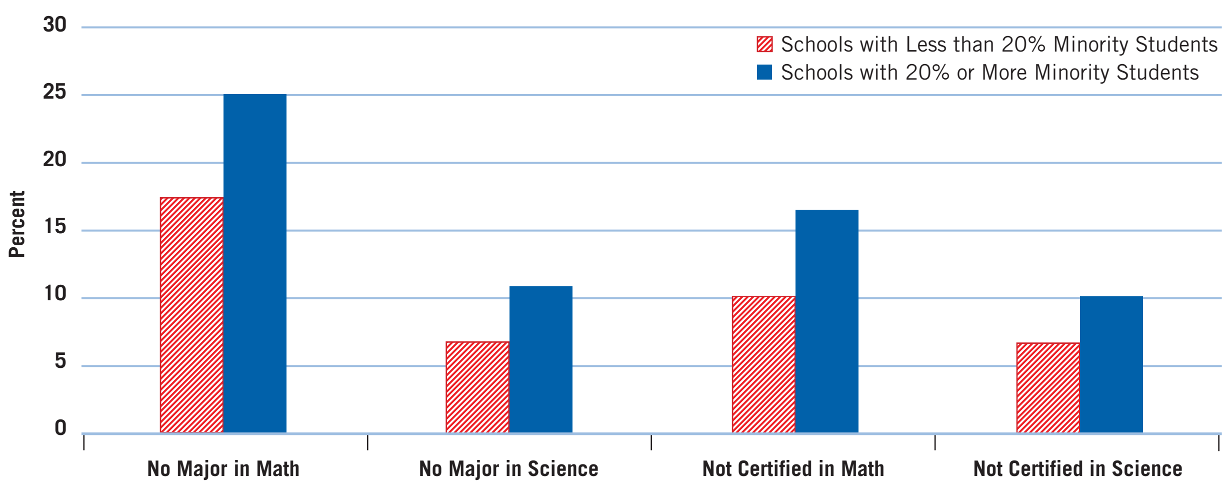


Source: Council on Competitiveness, U.S. Competitiveness 2001

Both the Hart-Rudman Report, "Road Map to National Security," and the Glenn Report, "Before it is Too Late," highlight this fact. "Thirty-four percent of public school math teachers and nearly 40 percent of science teachers lack an academic major or minor in these fields and a serious shortage of K-12 teachers exists in science and math. About 56 percent of high school students taking physical sciences are taught by out-of-field teachers, as are 27 percent of those taking mathematics."[19]

The prevalence of out-of-field math and science teachers is much greater in high-poverty areas and schools where a high proportion of students are

Figure 8-4 Percent of Public School Math and Science Teachers Without a Major or Certification in Class Subject



Source: Council on Competitiveness, U.S. Competitiveness 2001

ISLANDS OF EXCELLENCE
AVIATION HIGH SCHOOL

Aviation High School, located just outside New York City, is a unique public magnet high school that prepares students to enter the aviation field. Students take all the academic course requirements to earn a high school diploma, plus vocational course requirements to earn a Federal Aviation Administration (FAA) aircraft mechanic license. More than 90 percent of graduates pass the FAA certification exams and 75 percent of graduates go on to either a four-year university or attend a two-year college or technical school.

members of racial minority groups. According to the U.S. Council on Competitiveness, boosting the participation of women and minorities in the science and engineering workforce presents the single greatest opportunity to expand the nation's pool of technical talent.[20] Sadly, for the past 20 years, this country has been on a flat or declining trajectory in K-12 math and science teaching.

Teacher shortages in these disciplines are likely to worsen in the near future. Because of retirements, attrition, job changes, and other reasons, U.S. school districts will need to hire 240,000 middle school and high school math and science teachers between now and 2010.[21] Even with innovative efforts such as the Defense Department's "Troops to Teachers" and alternative certification programs in most states, there will continue to be a shortage of qualified teachers.

The Commission applauds the recent government efforts to address these problems including the "No Child Left Behind" legislation, proposed increases to the NSF budget for science and technology education and the recently passed "Tech Talent Act." Unfortunately, these steps are likely to be negated by the growing financial crisis that exists in many states and school districts.

The failure of the educational system to engage U.S. students in math and science has a cascading, negative impact on U.S. technological leadership and foretells an ever-shrinking cohort of engineers, mathematicians and scientists. Additionally, this means that many employers must assume remediation and retraining costs, which have been estimated to be over $60 billion a year.[22] Consequently, the Commission believes that if we are to remain a global leader in aerospace science, engineering and technology, we must address the immediate and critical national crisis in our K-12 education system.

Lifelong Learning and Individualized Instruction. The Commission believes that increased efforts must be made to teach math and science in a contextual way that engages students in workplace applications. Understanding and solving problems using real world examples (e.g., the ballistics of a baseball, computing gas mileage in Corvettes, the chemistry of cosmetics, etc.) provokes student interest in core scientific areas and applications. Institutional software packages can be used to overcome lack of familiarity with the subject matter by some teachers. The Commission especially encourages the development of curricula using aerospace problems and examples as the basis for teaching these subjects.

Additionally, the Commission believes that emphasis must be placed on the concepts of "lifelong learning" and "individualized instruction" as key elements of education reform. It is likely that individuals now entering the workforce will hold five or more jobs in their lifetime. The education system must be

ISLANDS OF EXCELLENCE

HONEYWELL SCHOOL-TO-APPRENTICESHIP PROGRAM

Honeywell, a leading global aerospace business based in Phoenix, AZ, invests in an innovative apprenticeship program that begins with high school seniors and takes them through a four-year program ending with an associate's degree in Manufacturing Technology.

Honeywell pays participants' wages during the training, as well as course tuition costs. Upon completion, these apprentices will be state-certified machinists or maintenance journey workers.

prepared to deliver training and education to meet these changing skill requirements and meet labor market needs. U.S. community colleges are doing this job well. They are adept at designing and delivering the workforce training and individualized instruction called for in this kind of effort.

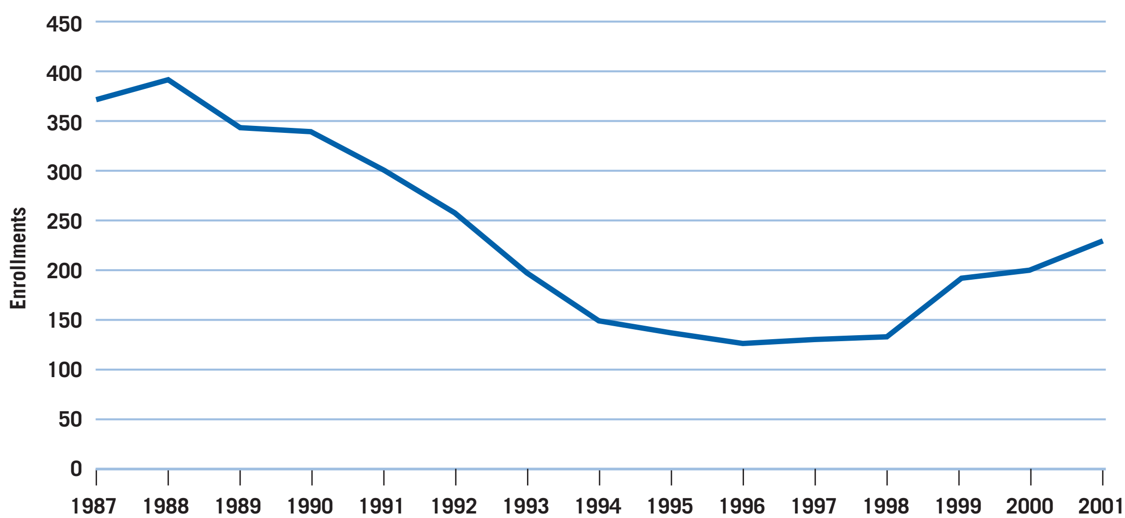
Higher Education in Aerospace Disciplines. From technician to Ph.D., the growth in technology, coupled with pending retirements, are driving a need for a well-educated, highly-skilled workforce.

Vocational Education and Apprenticeships. Vocational aerospace programs have had declining enrollments over the past 10 years, even though 50 percent of the current aerospace workforce is made up of workers in installation, maintenance, repair and production.[23] Most of these workers have completed stand-alone apprenticeship programs, or intensive training programs that combine on-the-job training with classroom instruction leading to an Associates degree from a community college.

While some of the major aerospace companies have apprenticeship programs to train production and technical personnel, few currently have apprentices in their programs due to the downturn in the economy. The need to replace retiring workers over the next 10 years, however, demonstrates the crucial need to start refilling the "pipeline" of qualified workers now. Analysis of the economic benefits of apprenticeship programs shows an impressive $50 return for every dollar of federal investment.[24] As stated in Interim Report #3, the Commission believes that the nation should make investments in vocational education to develop workforce skills needed by the industry, promote registered apprenticeship programs for technical and skilled occupations, and target tax credits for employers who invest in needed skills.

Undergraduate Education. At the undergraduate level, degrees awarded to U.S. students in science and engineering programs have been flat or declining. From a peak of 441,205 in l983, undergraduate

Figure 8-5 Aerospace Undergraduate Enrollment Trends (1987 – 2001)



Source: Dr. Bernard Grossman, Aerospace Department Chair Association, Testimony to the Commission on the Future of the Aerospace Industry, May 2002

ISLANDS OF EXCELLENCE

SPACETEC

A consortium of community colleges, led by Brevard Community College (near the Kennedy Space Center in Florida), is implementing an industry-driven technical education system for aerospace technicians. Through a grant from the National Science Foundation, SpaceTEC will formalize aerospace technical education nationally and establish a skills-based standards program that is recognized and endorsed by industry. SpaceTEC will work with K-12 and post-secondary institutes to coordinate curriculum development and instructional materials.

THE AVIATION CENTER OF EXCELLENCE

Florida Community College in Jacksonville has developed four programs to address the shortages of aviation mechanics, managers, administrators and professional pilots in the state. The Aviation Center of Excellence is certified by the FAA and offers Associate of Science degree programs in Aviation Maintenance Management, Aviation Operations, Professional Pilot Technology and a Post Secondary Adult Vocational certificate in Aviation Maintenance Technology. The program works with discharged military personnel as part of their recruitment efforts and offers short-term customized courses to address specific employer and student needs.

enrollment in engineering declined by more than 20 percent, to 361,991 in 1998.[25] In contrast, engineering enrollments are rising at universities in other countries. Since 1975, the U.S. has dropped from third to 13th in the world in terms of proportion of 24 year-olds who hold engineering degrees.[26]

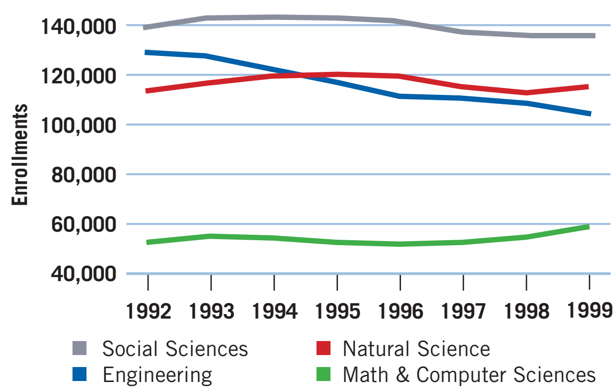
Within the United States, the number of aerospace engineering degrees awarded fell 47 percent from 1991 to 2000.[27] Although there has been a slight increase in undergraduate enrollment since 1997, it is not known whether this increase will continue. There has not been a corresponding increase in graduate enrollment.

This overall downward trend raises a serious concern about the availability of an educated engineering cohort to maintain U.S. leadership in science and technology and in the aerospace industry in particular.

Graduate Education. U.S. graduate enrollment in science and engineering fields has also been flat or in decline. From the mid-1990s, the number of doctorate degrees awarded annually in engineering declined by 15 percent.[28] The number of doctorates in physics declined by 22 percent, and there were declines in mathematics and computer science degrees as well.[29]

While the total numbers of advanced graduate degrees awarded in science and engineering to U.S. students are declining, the proportion of those degrees awarded to foreign students has increased dramatically. In engineering, fewer U.S. citizens earned doctorates in 2000 than in 1970: 2,514 in 1970 and 2,206 in 2000. Meanwhile, the number of engineering doctorates earned by foreign students on temporary visas grew substantially, from 471 in 1970 to 2,444 in 2000.[30]

Figure 8-6 Graduate Enrollment in Science and Engineering Fields (1992 – 1999)



Source: NSF, Science and Engineering Indicators, 2002

In the physical sciences, which include math and computer sciences, the numbers are also startling. In 1970, 4,631 U.S. citizens and 568 foreign nationals earned doctorates.[31] In 2000, 3,260 U.S. citizens and 2,161 foreign nationals earned doctorates.[32]

Foreign students now comprise over 40 percent of all Ph.D's awarded in science and engineering.[33] This situation presents two problems for the aerospace workforce. First, a significant percentage of these highly educated scientists and engineers return to their home countries. Second, many of the foreign Ph.D. graduates who stay in the United States cannot obtain the security clearances required for some aerospace positions. Consequently, a considerable amount of the talent being trained at our universities cannot contribute to the U.S. aerospace industry or to the long-term development of the U.S. economy.

The purpose of this discussion is not to criticize the foreign students seeking advanced degrees from some of the best universities in the world, or the U.S. universities that award the degrees. But serious reflection is called for when too few of our own citizens pursue the scientific and technological skills and credentials needed to maintain this country's global leadership.

The Commission believes that the U.S. government must make substantive, long-term investments in education and training with major emphasis on mathematics and science, so that the aerospace industry has access to a scientifically and technologically trained workforce, second to none in the world.

Conclusions

Clearly, there is a major workforce crisis in the aerospace industry. Our nation has lost over 600,000 scientific and technical aerospace jobs in the past 13 years. These layoffs initially began as a result of reduced defense spending following the conclusion of the Cold War. This led to an industry shift from reliance on defense sales to one dependent upon commercial markets. Increasing foreign competition in the commercial aerospace market has led to contractions in the industry, resulting in mergers and acquisitions. Job losses from this consolidation have been compounded by the cyclical nature of the industry.

Due to these uncertainties, most of the workers who have lost their jobs are unlikely to return to the industry. These losses, coupled with pending retirements, represent a devastating loss of skill, experience, and intellectual capital to the industry.

Reverse the Decline and Promote the Growth of Today's Aerospace Workforce. The Commission was unable to agree to any immediate solutions to help stem the loss of jobs within the industry. It hopes that its recommendations for a high-level federal management structure focused on establishing a national aerospace consensus (Chapter 5) and other actions to promote the industry will have a positive effect in the future. What is clear is that industry, government, and labor must begin to work now to restore an aerospace industry that will be healthy, stable, and vibrant.

U.S. policy towards domestic aerospace employment must reaffirm the goal of stabilizing and increasing the number of good and decent jobs in the industry. The Administration and the Congress should consider the impact of domestic and international policies on U.S. aerospace employment.

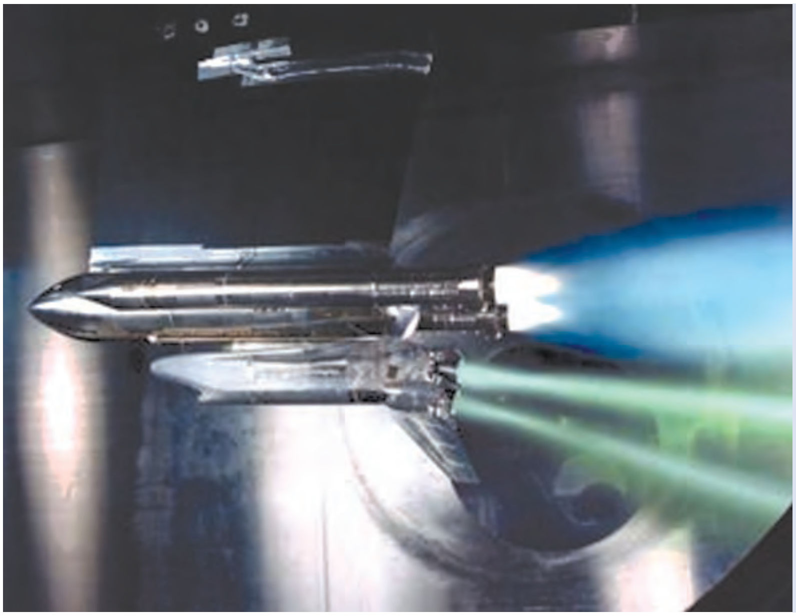
Address the Failure of the Math, Science, and Technology Education. The aerospace industry must have access to a scientifically and technologically trained workforce. In the long term, the Commission stresses that action must be taken to improve mathematics and science instruction across the entire education range—K-12 through graduate school. These actions and investments should include scholarships and internship programs to encourage more U.S. students to study and work in mathematics, science, and engineering fields. In addition, investments should be made in vocational education to develop a highly skilled workforce, including registered apprenticeship programs for skilled and technical occupations. Further, as recommended in Commission Interim Report #3, targeted tax credits should be made available to employers who invest in the skills and training programs needed by the industry.

In addition, the Commission concludes that emphasis must be placed on the concepts of "lifelong learning" and "individualized instruction" as key elements of education reform. It is likely that individuals now entering the workforce will hold five or more jobs in their lifetime and the education system must be prepared to deliver training and education to meet these changing skill requirements and meet labor market needs. U.S. community colleges are adept at designing and delivering workforce training and individualized instruction.

Our policymakers need to acknowledge that the nation's apathy toward developing a scientifically and technologically trained workforce is the equivalent of intellectual and industrial disarmament and is a direct threat to our nation's capability to continue as a world leader.

RECOMMENDATION #8: The Commission recommends the nation immediately reverse the decline in, and promote the growth of, a scientifically and technologically trained U.S. aerospace workforce. In addition, the nation must address the failure of the math, science and technology education of Americans. The breakdown of America's intellectual and industrial capacity is a threat to national security and our capability to continue as a world leader. Congress and the Administration must therefore:

- Create an interagency task force that develops a national strategy on the aerospace workforce to attract public attention to the importance and opportunities within the aerospace industry;
- Establish lifelong learning and individualized instruction as key elements of educational reform; and
- Make long-term investments in education and training with major emphasis in math and science so that the aerospace industry has access to a scientifically and technologically trained workforce.



RECOMMENDATION #9: The Commission recommends that the federal government significantly increase its investment in basic aerospace research, which enhances U.S. national security, enables breakthrough capabilities, and fosters an efficient, secure and safe aerospace transportation system. The U.S. aerospace industry should take a leading role in applying research to product development.

Chapter 9

Research: Enable Breakthrough Aerospace Capabilities

Aerospace is a technology-driven industry. Long-term research and innovation are the fuel for technology. U.S. aerospace leadership is a direct result of our preeminence in research and innovation.

Think of what we have achieved since the Wright brothers first flew. Aerospace technology has transformed the way we live, work and play. Today, we routinely travel thousands of miles by air in a matter of hours; mail and cargo can be delivered almost anywhere in the world overnight; people can communicate with others around the world instantaneously; and air and space systems play an integral role in our national security and homeland defense. Satellites monitor the health of the planet and its atmosphere and provide global information about the weather; robotic spacecraft visit the planets; space telescopes look back at the origins of the solar system; and the International Space Station orbits the Earth as the first permanent international habitat in space.

RESEARCH: Scientific investigation aimed at discovering and applying new facts, techniques and natural laws.

McGraw-Hill Dictionary of
Scientific and Technical Terms

The U.S. aerospace sector has achieved many firsts over the last century, but it could have done even more. Man walked on the moon 30 years ago, but we have failed to return. We built the SR-71 "Blackbird" aircraft, and 30 years later it still holds the speed record. Aerospace infrastructure built decades ago is still the mainstay of our capability. If our next 100 years are to be as exciting as the last, we must continue to sustain the U.S. research capability to produce new breakthroughs in technology.

Government policies and investments in long-term research are essential if the United States is going to maintain its global aerospace technology leadership. Long-term research enables breakthroughs in new capabilities and concepts and provides new knowledge and understanding, often resulting in unexpected applications in other industries, and in the creation of new markets. Research is an indispensable part of the U.S. innovation engine for generating new ideas and knowledge and for accelerating their transformation into new products, processes and services. But, government and private investments in long-term research have not kept pace with the nation's technological needs.

Industry has the responsibility for leveraging government and university research and for transforming it into new products and services, quickly and affordably. But, the U.S. aerospace industry has not invested sufficiently to transition research into marketable products and services.

Academia has the responsibility for educating the nation's scientists and engineers and for partnering with government and industry on long-term, high-risk research. But, they are dependent on government and industry investments.

Objective: U.S. Preeminence in Research and Innovation

U.S. preeminence in research and innovation will provide revolutionary aerospace capabilities in the 21st century—safe, secure, fast, clean, quiet.

Imagine a future in which:

- You can travel wherever and whenever you want on Earth or in space;
- You will be able to get from your doorstep to your destination on time and without delay;
- You will be able to have customized products delivered to you where and when you need them;
- You will know the weather accurately days in advance;
- Rogue nations and terrorists will no longer threaten the free world because their actions are monitored continuously and, if necessary, are responded to instantaneously wherever they are, day or night;
- We will have not only answered fundamental questions about our universe but also will have explored new worlds and reaped their untold treasures;
- You have clean and quiet aerospace vehicles; and
- Our nation's "best and brightest" seek out the excitement provided by careers in aerospace.

All of these are possible if the nation invests in the future.

Issues

Over the last several decades, the U.S. aerospace sector has been living off the research investments made primarily for defense during the Cold War, which enabled intercontinental ballistic missiles, the Saturn V, SR-71, space-based reconnaissance, missile defense systems, global positioning systems, stealth, and unmanned aerial vehicles. In the past, the aerospace sector led the technology revolution primarily because of large public investments in research directed at national security imperatives and goals.

Today, we have no integrated national aerospace consensus to guide policies and programs. This has resulted in unfocused government and industry investments spread over a broad range of long-range research programs and associated aging infrastructure. Meanwhile, foreign governments realize the importance of public investments in research and infrastructure. As a result, they are defining their

ISSUES

- Public Funding For Long-Term Research and Infrastructure
  - Long-Term Research
  - Infrastructure
- National Technology Demonstration Goals
- Transition of Government Research to Aerospace Sector
  - Information Transfer
  - Public-Private Partnerships
  - Product Development Process

> "But it is not really necessary to look too far into the future; we see enough already to be certain that it will be magnificent. Only let us hurry and open the roads."
>
> Wilbur Wright
> Speaking to the Aero-Club de France
> November 5, 1908

priorities and increasing their investments.[1] The European Union, for example, has made increased funding of civil aeronautics research a priority in its openly stated drive for world leadership in the aerospace industry. Asia, likewise, has targeted aerospace as a strategic industry and increased government research and development (R&D) investments in its national manufacturers.

The war on terrorism has created a new national imperative that demands we make aerospace a national priority again and focus our resources on developing new products and processes as fast as possible. Because of the unique capabilities it can provide, aerospace can help us win the war on terrorism while simultaneously strengthening our economy. This can only be done if we unleash the aerospace sector's full potential.

Public Funding for Long-Term Research and Infrastructure: Insufficient and Unfocused

Many in government and on Wall Street view the aerospace sector as "mature." They view government investments in research as "corporate welfare" and not as an opportunity to make major breakthroughs in aerospace capabilities that could open new markets and usher in a new era of U.S. global aerospace leadership. The lack of sufficient and sustained public funding for research and associated research, development, test and evaluation (RDT&E) infrastructure limits the nation's ability to address critical national challenges and to enable breakthrough aerospace capabilities.

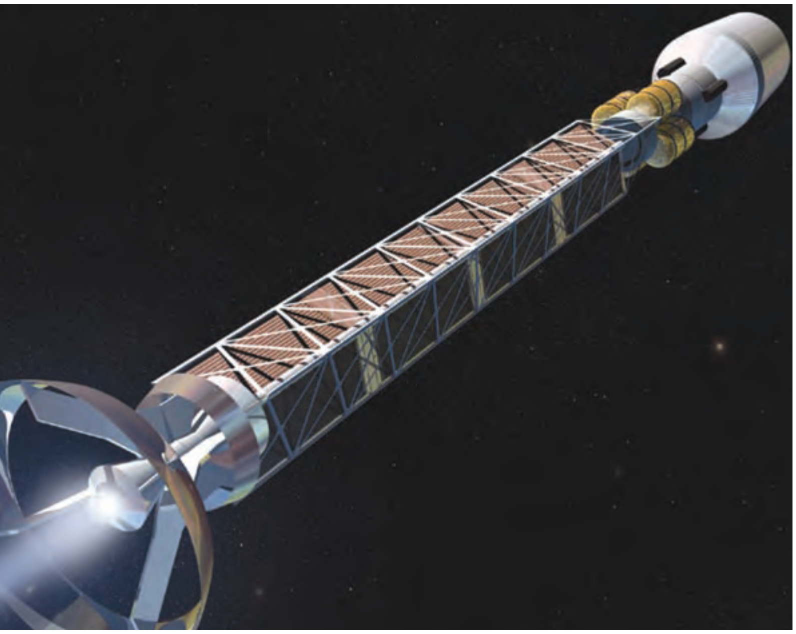
LONG-TERM RESEARCH. Most of our aerospace capabilities today are the result of breakthrough technologies developed in the 1940-1960s for military applications, including the jet engine, radar, space launch, and satellites. In many cases, these capabilities gradually migrated into civil and commercial applications in the 1960s through the 1990s. This includes commercial jet aircraft, the air traffic control system, telecommunications, and space-based commercial remote sensing.

Countless breakthrough capabilities are possible over the next 100 years. But, they will only be of military and economic benefit, if the United States maintains its preeminence in conducting long-term basic research that delivers revolutionary, breakthrough aerospace capabilities to market faster than its international competition. Aerospace research that will enable these breakthrough capabilities include:

LONG-TERM AEROSPACE RESEARCH

- Information Technology
- Propulsion and Power
- Noise and Emissions
- Breakthrough Energy Sources
- Human Factors
- Nanotechnology

Information Technology. The information revolution will ultimately be as important to transportation as the invention of the automobile and the jet engine.[2] High performance computers will enable us to model and simulate new aerospace vehicle designs, prototype them and field them quickly. High confidence systems and high-bandwidth communications, including lasers, will ensure that communication links between space, air and ground elements are secure from cyber attack. Large-scale networks will enable the development of system-of-systems solutions for defending America, projecting power globally, and moving aircraft around the world when and where needed.



Advances in propulsion will remain the critical enabling technology to revolutionary aerospace capabilities. Anti-matter propulsion holds promise as a means of enabling faster travel through space.

Advanced engineering tools will make software more reliable, robust and fault tolerant. Micro- and nano-computers and sensors will revolutionize flight systems, enabling them to acquire, process, and automatically fly aerospace vehicles. New integrated air, space and ground networks will enable us to acquire large volumes of data, process that data and then make it available to decision makers anywhere in the world, in near-real time. Computer and network technologies will revolutionize the workplace, increasing individual and organizational productivity.

Propulsion and Power. Advances in aerospace propulsion and power have been foundational in achieving nearly every significant breakthrough in aerospace capability over the past century. The piston engine enabled the Wright brothers to inaugurate the age of powered flight. Development of the turbine engine ushered in the jet age. Rocket propulsion opened our access to space. And nuclear generated electric power made possible our initial exploration of the solar system.

In the next century, advances in propulsion and power will remain the critical enabling technology to revolutionary aerospace capabilities. These advances will come in four flight regimes: subsonic and supersonic flight (gas turbine/pulse detonation engines), hypersonic flight (ramjets/scramjets), access-to-space (rocket/combined cycle systems), and travel through space (nuclear, plasma, and anti-matter propulsion and power).

- *Subsonic and Supersonic Flight.* Advanced air-breathing propulsion systems will enable a new generation of quiet, clean, affordable, and highly capable military and civil aircraft. Since the 1950s, aggressive gas turbine engine technology efforts have increased production engine performance by a factor of three and improved fuel efficiency by 70 percent. Further substantial improvements in the capability and cost of hydrocarbon-fueled turbine engines are being actively pursued under the newly formed Versatile, Affordable, Advanced Turbine Engines (VAATE) Program, which focuses Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and industry investments on a common set of national goals.
- *Hypersonic Flight.* Ramjet/scramjet technology offers the potential for new classes of aircraft and weapons that can provide the military with global reach and time critical strike capabilities. In addition, dual-use benefits can be derived within the civil aviation sector, permitting significantly reduced transit times around the world. U.S.

Artist concept of a hypersonic missile.

THE NATIONAL AEROSPACE INITIATIVE

- High-Speed/Hypersonics
- Space Access
- Space Technology

ramjet/scramjet technology efforts over the past decade have been limited and unfocused. An aggressive and sustained investment is needed in this arena, with the objective of overcoming the critical technical barriers of high-speed flight and providing the demonstrations necessary to validate the operational feasibility of hypersonic systems. The Commission supports the joint DoD and NASA National Aerospace Initiative objective of achieving Mach 12 capability by 2012. This initiative should begin as soon as possible.

- *Access-to-Space.* Affordability will be key to seamless, on-demand space access, as well as the future successful commercialization of space. New families of rocket-based and air-breathing propulsion technologies are needed to support development of the reusable and expendable launch vehicle concepts that can provide order-of-magnitude reductions in payload-to-orbit cost. Single- and two-stage-to-orbit configurations offer the potential for airline-like operations not achievable with current launch systems.

- *Travel Through Space.* The lengthy transit times that result from the use of currently available propulsion systems make human exploration of our solar system difficult, if not infeasible. While propulsion concepts, such as ion and plasma, and power sources, such as nuclear, offer the potential of cutting transit times for space exploration by half or more—they are unable to significantly reduce the duration of deep-space missions. New propulsion concepts based on breakthrough energy sources, such as anti-matter energy systems, could result in a new propulsion paradigm that will revolutionize space transportation. See Figure 9-1.

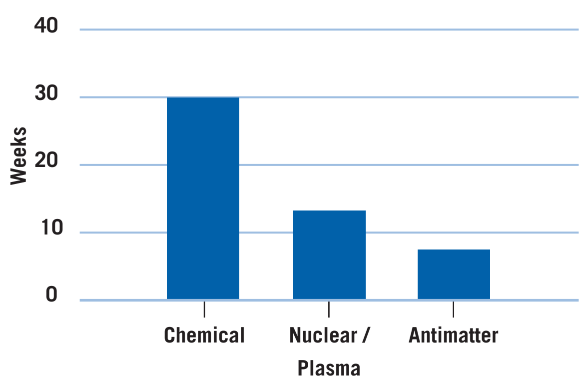
THE COMING HYDROGEN ECONOMY:

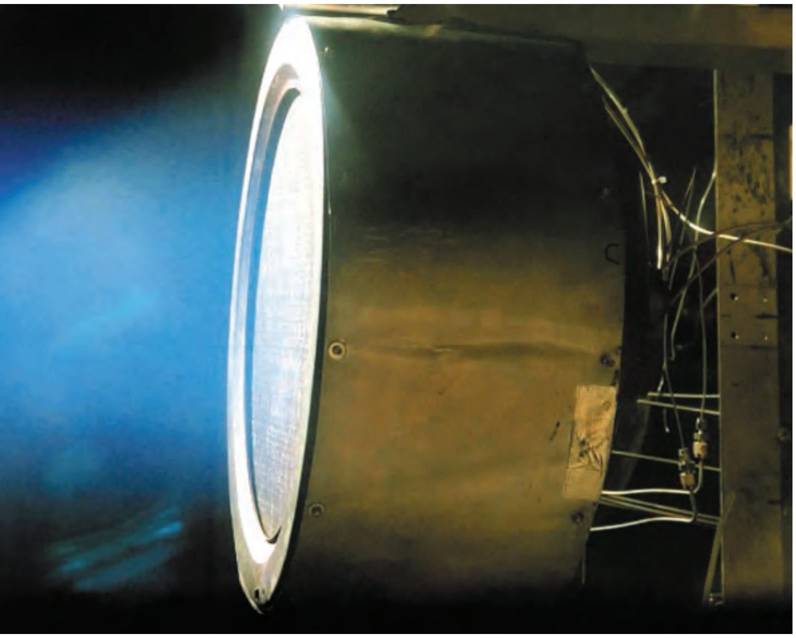
Hydrogen may be the next breakthrough energy source for aircraft. Hydrogen-fueled engines produce zero emissions of carbon dioxide, the primary gas of concern for global warming. Hydrogen-fuel-cell-powered aircraft would eliminate the combustion cycle altogether, thereby producing no combustion emissions and drastically reducing engine noise.

Noise and Emissions. Quiet and clean aircraft offer the potential to greatly expand the capacity of the national airspace system—making airports sought-after centers of economic activity. With the advent of the high-bypass turbofan engine, aircraft propulsion systems noise and emissions have been greatly reduced. Advanced vehicle concepts—such as blended-wing-body, strutbrace-wing, and noise cancellation technologies—could produce further reductions. Research investments are needed to further mitigate jet noise, sonic boom, and emissions. Near zero-emissions aircraft may someday be possible through the introduction of breakthrough energy sources, such as hydrogen.

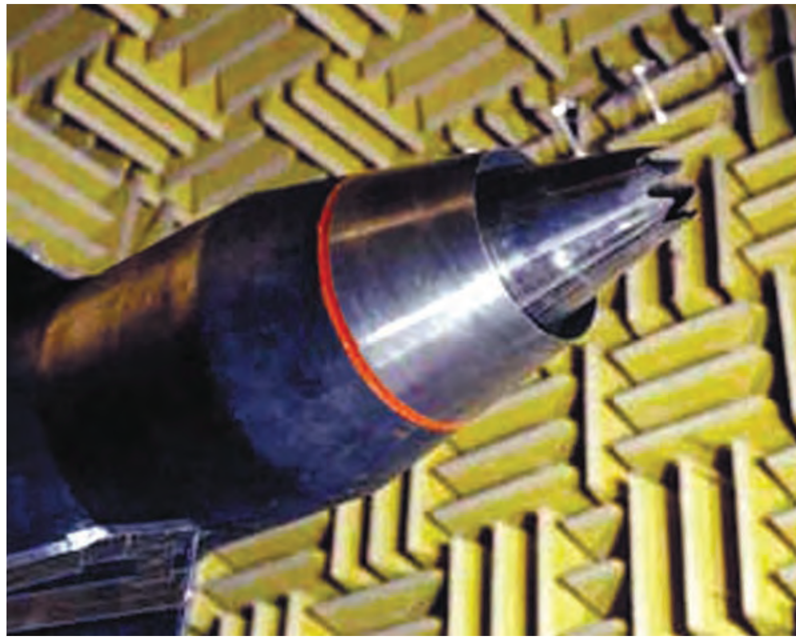
Breakthrough Energy Sources. In the 20th century, hydrocarbon-based fuels served as the predominant energy sources for aerospace applications. In the 21st century, new energy sources must be developed in order to achieve revolutionary new air and space capabilities.

Figure 9-1 Transit Time From Earth to Mars





Ion engines may propel future spacecraft.



Advanced engine exhaust nozzles like the one in this NASA test chamber will help reduce the noise near airports.

- *Air Applications.* In the near term, hydrogen fuel cell technology can be used to provide aircraft auxiliary power, increasing aircraft safety and propulsion system efficiency. Aircraft use of hydrogen can be an important step in establishing a hydrogen economy that could free the U.S. from dependence on foreign sources of energy. The benefits of moving from hydrocarbon-fueled to hydrogen-powered aircraft clearly justify an expanded and accelerated program to make aerospace a leader in hydrogen energy research.

New cockpits will be radically different from those of today.

- *Space Applications.* In the nearer-term, nuclear fission and plasma sources should be actively pursued for space applications. In the longer-term, breakthrough energy sources that go beyond our current understanding of physical laws, such as nuclear fusion and anti-matter, must be credibly investigated in order for us to practically pursue human exploration of the solar system and beyond. These energy sources should be the topic of a focused basic research effort.

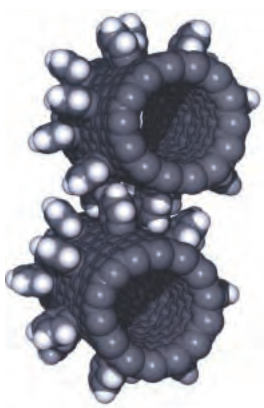
Human Factors. In the final analysis, all technology involves the human.

- *Human-Centered Design.* Automated systems can increase capacity and safety of aerospace systems, but not without human factors research. In air traffic management, for example, one of the main constraints on system capacity is human cognitive workload limitations. A typical air traffic controller can only maintain awareness of four to seven aircraft at a time. Automation could remove this limitation but would change the controllers' function. This will require human factors research to examine: human-automation interaction; the display, exchange and interpretation of information; the role of the operator; and operator selection and training.

Improving safety is possible using automation to compensate for and to assist humans. To achieve this, human factors research is needed to advance our fundamental understanding of how people process information, make decisions, and collaborate with human and machine systems. The result will be enhanced performance and situational awareness of the human—in and out of the cockpit.

- *Space Radiation Effects.* Radiation is a significant limiting factor for long-duration human space missions. Human factors research is needed to better understand and counteract/overcome the effects of radiation to maximize crew physical health, psychological integrity, protection and survival during long-duration space flight.

Nanotechnology. Not only did microtechnology lead to computers and the Internet during the second half of the 20th century, but it also brought us to the beginning of an exciting scientific revolution we now call "nanotechnology." Microtechnology helped develop scientific instruments that make it possible for the first time to image, manipulate, and probe objects that can be more than one thousand times smaller than the microcircuits of the most advanced computers. These objects have dimensions on the scale of nanometers, 1/100,000th the width of a human hair.



Nanotechnology is the creation of functional devices on the nanometer length scale (1-100 nanometers).

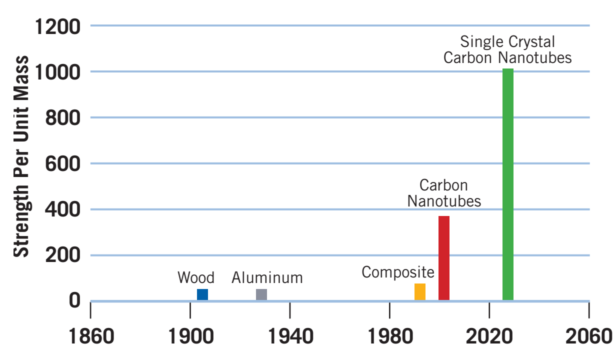
Recent discoveries indicate that, at the nano scale, devices and systems have completely different electrical, mechanical, magnetic, and optical properties from those of the same material in bulk form. This could lead to over an order of magnitude increase in material strength which could revolutionize aerospace vehicle structural design and performance. See Figure 9-2. In addition, they will enable the development of miniaturized, inherently radiation-hardened materials and electronic components. They could also help eliminate aviation noise, provide morphing-capable airframes, reduce the cost of space access and help bring about a new, highly advanced generation of small satellites for surveillance and atmospheric monitoring.

The benefits of research may not be realized for decades but are critical to innovation and to keeping the nation's intellectual capital "ever green." Research needs to be world-class and be increasingly interdisciplinary in nature.

Infrastructure. Maintaining a world-class national aerospace RDT&E infrastructure is needed to ensure that this country's research programs can be performed successfully. Testimony before the Commission and studies conducted by the federal government over the last decade have found that the nation's research infrastructure is aging, locally optimized, and unable to meet our future needs.

Aging. Much of the U.S. RDT&E infrastructure is 40 to 50 years old and marginally maintained. The nation must properly fund: routine maintenance and upgrades; the development of advanced computational/simulation tools and the integration into the research facilities and test processes; the development of new test technology and associated instrumentation; and the implementation of these new technologies in national research assets.

Figure 9-2 Past and Projected Strength of Materials for Air and Spacecraft Structures



Source: Langley Research Center, NASA

Locally Optimized. Government and industry managers optimize their infrastructure resources locally and not from a national perspective. The federal government needs a process to ensure that the U.S. aerospace RDT&E infrastructure is right-sized, state-of-the-art, affordable, and supports joint government-industry use in achieving our national objectives.

Unable to Meet Future Needs. The nation needs to identify and invest in a new infrastructure that supports U.S. government and aerospace industry needs so our infrastructure does not become a constraint on our country's technology advancement. For example, the nation will need production-oriented wind tunnels, with test capabilities beyond those currently available, to design and test new hypersonic vehicles and systems.

The Commission believes that the White House and the Congress must increase and sustain funding in long-term research and associated RDT&E infrastructure to develop and demonstrate new breakthrough aerospace capabilities.

National Technology Demonstration Goals: Do Not Exist

Long-term research and the associated RDT&E infrastructure are the building blocks for developing breakthrough aerospace capabilities and is an indispensable part of the U.S. innovation process. Just as the government invested in aerospace capabilities that transformed the second half of the 20th century (e.g., jets, radar, space launch, satellites), it must invest in capabilities that will transform the first part of the 21st century. To focus our aerospace research investments on developing these breakthrough capabilities, the Commission suggests the Administration adopt—as a national priority—the achievement of the following aerospace technology demonstration goals by 2010.

Wind tunnels at NASA's Ames Research Center, some of which are over 50 years old.

Air Transportation

- Demonstrate an automated and integrated air transportation capability that would triple capacity by 2025;
- Reduce aviation noise and emissions by 90 percent;
- Reduce aviation fatal accident rate by 90 percent; and
- Reduce transit time between any two points on earth by 50 percent.

Space

- Reduce cost and time to access space by 50 percent;
- Reduce transit time between two points in space by 50 percent; and
- Demonstrate the capability to continuously monitor and surveil the earth, its atmosphere and space for a wide range of military, intelligence, civil and commercial applications.

Time to Market and Product Cycle Time

- Cut the transition time from technology demonstration to operational capability from years and decades to weeks and months.

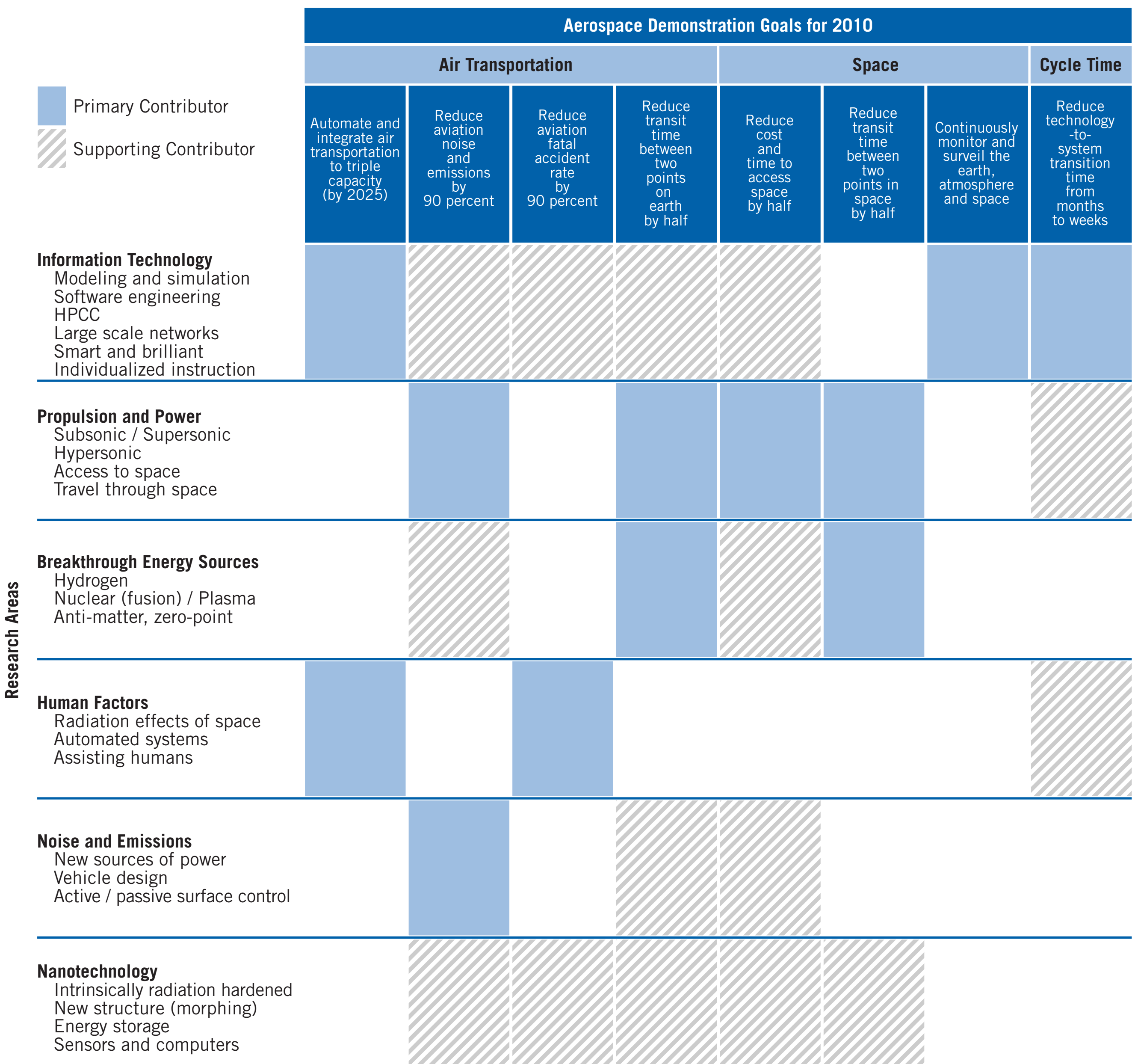
Figure 9-3 shows how the research areas discussed earlier support the demonstration goals.

Transition of Government Research to Aerospace Sector: Slow

The Commission believes that the U.S. aerospace industry must take the leadership role in transitioning research into products and services for the nation and the world. To assist them, the government must provide industry with insight into its long-term research goals and programs. With this information, the industry needs to develop business strategies that can incorporate this research into new products and services. Industry also needs to provide an input to the government on its research priorities. Lastly, government and industry need to create an environment that will facilitate acceleration of technology transition into application.

Information Transfer. The government has attempted to transfer technology that it develops for its unique department and agency missions to indus-

Figure 9-3 Aerospace Research Areas vs. Demonstration Goals



try through various mechanisms, such as cooperative agreements. These mechanisms, however, tend to be cumbersome and slow, which many times results in technology being obsolete before the agreements are signed and the products fielded. In addition, industry has been slow to utilize technology from federal laboratories as part of their products and services. Government and industry need to develop new ways of transferring research and technology developed in federal laboratories and in academia.

In the future, new ideas and knowledge will be translated directly into prototype products and services for customer testing. Industrial design, modeling, simulation, and computer-aided manufacturing and software development will become major elements in an integrated and streamlined innovation process that can apply "tomorrow's ideas to today's products and services."

These opportunities, plus the dramatic improvements in individual and group productivity through automation, networking, and modeling, will radically alter the way we apply research to develop new and innovative products and services. Information (and intellectual capital) will become the new "transfer" function of the 21st century. This new function will enable industry to transition research into new products and services quickly.

Public-Private Partnerships. Government, industry, labor and academia need incentives that encourage them to think and act in the common interest of the nation. They need to be motivated and rewarded for performing world-class research, for reengineering product-development processes, for taking a national perspective and for delivering quality products and services quickly and affordably. In short, they need incentives for change, so that they can deliver more for less, quickly and affordably.

For example, to encourage industry and academia to work together, the government should consider providing tax incentives to the industry for both research sponsorship and capital investments that they make in universities. This would provide trained technical staff and focused research products for the industry, while providing more resources for academia to perform cutting-edge research.

Under the leadership of the White House, the government, industry, labor and academia need to work together to transform the way they do business, allowing the nation to capitalize on the best ideas available and apply them rapidly to new products, processes and services. Each plays an important role in the process, but each often has conflicting goals and objectives. These goals and objectives need to be reconciled and an environment established that permits joint governance over the process. The government and industry should jointly publish these goals and objectives with a set of metrics and milestones to measure the success of the process.

Product Development Process. Government, industry, labor and academia view long-range science and technology research as a separate function from acquisition, rather than an integral part of a larger product-development process. Furthermore, they view science ("S") and technology ("T") as separate functions, further hindering the application of new ideas and concepts to the development and manufacture of new products and services. See Figure 9-4.

VAATE: A MODEL FOR PUBLIC-PRIVATE PARTNERSHIPS

- Addresses a critical dual-use technology
- Has well-defined goals, objectives, and milestones
- Integrates a variety of disciplines (e.g., materials and structures, aerodynamics, computational fluid dynamics, etc.)
- Coordinates government/industry efforts
- Provides near-term payoffs to existing systems and enabling technologies for new systems
- Possesses strong government (DoD/NASA) leadership/oversight

Figure 9-4 Traditional Linear U.S. Science & Technology and Acquisition Model

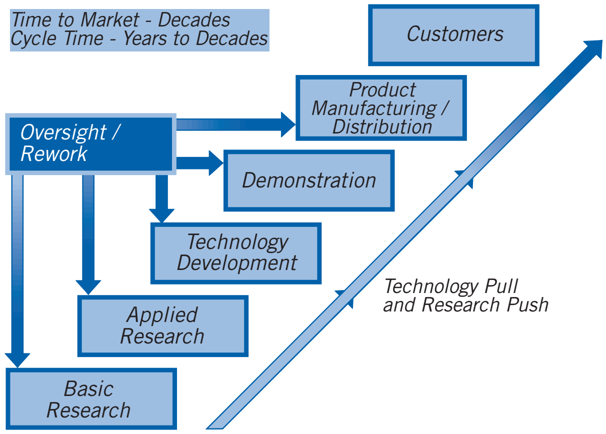
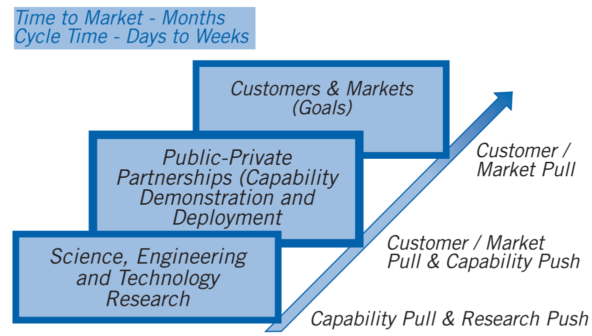


Figure 9-5 New Innovation Process for the Aerospace Sector



The aerospace sector in the 21st century will be driven by the need for speed, quality, service, cost and innovation. If government is to help industry be competitive, it must think and act on the same time scale as industry—days, weeks and months as opposed to years and decades.

Global competition dictates that the U.S. transition from a research, development and acquisition process that is fragmented, serial, and functionally-oriented to an innovative process that is dramatically simpler, integrated, and streamlined. The public and private sectors need a process that enables them to apply the best ideas available domestically and internationally in order to provide the very best quality products and services to their customers faster and cheaper. See Figure 9-5.

Government… must think and act on the same time scale as the industry—days, weeks and months as opposed to years and decades.

The Commission believes that the nation needs a new, more flexible and integrated product-development process that stimulates new ideas and turns them into new aerospace products and services faster than our international competition. Essential characteristics of this new process are:

- Coordinated national goals;
- The aggressive use of information technologies;
- Incentives for real government, industry, labor and academia partnering; and
- An acquisition process that integrates science and technology as part of the acquisition—or product development—process.

Conclusions

The United States must maintain its preeminence in aerospace research and innovation to be the global aerospace leader in the 21st century. This can only be achieved through proactive government policies and sustained public investments in long-term research and state-of-the-art RDT&E infrastructure that will result in new breakthrough aerospace capabilities.

Over the last several decades, the U.S. aerospace sector has been living off the research investments made primarily for defense during the Cold War—intercontinental ballistic missiles, the Saturn V, space-based reconnaissance, the global positioning system, stealth and unmanned aerial vehicles. The challenges posed by our rapidly changing world—asymmetric threats, international competition, environmental awareness, advances in technology—demand that we, like the Wright brothers 100 years ago, look at the challenges as opportunities for aerospace and turn them into reality.

Government policies and investments in long-term research have not kept pace with the changing world. Our nation does not have bold national aerospace technology goals to focus and sustain federal research and related infrastructure investments. It lacks a streamlined innovation process to transform those investments rapidly into new aerospace products, processes and services.

The United States has unlimited opportunities to revolutionize aerospace in the 21st century, opening up new markets and launching a new era of U.S. global aerospace leadership. The nation needs to capitalize on these opportunities, and the federal government needs to lead the effort. Specifically, it needs to invest in long-term enabling research and related RDT&E infrastructure, establish national aerospace technology demonstration goals, create an environment that fosters innovation and provide the incentives necessary to encourage risk taking and rapid introduction of new products and services.

Increase Public Funding for Long-Term Research and RDT&E Infrastructure. The Administration and Congress need to sustain significant and stable funding in order to achieve national technology demonstration goals, especially in the area of long-term research and related RDT&E infrastructure. Research areas that provide the potential for breakthroughs in aerospace capabilities include:

- Information Technology;
- Propulsion and Power;
- Noise and Emissions;
- Breakthrough Energy Sources;
- Human Factors; and
- Nanotechnology.

Establish National Technology Demonstration Goals. The Administration and Congress should adopt the following aerospace technology demonstration goals for 2010 as a national priority. These goals, if achieved, could revolutionize aerospace in the next half century much like the development of the jet, radar, space launch, and satellites did over the last half-century.

Air Transportation

- Demonstrate an automated and integrated air transportation capability that would triple capacity by 2025;
- Reduce aviation noise and emissions by 90 percent;
- Reduce aviation fatal accident rate by 90 percent; and
- Reduce transit time between any two points on earth by 50 percent.

Space

- Reduce cost and time to access space by 50 percent;
- Reduce transit time between two points in space by 50 percent; and
- Demonstrate the capability to continuously monitor and surveil the earth, its atmosphere and space for a wide range of military, intelligence, civil and commercial applications.

Time to Market and Product Cycle Time

- Reduce the transition time from technology demonstration to operational capability from years and decades to weeks and months.

Accelerate the Transition of Government Research to the Aerospace Sector. The U.S. aerospace industry must take the leadership role in transitioning research into products and services for the nation and the world. Government must assist by providing them with insight into its long-term research programs. The industry must aggressively develop business strategies that can incorporate this research into new products and services. Industry also needs to provide input to government on its research priorities. Together industry and government need to create an environment that will accelerate the transition of research into application. The Departments of Defense, Transportation, Commerce and Energy, NASA, and others need to work with industry and academia to create new partnerships and transform the way they do business.

RECOMMENDATION #9

The Commission recommends that the federal government significantly increase its investment in basic aerospace research, which enhances U.S. national security, enables breakthrough capabilities, and fosters an efficient, secure and safe aerospace transportation system. The U.S. aerospace industry should take a leading role in applying research to product development.

N - 1

Notes

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No notes

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Additional Commissioner Views

Commissioner R. T. Buffenbarger – Dissenting Views

This Commission was formed to address a variety of issues facing the future of the United States aerospace industry. Among them, the Commission was directed to "study the issues associated with the future of the U.S. aerospace industry in the global economy…; and assess the future importance of the domestic aerospace industry for the economic and national security of the United States."[1] The Commission was also required to make "recommendations for actions by federal departments and agencies to support the maintenance of a robust aerospace industry in the United States in the 21st Century…"[2]

Despite the Commission's mandate, its final report fails to adequately address the current crisis facing U.S. aerospace workers. While the Report acknowledges that several hundred thousand jobs have been lost in this industry over the past decade, this statistic captures only part of the problem. In states like Washington, Texas and California, that contain high concentration levels of the aerospace industry, the loss of aerospace jobs has been devastating. In Washington, more than 30% of jobs in the aircraft and parts sectors, almost 36,000, were lost between July 1992 and July 2002. In California, more than half the jobs, over 67,000, have been lost in this sector; and in Texas, over 30%, almost 20,000, jobs have been lost in the same sector.[3] The failure to address these job losses in a meaningful way signals an ominous future for U.S. aerospace workers. It is estimated that nearly 180,000 additional aerospace workers could lose their jobs by 2010.[4]

The Report does not contain comprehensive and "immediate solutions" to the job crisis in the U.S. aerospace industry. Its failure to sufficiently recognize and provide meaningful solutions for the aerospace employment crisis is a serious and glaring omission. Without well-thought out, practical recommendations for increasing the number of jobs in this industry in the short, medium, and long term, the future of the U.S. aerospace industry is in doubt. If U.S. aerospace workers have no future, the U.S. aerospace industry has no future.

I am particularly troubled by the number of proposals contained in the Report that, if implemented, would lead to further erosion of U.S. aerospace jobs and increase the economic pain currently being experienced by a generation of U.S. aerospace workers. While this dissent does not provide a comprehensive list of my objections, I would like to note some particular concerns.

- The Commission's Report encourages privatization, competitive sourcing, and public-private partnerships with respect to "Business: A New Model for the Aerospace Sector." However, it fails to recognize that private sector business goals do not always coincide with the public interest or governmental program goals. As a result, proposals in this area would result in layoffs and the erosion of basic wage and benefit standards for workers and a concomitant loss of service to the public.
- If not closely restricted, provisions regarding the "shared savings" initiative have a great potential to further damage the employment situation in the U.S. by using the government to encourage private sector contractors to layoff workers or hold down wages and benefits. Some contractors could receive great windfalls, at a great cost to their workers, with U.S. taxpayers paying the bill. This is not the way to improve cost-effectiveness.

1 Public Law 106-398

2 Id.

3 U.S. Department of Labor, Bureau of Labor Statistics, data extracted on October 17, 2002, Series ID: SAU5300003372031 (not seasonally adjusted).

4 Testimony of Jeff Faux, Commissionon the Future of the United States Aerospace Industry, Public Meeting, May 14, 2002; hereinafter, referred to as "Public Meeting May 14, 2002.

- Provisions that encourage the U.S. aerospace industry to transfer work and/or technology to other countries and to utilize foreign sourcing through a variety of means (e.g., procurement, international collaboration, mergers and teaming, global partnerships, joint ventures, and other proposals contained throughout the Report) are shortsighted. The U.S. aerospace industry should be encouraged to maintain production at home and to use U.S. suppliers (and products made and assembled in the U.S.) whenever possible. While the "globalization" of the aerospace industry is a reality, the impact of globalization on U.S. jobs and our security must be taken seriously.
- Other proposals and comments which I take issue with include, but are not limited to, export control reform, "open skies," and references to labor relations issues concerning the air traffic system.

I am also deeply troubled that three of my recommendations were "tabled" by the Commission without a full discussion on the substance of the recommendations.[5] These recommendations involved common sense proposals that would assist our Nation's policymakers in formulating meaningful solutions to the current and future crisis facing the industry and its workforce. I am particularly disappointed that they were not substantively considered by the Commission. As a result, the Commission missed a valuable opportunity to discuss, exchange ideas, and deliberate on three important workforce related proposals.

My first recommendation concerned the issue of offsets and outsourcing—both of which are significant in the U.S. aerospace industry. These activities threaten the U.S. workforce and our nation's economy and national security by, among other things, transferring production and technology to other countries. To facilitate a constructive dialogue on these points, I recommended that the Commission support the "establishment of a permanent, high-level Commission consisting of representatives of industry, government, labor, and academia to develop a comprehensive policy to address the numerous issues related to offsets and outsourcing." The purpose of such a Commission would be to "advance a policy that will mitigate the negative impact that offsets pose for U.S. aerospace workers now and in the future." The Commission tabled my proposal and rejected my efforts to "remove" the recommendation from being tabled.

The second recommendation I offered regarded the use of economic impact statements. It is my firm belief that various agencies of the U.S. Government must be accountable to the taxpayers. This means that taxpayers should know whether their hard-earned dollars are going to support good jobs at home or are going to create jobs in other countries. Unfortunately, as I explained to the Commission, information gathered by the U.S. Government with respect to the number of aerospace and aerospace-related jobs that are created (or lost) by Government programs is often imprecise. Accordingly, I urged the Commission to recommend the adoption and implementation of more effective methods of gathering data to evaluate the impact of Government programs on jobs in the U.S. The Commission also tabled this proposal and rejected my efforts to "remove" the recommendation from the table—thus barring substantive discussion of this important matter.

Finally, I proposed that the Commission recommend that internationally recognized labor standards be honored and enforced. The need to recognize and enforce international labor standards implicates significant social and economic issues. It also raises the related trade issue of "fairness". U.S. aerospace workers should not have to compete with workers in other countries where basic human rights are neither recognized nor respected. The fundamental rights to freedom of association and collective bargaining do not exist in many foreign countries. Moreover, it should be no surprise, decent wages and rules to ensure even moderately safe and healthy work-

5 See, Public Meetings of May 14, 2002 and September 17, 2002.

ing conditions are nonexistent in these countries. Even basic prohibitions on child labor, discrimination, and the use of forced or prison labor often fail to be recognized or effectively enforced.

I fear that if these internationally recognized labor standards are not uniformly respected, there will be a rapid race to the bottom as labor standards in the United States are dragged down towards the labor standards in far off lands. The aerospace industry should be a model for lifting the standard of living up for workers everywhere. It was my hope that this Commission in devising its proposals for the future of the U.S. aerospace industry, would at least discuss these very important standards. Sadly, a majority of the Commission tabled the recommendation and left it to die on the table, along with my other two recommendations.

I am heartened by the words of people like Denny Lee-Si Reyes, a high school student who testified before the Commission that "[U]ltimately my dream is to not only become part of the team that designs the travel of the future, but to become part of the dream that redefines it.[6] I am pleased that the future of the U.S. aerospace industry rests with Mr. Lee-Si Reyes and others like him but fear that unless work is done to ensure that the aerospace workforce remains strong and healthy here in the U.S., they will see their dreams disappear along with the aerospace jobs in the U.S.

This is not acceptable. The U.S. aerospace industry is about more than corporate profits. It is about the workers and their communities that have made this industry so successful. It is the workers and their communities, after all, that are key to our nation's economic security and our nation's national security. Today, aerospace workers are in a deep, deep crisis. We urgently need effective solutions for resolving this state of affairs and preventing future crises in this industry. This Commission wasted a valuable opportunity to meet this great need.

6 Testimony of Denny Lee-Si Reyes, Public Meeting, May 14, 2002

Commissioner John W. Douglass

ASSURING THE SECURITY OF OUR AVIATION SYSTEM PROPERLY RESTS WITH THE UNITED STATES GOVERNMENT

I am submitting these additional views to the commission in recognition of the fact that the crisis in civil aviation has intensified as the commission is writing its final report. They should not be construed as opposed to any recommendation of the commission.

The attacks on the United States that took place on September 11, 2001, were just that -attacks on our country and all that it stands for around the world. Although the instruments of the attacks were highjacked aircraft, the purpose and effect were no different than an attack on our nation by hostile foreign forces. In my opinion, defending against such attacks—defending against foreign aggression and providing for our common defense—is the responsibility of the United States government, a responsibility expressly provided for in the Constitution.

For over thirty years, international terrorists, intent upon attacking the United States, have, unfortunately, selected and utilized our airlines and their customers as surrogate targets. Throughout this period, the aviation industry, working cooperatively with the government, has attempted to do its part to counteract this threat.

Fundamentally, however, the United States government has within its sole discretion and unique competence virtually all of the means available to counteract the threat of aviation terrorism—diplomacy, intelligence gathering, economic sanctions, military action, covert action and general law enforcement powers all reside exclusively with the government.

In addition to the inherent responsibility of the Federal government for security, the government controls or regulates many of the costs associated with air travel.

Under normal conditions the relationship between the government and the industry has yielded an ever more efficient air transportation system for our nation. Safe, secure, reliable, and affordable air transportation has become a key ingredient in the American standard of living and the international competitiveness of our economy.

The commission report deals correctly with the developing challenges of the air transportation system concerning air traffic management, airport construction, safety regulation, and research and development. However, in my view the ongoing economic crisis warrants further action.

There is no question that the airline industry was in poor economic condition prior to the 9/11 attacks as a consequence of the softened economy. The industry has survived similar economic downturns in the past, but the meltdown that has occurred since 9/11 is without precedent. The combination of the economic downturn and post 9/11 government policy decisions produced an untenable situation for the industry. Looking just at estimated industry pre-tax costs for 2002, airline industry executives have testified that those well-intentioned policies have resulted in billions in post 9/11 costs and lost revenues, and account for a great majority of the projected $9 billion in 2002 industry losses. These massive and mounting losses reveal the absence of pricing power within the airline industry and the fallacy of government assumptions concerning customer absorption of additional security fees and costs.

The economic downturn and the substantial added security burden have combined to disrupt the economic balance of the airline industry. As a result, the airlines have been forced to borrow on a massive scale just to fund their continuing operations. The nine largest passenger airlines now carry over $100 billion in debt on their balance sheets, but only have a total market capitalization of approximately $15 billion. As the forced contraction of the industry continues, smaller and midsize communities across the country are being disconnected from the national air transportation system that is vital to their economies. In addition, manufacturers and aviation suppliers have been seriously affected by the crisis in the airline industry. The impact is now rippling through the rest of the economy.

The effects of the terrorist threat are not limited to the airline industry. General aviation has been seriously affected as well. Fixed base operators of all sizes have suffered in varying degrees, some being forced out of business. As in the case of the airlines, measures have been imposed without a thorough analysis of whether or not specific measures will be effective in helping to achieve security objectives, and whether the incremental benefit of a specific measure is commensurate with its incremental cost. The long term consequences of onerous restrictions on general aviation that do not produce a corresponding increase in national security will be a further isolation of towns and regions that have lost commercial air service.

Further, the traditional source of new pilots for the airlines—former U.S. military pilots—is increasingly being supplemented if not replaced by civilian training organizations. Actions that reduce or destroy the economic viability of the general aviation community, including small airport operators and flight school operators, will have a long term impact on the ability of airlines to find qualified pilots.

If we are to avoid the economic dislocations that are virtually certain to result from the continuing meltdown of the airline industry, decisive action must be undertaken immediately in two vital areas:

- First, the airline industry must continue to eliminate unnecessary costs and deal aggressively with the vast array of critical business issues. Only the airline industry with the cooperation of labor can address these matters.

- Second, and just as importantly, the United States government must assume the full costs and responsibility for assuring the protection of our aviation system against terrorist attack. At the same time, the government must adopt rational security measures that facilitate public access to the system and thereby encourage rather than discourage air travel. The government must reject the false premise that the airlines and their customers can or should bear this national defense burden, if for no other reason than to maintain the health of our broader, transportation-dependent economy.

Finally, the government must work with the aviation community to develop a framework to enable cooperative real-time analysis of security threats and effective means to defeat them. The FAA Safer Skies program has developed such a framework, which enables the government and private sector to work together to identify and implement the most effective ways to improve aviation safety. The government should also establish a security forum based on this model. Aviation is complex. Those who use the aviation system and make it work are the ones who have the greatest understanding of that complexity. They can provide the insight that will enable the government to develop measures that can improve security while ensuring the economic viability of the aviation industry in the United States.

Commissioner Tillie K. Fowler

I commend the hard work and deliberations of the Commission on the Future of the United States Aerospace Industry and particularly the dedication and vision of Chairman Robert Walker. I strongly believe the Commission has fulfilled its statutory mandate to examine the role of the domestic aerospace industry as part of the nation's overall economic and national security.

While I agree with the majority of the Commission's findings and recommendations contained in this final report, I am concerned with several assertions that have a direct impact on our armed forces. In particular, in Chapter 6, the report states that "current export controls are increasingly counter-productive to our national security interests in their current form and under current practices of implementation." I agree that the economic and national security environment has changed radically since Congress passed the 1979 Export Administration Act and believe a thorough revision of our export control policies is warranted. At minimum, I support a regular review of the Munitions List and a more expeditious license review process. However, I firmly believe that national security interest must always take precedence over economic or foreign policy considerations in application of the export control process.

While the United States should not, as a matter of course, seek to control commodities with wide foreign availability or mass-market penetration, the export control system must focus on sophisticated technologies and equipment that have limited foreign availability and pose a potential threat to the U.S. and its allies. For these reasons, the Department of Defense must continue to be a full partner in the process to guarantee that national security equities are considered when approving, denying or conditioning an export license.

In Chapter 7, the report states there are "many opportunities for redefinition and prioritization of routine non-inherently governmental activities currently performed by government agencies." While the government must continuously examine cost savings to be derived from outsourcing, I believe it is essential that risks associated with the process of shifting functions to the private sector are properly weighed. Notably, in the mid 1990s, the Department of Defense endorsed outsourcing of its commercial functions as a means to fund modernization. At that time, DoD adopted the procedures contained in OMB Circular A-76 to accomplish this task and contended that, irrespective of the public/private outcome of the competitions, there would be substantial savings. Unfortunately, these savings never fully materialized and modernization and readiness suffered as a result.

The Commission's call for a comprehensive review to identify functions and services that are not "core" to the effective execution of the government's mission raises a number of significant questions. Congress has repeatedly voiced concern that the military services have not adequately or uniformly applied criteria to determine the definition of "core" with respect to warfighting capability. I am also concerned with the process by which competitive sourcing decisions can be authoritatively made by the Department of Defense. In particular, the military services have struggled to provide dependable technical data on the performance of military depot workloads. Accordingly, using such unreliable data as the basis for public-private competitions may jeopardize the nation's military readiness and surge capability. As recent history has demonstrated, combat is not a "just-in-time business," and adequate stocks of munitions, parts, and spares are essential to achieving mission success. The remaining military depot facilities are unique in their workforce flexibility, capability, and commitment to the warfighter and must be sustained as an integral part of the nation's critical defense infrastructure.

Commissioner John J. Hamre

Any commission report is necessarily the product of compromises and cannot reflect totally the views of any one commissioner. I agree with the general thrust of this report and the bulk of its findings and recommendations. There are some findings and recommendations (e.g. mining asteroids, anti-gravity propulsion, etc) that would not be in this report, were I its single author. But commission products are stronger by the collective judgment that informs its work, and I endorse this report.

My larger concern, however, is that this report is too general and diffuse to have the impact that I believe is needed. I believe that the American aerospace industry is in deep trouble. Satellite and space-launch manufacturers are in serious financial difficulty and the industry is near collapse. The entire aerospace industry is choking under a blanket of ineffective and increasingly obsolete export control and technology regulations. Government regulations are now effectively isolating American industry and limiting its competitiveness. The American airline industry is near collapse, with operations unprofitable and service in decline. These are fundamental issues, yet too much of our report is devoted to secondary and tertiary concerns.

I still commend the reader to the report because I believe it does touch on some of the central challenges facing this critical industry. My purpose in filing additional views is to highlight the exceptional challenges the American aerospace industry is facing and the need for urgent action on behalf of the government to deal with them. This report offers a starting point.

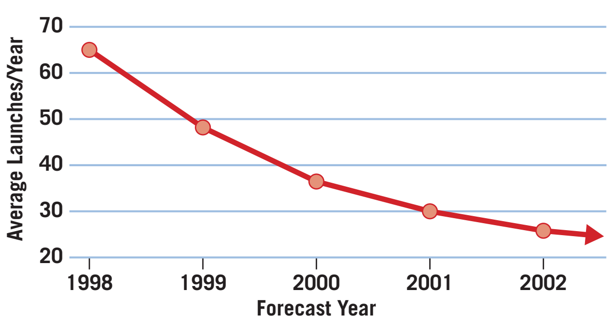
Commissioner Robert J. Stevens

Although I agree with and support virtually every aspect of the commission's report, there are a number of issues raised in Chapter 3 that I believe require additional clarification. Although the chapter on space does highlight the continuing decline in expected launch service demand, I believe that the situation is actually more serious than depicted in the report. Additionally, the report does not address critical steps that must be taken in the near-term to address these problems.

I am concerned that Chapter 3 does not fully address the continuing deterioration of the space launch industry base. An estimate published in May 2002 by the Commercial Space Transportation Advisory Committee (COMSTAC), forecasts that only 30 commercial payloads in total are available for launch in 2003, amounting to only 24 worldwide commercial launches (including all payload classes to all orbits). Even this estimate may be overly optimistic, based on trends that we are seeing as we approach the end of 2002 (See Figure 1). To date, there have been only two commercial satellite sales during 2002, with limited prospects for additional sales before the end of the year. This reinforces my concern that the trend is getting worse. As the Federal Aviation Administration and others have documented, during 2001, there were only 16 commercial launches worldwide, with little hope for reversal of this trend in the near or intermediate future (10 years).

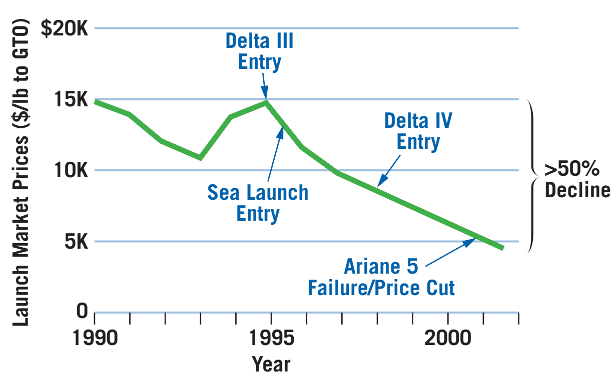
Chapter 3 correctly points out that decreasing launch costs has been a fundamental goal for the space launch industry. The Air Force's Evolved Expendable Launch Vehicle (EELV) program established a goal of reducing launch costs by 25-50 percent, a goal that Atlas V has already met. I am concerned, however, by the view stated in the report that lowering cost to orbit would reverse negative trends in launch demand. While this may be true over an extended period of time (perhaps decades), there is no evidence that recent reductions in launch costs have in any way altered deteriorating demand. The market conditions that prevail today appear to be relatively insensitive to reductions in launch costs (See Figure 2). Of course, as the commission correctly indicates, it is possible that a new launch paradigm, involving affordable, reusable launch vehicles, could ultimately help usher in a new paradigm in the satellite sector that would entail significant increases in launch demand. In the near-term, however, the United States must address the critical state of the existing launch industrial base. In particular, the United States government must take steps to sustain our assured and reliable access to space for critical national security missions.

Figure 1 Decline in Annual Forecasts for 2002 – 2007 Launches



*Compilations of Government, Industry and Research Analyst data

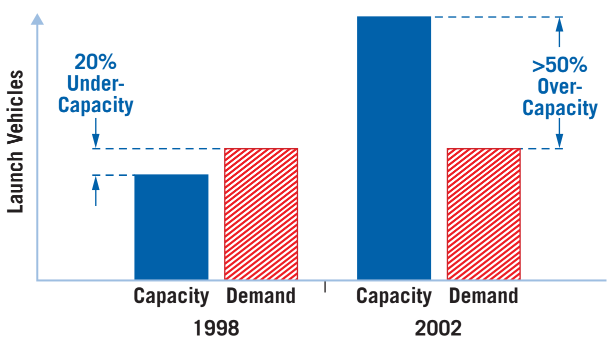
Figure 2 Launch Market Prices ($/lb to GTO)



*Based on actual launch vehicle transactions

The EELV program is the Defense Department's assured access solution for the foreseeable future. EELV is designed to be more responsive and affordable than current launch vehicles. With EELV, the Air Force has adopted a commercial launch services approach, with the contractors financing the majority of the development costs associated with the next generation launch vehicles (Atlas V and Delta IV). In 1997, at a time when worldwide projections envisioned 70 launches per year, the Air Force decided to retain both EELV contractors rather than selecting a single provider. The commercial satellite marketplace, it appeared, would provide adequate sustainment for the U.S. space launch industrial base, thereby justifying the large contractor investments in EELV, and providing the DOD a more robust assured access capability for a relatively modest investment. As indicated above, since 1997, such launch projections have deteriorated by approximately 65 percent. The current market situation is inadequate to sustain two healthy U.S. launch providers in a globally competitive market (See Figure 3). Therefore, in the interest of U.S. national security, it is imperative that the United States government address this problem immediately.

Figure 3 Launch Market Capacity/Demand



*Based on actual launch transactions and industry capacity analysis

Fortunately, the Department of Defense is in fact developing an assured access program to help sustain the U.S. launch infrastructure and industrial base, while preserving the principal tenets of the EELV program. The key to this effort is the maintenance of two financially stable launch service providers to keep the U.S. competitive in the global market and provide backup for any technical or operational problems that may be encountered with either of the EELV systems. This effort is also essential for preserving the technological and industrial base needed to bring about further improvements in the flexibility and affordability of space launch. The Defense Department's assured access to space initiative is the single most important near-term element of a broader strategy for preserving U.S. competitiveness and innovation in the space launch arena.

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Appendices

Appendix A

Commission Charter

THE WHITE HOUSE

WASHINGTON

Commission on the Future of the United States Aerospace Industry Charter

Purpose:

The Commission on the Future of the United States Aerospace Industry will study the issues associated with the future of the United States aerospace industry in the global economy, particularly in relationship to United States national security; and assess the future importance of the domestic aerospace industry for the economic and national security of the United States.

Authority:

Section 1092 of the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001, Public Law 106-398 establishes the Commission. Section 309 of Appendix D of Public Law 106-554 authorizes the General Services Administration (GSA) to utilize funds available to the National Science and Technology Council under section 635 of Appendix C of Public Law 106-554 for the Commission. This Commission is governed by the provisions of the Federal Advisory Committee Act (FACA), Public Law 92-463, as amended (5 U.S.C. Appendix 2), which sets forth standards for the formation of advisory committees, and implementing regulations (41 C. F. R. Subpart 101-6.10).

Scope:

The Commission shall study the following:

1. The budget process of the United States Government, particularly with a view to assessing the adequacy of projected budgets of the federal departments and agencies for aerospace research and development and procurement.

2. The acquisition process of the Government, particularly with a view to assessing:

   (a) the adequacy of the current acquisition process of Federal departments and agencies; and,

   (b) the procedures for developing and fielding aerospace systems incorporating new technology in a timely fashion.

3. The policies, procedures, and methods for the financing and payment of government contracts.

4. Statutes and regulations governing international trade and the export of technology, particularly with a view to assessing:

   (a) the extent to which the current system for controlling the export of aerospace goods, services, and technologies reflects an adequate balance between the need to protect national security and the need to ensure unhindered access to the global marketplace; and

(b) the adequacy of United States and multilateral trade laws and policies for maintaining the international competitiveness of the United States aerospace industry.

5. Policies governing taxation, particularly with a view to assessing the impact of current tax laws and practices on the international competitiveness of the aerospace industry.

6. Programs for the maintenance of the national space launch infrastructure, particularly with a view to assessing the adequacy of current and projected programs for maintaining the national space launch infrastructure.

7. Programs for the support of science and engineering education, including current programs for supporting aerospace science and engineering efforts at institutions of higher learning, with a view to determining the adequacy of those programs.

Report:

Not later than March 1, 2002, the Commission shall submit a report on its activities to the President and Congress. The report shall include the following:

1. The Commission's findings and conclusions.

2. The Commission's recommendations for actions by federal departments and agencies to support the maintenance of a robust aerospace industry in the United States in the 21st century and any recommendations for statutory and regulatory changes to support the implementation of the Commission's findings.

3. A discussion of the appropriate means for implementing the Commission's recommendations.

The commission should also plan to submit an interim report outlining the areas the commission proposes to review and any preliminary findings.

Membership:

1. The Commission shall be composed of 12 members as follows:

   (a) Up to six members shall be appointed by the President;

   (b) Two members shall be appointed by the Speaker of the House of Representatives;

   (c) Two members shall be appointed by the majority leader of the Senate;

   (d) One member shall be appointed by the minority leader of the Senate;

   (e) One member shall be appointed by the minority leader of the House of Representatives.

2. The members of the Commission shall be appointed from among persons with extensive experience and national reputations in aerospace manufacturing, economics, finance, national security, international trade, or foreign policy and persons who are representative of labor organizations associated with the aerospace industry.

3. Members shall be appointed for the life of the Commission. A vacancy in the Commission shall not affect its powers, but shall be filled in the same manner as the original appointment.

4. The President shall designate one member of the Commission to serve as the chairman of the Commission.

5. The Commission shall meet at the call of the chairman. A majority of the members shall constitute a quorum, but a lesser number may hold hearings.

Administrative Requirements and Authorities:

1. In accordance with section 309 of the Miscellaneous Appropriations Act, 2001, the Administrator of the General Services Administration may utilize funds available to the National Science and Technology Council (authorized by Executive Order No. 12881), or any successor entity to the council, under section 635 of the Treasury and General Government Appropriations Act, 2001 for payment of any expenses of, and shall ensure that administrative services, facilities, staff and other support are provided for the Commission.

2. The Commission may hold hearings, sit and act at times and places, take testimony, and receive evidence that the Commission considers advisable to carry out the purposes of this section.

3. The Commission may request directly from any department or agency of the United States any information that the Commission considers necessary to carry out the provisions of this section. To the extent consistent with applicable requirements of law and regulations, the head of such department or agency shall furnish such information to the Commission.

4. The Commission may use the United States mails in the same manner and under the same conditions as other departments and agencies of the United States.

Compensation and Funding:

1. Members of the Commission shall serve without additional compensation for their service on the Commission, except that members appointed from among private citizens may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by law for persons serving intermittently in government service under subchapter I of chapter 57 of title 5, United States Code, while away from their homes and places of business in the performance of services for the Commission.

2. The chairman of the Commission may appoint staff of the Commission, request the detail of Federal employees, and accept temporary and intermittent services in accordance with section 3161 of title 5, United States Code (as added by section 1101 of this Act).

3. Staffing: The Commission support staff will be full and part-time, determined by the Staff Director in accordance with the needs of the Commission Chairman. Staff will be provided

through details from NSTC organizations and direct hires as provided under Title 5, USC, Section 3161. Full time staffing is estimated to be 13 including administrative staff.

4. Funding: DOD will assist by providing the Commission with its space, phone, mail service, computer support, contracting, and other related administrative services consistent with their internal policies and practices. Funding of government-provided support personnel will be the responsibility of the respective parent organizations. The Commission costs, including Commissioner and staff travel, but excluding independent studies are estimated to be $1.13 million through March 31, 2002. Funding for independent studies is budgeted for $440 thousand. Actual amounts will be based on the availability of funds and the scope and specific needs determined by the Commission.

Termination:

The Commission shall terminate 30 days after the date of the submission of its final report.

General Provisions:

The functions of the President under the Federal Advisory Committee Act that are applicable to the Commission shall be performed by the National Science and Technology Council, in accordance with the guidelines and procedures established by the Administrator of General Services. The NSTC will appoint an Executive Director for the Commission who will represent the NSTC on the Commission and serve as the Designated Federal Officer according to the Act.

Approved: Date:

Lawrence B. Lindsey 7-19-01

Lawrence B. Lindsey
Assistant to the President for Economic Affairs

Appendix B

Commission Interim Reports

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B1 – Interim Report #1

Commission on the Future of the United States Aerospace Industry
1235 Jefferson Davis Highway, Suite 940
Arlington, Virginia 22202

December 18, 2001

The Honorable George W. Bush
President
The White House
1600 Pennsylvania Avenue, NW
Washington, DC 20500

Dear Mr. President:

As you know, your *Commission on the Future of the United States Aerospace Industry* is chartered to study federal department and agency actions to maintain a robust aerospace industry in the 21st Century and report its findings and recommendations to you and the Congress. Within that charter, the Commission was specifically asked to assess the adequacy of projected aerospace research and development and procurement budgets.

The Commission held its first public meeting at the U.S. Department of Commerce on November 27th, 2001, at which time we received testimony from Dr. John Marburger, Congressman Dave Weldon, our Commissioners, and senior representatives from a number of government departments and agencies. An initial determination from our deliberations was that federal government aerospace sector spending is currently spread across multiple government agency budgets, with oversight by numerous and different Congressional committees. As a result, none of these government groups has an integrated view of our national aerospace efforts. We further determined that the current process and structure lack the necessary overall insight and accountability for development and implementation of a coherent national strategy and program – making it difficult to provide overall national aerospace leadership and oversight.

From these findings, the Commission unanimously voted to issue this interim report recommending that the following sectoral budget analyses be conducted of federal government and industry aerospace spending and submitted to the Commission on or before March 15, 2002:

(1) The Office of Management and Budget (OMB) prepare a spending breakout, by category, as an addendum to the FY03 President's Budget Request;

(2) The Department of Commerce compile and present baseline statistics on the economic performance and investment expenditures of each aerospace industry sector for the purposes of comparison to the federal outlays; and

(3) The Congressional Budget Office provide an FY02 sectoral budget breakdown that parallels the OMB FY03 submission.

The Commission staff will work with OMB to develop an acceptable categorical definition of the aerospace sector for this analysis.

As the Commission continues moving forward with its assessment of our national aerospace enterprise in the upcoming year, it is my intent to provide you and the Congress with timely interim products to help strengthen and improve the U.S. aerospace enterprise. Your support for this critical work is greatly appreciated.

An identical interim report has been submitted to the Congress.

Respectfully yours,

Robert S. Walker
Chairman

cc: The Honorable Donald L. Evans, Secretary of Commerce
The Honorable Mitchell E. Daniels, Jr., Director, Office of Management and Budget
Dan L. Crippen, Director, Congressional Budget Office

B2 – Interim Report #2

Commission on the Future of the United States Aerospace Industry
1235 Jefferson Davis Highway, Suite 940
Arlington, Virginia 22202

Tel: (703) 602-1515
Fax: (703) 602-1532

March 20, 2002

The Honorable George W. Bush
President
The White House
1600 Pennsylvania Avenue, NW
Washington, DC 20500

Dear Mr. President:

The Commission has been meeting since November 2001 to study and recommend public policy reforms that will help sustain a robust U.S. aerospace industry in the 21st Century. While the Commission will not publish its final report until November 2002, we are pleased to provide the enclosed interim report that we approved at our February 12 public meeting. The report focuses on three issues that the Commission believes require immediate Administration and Congressional attention – improving the business climate for the aerospace industry, reforming the U.S. export control system, and creating the infrastructure needed to meet the nation's future air transportation needs.

The aerospace industry is critical to the nation's economy, national security and the quality of life for all Americans. As an important high technology engine of the American economy, the U.S. aerospace industry generates 15 percent of the U.S. gross domestic product and over 11 million jobs. Aerospace products account for the largest positive balance of payments contribution of any sector of the nation's economy. Over 40 percent of the industry's products are exported. We depend on the aerospace industry to arm our military with the superior weapons needed to defend our nation from those who seek to harm our citizens and threaten our democracy. We depend on air travel to move passengers and products rapidly across the nation and around the world. Each year, U.S. airlines move over 600 million passengers and many times that number of pieces of cargo. We depend on satellites for inexpensive and instantaneous global communications and navigation. A strong aerospace industry also enables scientific discovery and inspires our dreams to reach for the stars.

Our dependency on aerospace will continue to grow in the 21st Century, as we seek to move our citizens, goods and information anyplace, anytime. Aerospace systems will connect the world, providing fast, direct and accessible transportation for everyone. Aerospace will be a guarantor of public safety and national security. Aerospace leadership will enable us to explore, discover and settle new worlds while providing benefits for humanity and the Earth.

For these reasons, the United States must maintain its world leadership in aerospace. However, this can only happen with the direct interest and involvement of the White House, the Congress, the states, aerospace businesses, labor, academia and the American people.

We applaud the President for his foresight in proposing a federal budget for fiscal year 2003 that starts to reverse the downward trend in federal investments in aeronautics and space. We strongly urge the Congress to support these priorities and include a statement by the Commission to this effect in the enclosed report.

In addition to funding, we believe that the following issues discussed in the enclosed report could have a significant near-term impact on the aerospace industry and, hence, require immediate action:

- Business Environment. We must create a business environment in the United States that encourages the aerospace industry to grow and prosper and to be competitive in the global economy.

- Defense/Dual-Use Exports. Current export controls introduce so much uncertainty and delay that foreign customers are often reluctant to attempt to purchase U.S. products. In short, we need to reengineer the current export control system for the post-Cold War era. We must bring new thinking into the control of aerospace technology. It is counterproductive that the government, for example, prevents the sale of U.S. aerospace technology that is readily available from other sources worldwide. This is particularly true when the customer is a valued ally.

- Air Transportation. Our current air traffic control infrastructure is not scalable to meet future air transportation demand and is vulnerable to attack. We must begin to develop an infrastructure that meets the nation's future air traffic capacity and security needs. If we do not act now, we can expect the delays of the past few years to return and worsen, with resultant increases in cost and inconvenience for the American people and business. The temporary slowdown in air traffic resulting from the events of September 11, 2001, provide an opportunity to start developing a new air transportation system that can readily handle future air system capacity needs while improving public safety and homeland security.

The Commission's preliminary findings and recommendations in these three areas are provided in the enclosed report. We intend to make more sweeping recommendations in these areas in the final report. An identical letter has been sent to the Congress.

Respectfully yours,

Robert S. Walker
Chairman

Enclosure

Commission on the Future of the United States Aerospace Industry

www.aerospacecommission.gov

Interim Report #2

March 20, 2002

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I. Introduction

The Commission on the Future of the United States Aerospace Industry was established by Section 1092 of the Floyd D. Spence National Defense Authorization Act for fiscal year 2001, Public Law 106-398. It was formed to study the future of the U.S. aerospace industry in the global economy, particularly in relationship to U.S. national security; and to assess the future importance of the domestic aerospace industry for the economic and national security of the United States. The Commission will issue a final report to the President and Congress on November 19, 2002. Periodic interim reports will also be issued.

A. Mission Statement

The Commission shall develop and recommend a series of public policy reforms that will permit the U.S. aerospace industry to create superior technology, excel in the global marketplace, profit from investments in human and financial capital, benefit from coordinated and integrated government decision-making, assure our national security, access modern infrastructure, and give the United States a capacity throughout the 21st Century to reach for the stars.

B. Congressional Mandate

The Commission was given a broad mandate to study:

- The adequacy of projected budgets of the federal departments and agencies for aerospace research and development and procurement;
- The adequacy of the current acquisition process of federal departments and agencies;
- The procedures for developing and fielding aerospace systems incorporating new technology in a timely fashion;
- The policies, procedures, and methods for the financing and payment of government contracts;
- Statutes and regulations governing international trade and the export of technology;
- Policies governing taxation, particularly with a view to assessing the impact of current tax laws and practices on the international competitiveness of the aerospace industry;
- Programs for the maintenance of the national space launch infrastructure; and
- Programs for the support of science and engineering education.

C. Commissioners

The Commission is composed of 12 members: six appointed by the President, two each by the House and Senate Majority Leaders, and one each by the House and Senate Minority Leaders. The Chairman is the Honorable Robert S. Walker, former Chairman, U.S. House of Representatives Committee on Science, and the Vice Chairman is the Honorable F. Whitten Peters, former Secretary of the Air Force.

The commissioners appointed by the White House are:

Dr. Buzz Aldrin
President, Starcraft Enterprises, Sharespace, Starbooster & Starcycler

Mr. Edward M. Bolen
President, General Aviation Manufacturers Association

The Honorable John W. Douglass
President, CEO and General Manager, Aerospace Industries Association

Dr. Neil de Grasse Tyson
Director, Hayden Planetarium

The Honorable Robert S. Walker
Chairman, Wexler & Walker Public Policy Associates

Ms. Heidi R. Wood
Executive Director, Morgan Stanley

The commissioners appointed by the Congress are:

Mr. R. Thomas Buffenbarger
President, International Association of Machinists & Aerospace Workers

The Honorable Tillie K. Fowler
Partner, Holland & Knight

The Honorable John J. Hamre
President & Chief Executive Officer, Center for Strategic & International Studies

The Honorable F. Whitten Peters
Partner, Williams & Connolly

The Honorable William Schneider
President, International Planning Services, Inc.

Mr. Robert J. Stevens
President and Chief Operating Officer, Lockheed Martin Corporation

II. Present Trends in Federal Aerospace Research and Development Budgets

Technological advances have driven aerospace progress since the first flight of the Wright brothers and Dr. Robert Goddard's first rocket launch. It is clear to the Commission that investments in the research and development (R&D) of aerospace technology are absolutely crucial to continued U.S. aerospace progress and leadership.

A. Department of Defense

The Commission applauds the President's proposed fiscal year (FY) 03 augmentations to Department of Defense (DoD) R&D investments. The increases proposed both this year and last year are especially important because they follow a period of significant decline. The Commission supports the DoD goal to increase science and technology investment to three percent of the overall budget, and encourages continued progress toward this goal in the FY03 budget. The encouraging trends in defense R&D are a base to be built upon, but challenges will face us in future budget years. In future reports, the Commission will assess potential industrial base issues.

B. Civil Aviation

Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) R&D investments represent the fundamental long-term, high-risk, precompetitive technology development that individual suppliers of aviation and space systems need but cannot support under near-term pressures from financial markets. Technologies and systems in use today are the result of R&D investments made 20 or more years ago. The United States is just now beginning to see the effects of the R&D budget declines of the 1990s in our air traffic control system capabilities, the technological parity of foreign-built aircraft, and the aging facilities of our federal research laboratories.

In contrast, the research programs of the European Union (EU) are driven by a policy seeking world leadership for its civil aeronautics industry. The EU member states are also placing increased emphasis on integrating and coordinating national research programs.

As the President and Congress move ahead to address the nation's future aerospace needs, new investments will be required. The Commission encourages the Congress to assess these needs in its deliberations on the FY03 budget, and encourages the Administration to consider them in preparing the FY04 budget.

III. Business Environment

A. Negotiate Resolution of Foreign Sales Credit and Extra-Territorial Income Exclusion Act of 2000 Dispute

1. Issue

On January 14, 2002, a World Trade Organization (WTO) appellate body issued a final ruling that a U.S. law, called the "FSC Repeal and Extra-territorial Income Exclusion Act of 2000" (ETI), is an illegal export subsidy and, thus, inconsistent with WTO rules. This legislation replaced the Foreign Sales Corporation (FSC) tax regime with the ETI regime in an effort to be WTO-compliant. If the United States does not act to come into compliance with the WTO rules, U.S. exporters could face sanctions totaling as much as $4-6 billion per year in the form of tariffs on the sale of U.S. goods.

2. Background/Findings

European Union (EU) countries rely heavily on a value-added tax for revenue. The tax is imposed on imports and rebated at the border for exports. EU countries also tend to tax their companies more leniently on overseas earnings than on domestic profits. In order to partly offset the differences in tax treatments between Europe and America, United States tax law allowed domestic companies to establish FSCs that provided a means to reduce taxes on a share of profits derived from exports. When the WTO determined that the FSC regime was inconsistent with WTO rules, because it was deemed an illegal export subsidy, the United States repealed FSC and enacted the ETI regime in November 2000.

The WTO has now ruled that the ETI regime is also an illegal export subsidy. The loss of the ETI regime would negatively impact the competitiveness of U.S. exporters doing business in Europe by creating another competitive discriminator. This would add to several other factors already benefiting our European competitors, including outdated U.S. export control laws, increasing demand for offsets, and European government subsidies of national companies. Loss of the ETI tax incentive could result in the loss of U.S. employment if companies moved jobs to offshore facilities that enjoy favorable treatment by foreign governments.

Interim Report #2, Recommendation 1

The U.S. Trade Representative should seek additional time for the United States and EU to develop a long-term resolution of this issue that maintains the level of tax relief for all industries.

B. Strengthen Research and Experimentation Tax Credits

1. Issue

For the aerospace industry, heavily dependent on advanced technology, the federal research and experimentation (R&E) tax credit has become ineffective. Lack of permanence and the small number of firms qualifying for the full 20 percent R&E tax credit have virtually eliminated the desired incentive for companies to invest in R&D.

2. Background/Findings

U.S. tax law currently provides an incentive for R&D spending with a credit equal to 20 percent of incremental R&D expenditures measured by reference to the taxpayer's average R&D expenditures during the period 1984 through 1988. Very few aerospace companies qualify for the 20 percent R&E tax credit since the 1984-1988 base period was a high-water mark of military procurement and R&D spending. Since the base period, defense procurement (on a constant 2001 dollar basis) has declined by 57 percent. An Alternative Incremental Research Credit (AIRC) is available for companies that do not benefit from the regular R&E tax credit. The alternative rate is 2.65 percent to 3.75 percent of R&D expenditures exceeding one percent of gross receipts. These rates provide a small incentive but do not provide the full savings of the 20 percent regular credit.

The R&E tax credit is scheduled to expire in 2004. With the lengthy time frames of most R&D projects, the uncertainty of the credit's availability dampens the incentive for private investment in new technology. Legislative proposals currently pending in Congress (H.R. 41 and S. 41) would make the R&E credit permanent and increase the alternative credit rates to between 3 percent and 5 percent. The U.S. R&E credit is the third lowest of nine countries surveyed by the Organization for Economic Cooperation and Development (OECD). Increasing the alternative tax credit rates and making the credit permanent would improve the industry's financial capability and strengthen the country's technological base.

<u>Interim Report #2, Recommendation 2</u>

2.a. In the near term, revise the U.S. tax code to:

- Make the R&E tax credit permanent, and
- Increase the alternative credit rates to achieve parity with the savings provided by the regular credit.

2.b. In the longer term, enact structural changes to the R&E credit, including changes in the baseline period, increases in the rates for the AIRC and other improvements that enhance its effectiveness in stimulating private sector investment in new technologies.

C. Establish Shared Savings for Cost Efficiencies and Rationalization

1. Issue

The DoD and NASA ultimately pay for process inefficiencies and for underutilized and excess capacity in the defense industry by paying higher costs for products and services. Until sufficient incentives are provided for contractors to undertake cost-saving initiatives, DoD and NASA will not realize the potential for reducing program costs and improving the quality and timeliness of products and services delivered.

2. Background/Findings

There is little incentive for contractors to undertake initiatives that will have long-term positive benefits on program performance and cost because the government is the predominant beneficiary of the savings. On cost-based contracts, DoD receives the majority of any savings resulting from cost efficiencies and rationalization. During contract negotiations, government contract officers remove all contractor savings benefit through renegotiation of the overhead rate. On fixed price contracts, DoD contractors may realize some of the savings on the instant contract, but those savings then reduce the negotiation base for future contracts – often meaning that the benefit does not outweigh the cost.

The costs of rationalization without reward are a disincentive to contractors to pursue rationalization. One means of motivating the contractor to take on the cost of productivity and rationalization improvements is to share a portion of the savings over some number of years. Current Acquisition Excellence initiatives sponsored by the Under Secretary of Defense for Acquisition, Technology and Logistics to move most contracts from a cost to a performance basis would provide more contractor incentive to fund cost savings and rationalization.

Interim Report #2, Recommendation 3

Implement a strategy that provides incentives for contractors to pursue cost efficiencies and further rationalization of inefficient operations. The exact mechanism for achieving shared savings is not as important as the need to ensure that there is such a mechanism. One such strategy under consideration by the DoD is summarized below:

- Rules for Shared Savings Strategy
  - Ensure net savings result in each year of a not-to-exceed five-year period by amortizing associated costs. Recognize the cost of capital associated with amortized costs.
  - Contractor receives up to 50 percent of the net savings as long as the government receives at least $2 in savings for every $1 it expends (after deducting the negotiated shared savings amount and the cost of capital), and the contractor implements planned efforts to generate the savings.
  - Duplicate rewards are precluded for the same effort.

- Implementation. Contractor submits to the government-contracting officer a plan for efforts to achieve cost efficiencies and further rationalization. The government contracting officer ensures proposed savings are the direct result of the proposed efforts, contractor adequately supports the proposal, audits the proposal, negotiates an advance agreement for shared savings, and obtains the agreement of the appropriate departments, agencies and offices.

- Method for Sharing Savings
  - Additional "plus up" to profit on cost-based contracts is negotiated at the business segment level.
  - Government agrees to share up to 50 percent of savings from new cost savings initiatives for up to five years.

IV. Defense/Dual-Use Exports

Export controls have been and should be an important component of America's national security. The Commission believes, however, that export controls are increasingly counterproductive to our national security interests in their current form and method of implementation. Our export control system needs a thorough overhaul. In our judgment, export control reform is crucial to provide better security in the future and to insure the health and vitality of our aerospace industry. The Commission intends to make more sweeping recommendations in its final report. In the interim, we recommend the following steps be taken immediately.

A. Accelerate Implementation of the Defense Trade Security Initiative

1. Issue

The Defense Trade Security Initiative (DTSI) contains several important elements that can significantly improve the access of U.S. aerospace firms to the international market and strengthen defense-industrial collaboration within the alliance. The pace of implementation of several of these initiatives has slowed, including electronic licensing, the U.S. Munitions List (USML) review, bilateral negotiations with major allied nations to create exclusions from export licensing requirements, and a reduction in the barriers to Global Program/Project licenses.

2. Background/Findings

The Secretary of State promulgated the DTSI in May 2000. The DTSI contains 17 initiatives that can make a constructive contribution to defense trade process reform and liberalization and, hence, materially improve market opportunities for U.S. defense exporters. The implementation of the DTSI has slowed, thus limiting the pace of reform needed in defense trade policy and regulation. The implementation of electronic licensing can increase the speed of license processing, reduce costs, and improve compliance with export control regulations. The review of the USML can hasten the removal of items from the list that are needlessly burdening the compliance monitoring process and increasing cost to U.S. exporters by requiring the licensing of items that should not require export licenses.

The United States has begun negotiations with Australia and the United Kingdom (U.K.) to create a regulatory and compliance "template" to facilitate a wide range of exclusions from a requirement for export licensing. Although these negotiations began in earnest, they have stalled and need an impetus to reach an agreement. An effort to exploit residual authority under the Arms Export Control Act to facilitate issuing comprehensive licenses covering an entire defense industrial program or project has been burdened by needless regulatory barriers. These regulatory barriers have prevented the issuance of global program/project licenses, even though current efforts with the Joint Strike Fighter (F-35) may be productive.

Interim Report #2, Recommendation 4

Accelerate implementation of the DTSI as an important first step in a comprehensive reform of the nation's arms transfer policy and regulatory process. Specifically, the following items should proceed as quickly as possible to:

- Implement electronic licensing with system interface compatibility;
- Review the USML;
- Remove regulatory barriers to use global program/project licenses; and
- Reinvigorate U.S. bilateral negotiations with Australia and the U.K. to establish International Traffic in Arms Regulations (ITAR) country exemptions.

B. Update Country Risk Surveys to Modernize Export Licensing Compliance Practices

1. Issue

Effective compliance with U.S. Munitions List export regulations depends on up-to-date knowledge of the willingness and ability of nations abroad to implement their obligations to prevent unauthorized use or retransfer of U.S. defense hardware and technology exports. In many cases, U.S. government surveys of individual country risk are years out of date.

2. Background/Findings

The U.S. government conducts country risk surveys to support the export licensing function. U.S. export licensing practices, license provisos, and similar restrictions imposed on U.S. exporters are dependent on an up-to-date and detailed understanding of the willingness and ability of recipient nations to comply with restrictions on the unauthorized use or retransfer of U.S.-origin defense exports. Unfortunately many of these surveys are several years out of date. The absence of up-to-date data causes export-licensing authorities to depend on data that may no longer reflect current conditions in many United States defense export markets. Moreover, up-to-date country risk surveys will provide a basis for government-to-government consultations to strengthen compliance among the community of nations with whom the U.S. shares modern defense hardware and technology.

Interim Report #2, Recommendation 5

Country risk surveys should be updated immediately to align compliance practices with contemporary conditions in U.S. defense export markets.

C. Modernize the Defense Export Loan Guarantee Program

1. Issue

In 1996, the Congress established the Defense Export Loan Guarantee (DELG) program in the DoD. The purpose of the statute was to create an export credit mechanism for U.S. defense exporters. This program shares most of the characteristics of the U.S. Export-Import Bank loan guarantee program for civil sector exports with an important exception – the defense loan guarantees are not subsidized with funds appropriated to the DoD. Because of statutory constraints and regulatory and administrative practices, this program has proven to be unattractive to potential foreign customers – only one small transaction has been executed in more than five years of operation. As a result, the United States is the only significant exporter of defense-related equipment without an official exports credit mechanism. The DELG program needs to be modernized to facilitate the financing of U.S. defense exports.

2. Background/Findings

The Congress has been concerned with the inability of the Department of Defense to use the DELG to serve U.S. national security objectives. The FY02 DoD Authorization Act requires DoD to prepare a report describing its limitations in using the provision for the purpose intended in the statute. This report is now in preparation, and is likely to be delivered to the Congress in April 2002. The report could constitute an evidentiary basis for an Administration legislative initiative to modernize the DELG.

Interim Report #2, Recommendation 6

The DELG should be modernized to permit the DoD to create an effective unsubsidized export credit organization to facilitate the financing of defense exports to U.S. allies and friendly nations abroad. Modernization of the DELG should remove dysfunctional statutory and regulatory constraints that frustrate implementation of the DELG statute. Among the pertinent changes that should be implemented through both a legislative initiative and policy changes are:

- Eliminate restrictions on the capitalization of exposure fees by users of the DELG;

- Permit users of the DELG with allocations of Foreign Military Financing (FMF) to use their FMF to finance the payment of DELG exposure fees and other costs associated with the DELG;

- Broaden the eligibility for the DELG financing based on a waiver by the Secretary of Defense. This should include the financing of allied participation in collaborative defense-industrial projects with the United States to minimize the disruption to crucial multi-year programs from out-of-phase national budgeting;

- Implement administrative practices (including use of the U.S. Export-Import Bank as an administrative agent in exchange for a user fee) to reduce the DELG's administrative costs to the DoD and its users; and

- Modify administrative practices to facilitate the adding of nations to the list of eligible parties to the DELG program.

V. Air Transportation

A. Transform the U.S. Air Transportation System

1. Issue

Safe, secure and efficient air transportation is central to our nation's growth and economic development. Our current air traffic system, however, will not be able to meet the Nation's long-term needs. The suppressed capacity demand resulting from the September 11, 2001, terrorist attack and economic slowdown should not be misinterpreted as a reason to delay needed short-term and long-term improvements. We have an opportunity now to modernize the air transportation system and to increase its capacity, security and flexibility.

2. Background/Findings

Over the last century, aviation has become an integral part of the U.S. economy, a key catalyst for economic growth, and a profound influence on American quality of life. American citizens and businesses use air travel more than any country in the world. Aviation is responsible for more than $1 trillion in U.S. economic activity, employs nearly 11 million workers, and aviation products lead the development and use of advanced technologies. According to U.S. Government statistics, 31 percent of the value of international trade through the top 50 U.S. gateways was transported by air. Civil aviation integrates the United States into the world economy and promotes international exchange of people and ideas.

Our nation's security also depends on aviation. Federal, state, and local law enforcement agencies depend on aviation assets to ensure public safety. The contributions of the DoD and North American Air Defense Command to the nation's protection are inextricably linked to the operations and data shared with the air traffic control system.

Prior to September 11, 2001, the nation's air traffic control system was straining under progressively increasing demand and growing delays. The costs of those delays – both business and personal – were rapidly becoming unacceptable to the public, the true owners of America's airspace. Recent studies documented the annual loss associated with flight delays at over $8 billion. The aftermath of the September 11 terrorist attack highlights the vital importance of a safe, secure, and freely moving air transportation system as well as the fragile financial condition of the nation's air carriers.

There is no shortage of airspace – the skies are far larger than any highway and our current "capacity" of 6500 or so aircraft aloft use only a tiny fraction of existing airspace. The air carriers use only 12 percent of the more than 5000 public use airports in the United States. In fact, just 64 airports carry 85 percent of all air carrier traffic.

Today, we are not capable of fully exploiting the potential of this public asset. Our current air traffic system relies on, and is limited by, procedures and systems that have not substantially changed since the 1960s – imprecise radar tracking, voice radio communications, limited weather knowledge, severe visibility handicaps, lack of dynamic data sharing, and human monitoring throughout every flight with constant hand-offs between controllers.

a. Finding #1: Current Federal Aviation Administration (FAA) capacity enhancement plans are important and must be funded and remain on schedule.

The FAA's Operational Evolution Plan (OEP) is an organized collection of over 100 programs addressing capacity problems. The goal of the OEP is to increase the capacity of the National Airspace System by approximately 30 percent by the year 2010. This is equivalent to about 700-800 more flights in the air at a given time during normal operating hours.

Air traffic demand, however, is expected to grow by at least 30 percent by 2010. Expanded operations, innovative services, and efficient travel would benefit the entire nation and should be encouraged – not limited by a lack of sufficient infrastructure. So while we must continue aggressively with the OEP, greater capability and flexibility is clearly needed.

b. Finding #2: The FAA's OEP plan does not include funding for operator equipage or emerging technologies.

The OEP concept calls for incorporating additional technologies and capabilities as they emerge. Since these critical improvements are as yet unknown, no budget provision has been made for them. According to the FAA, "we are short now and we will be for the next eight years."

Moreover, OEP capacity improvements rely heavily on the voluntary purchase and installation of an estimated $11 billion in new equipment by the airlines. Given the economic realities airlines are facing today, this is a highly problematic assumption.

Since the events of September 11, the FAA has understandably focused on immediate actions required to meet security challenges. Some of the OEP activities have therefore been adjusted. Meanwhile, demand for air traffic services and airspace has already begun to recover.

c. Finding #3: Today's processes, laws, and plans for expanding airport and air traffic control infrastructure require many years' lead time and are fraught with technical, political, environmental, and management challenges.

Building, or even expanding, a single runway at a major airport can take one to two decades to complete, even if the local community favors its construction. Coordinating the upgrade of ground, airborne and space systems for improved operations is a hugely complex job that relies upon consensus and voluntary agreements between government and private operators and also requires planning lead times of many years.

d. Finding #4: All present and future air transportation system concepts place a heavy reliance on a robust, secure, and flexible communication, navigation and surveillance capability.

The deployment of such a capability will rely on ground-, air-, and space-based components and avionics in the aircraft. The system and the users will not achieve the benefits of the new technologies and capabilities unless they are deployed together. This will require the synchronization of both public and private investments.

e. Finding #5: The nation needs a clear air transportation policy with an objective to move air traffic capacity <u>substantially ahead</u> of anticipated demands while enhancing public safety and homeland security.

The aviation transportation system must not be allowed to constrain the nation's economic productivity and growth and should continue to improve the quality of life for every citizen. The Commission believes that the nation needs strong leadership, guided by a new national aviation policy, to provide what America demands of, and deserves from, aviation. The effective operation, innovative use, and strategic development of air transportation must become a clear national priority.

<u>Interim Report #2, Recommendation 7</u>

7.a. The Administration should immediately create a multi-agency task force with the leadership to develop and implement an integrated plan to transform our air transportation system.

An integrated plan is needed to define a new system architecture for the nation's air transportation system with procedures based on precision knowledge, automated systems, and instantaneous communications throughout the network. Capacity, safety, and security will all be improved with increasing precision and information sharing. The technologies needed to provide this capability are either available today or feasible to develop in the near future. However, we need a national focus and the will to move ahead.

The many government organizations with aviation interests should immediately be brought together under strong administration leadership to collaborate on the design strategy for a revolution in air transportation capacity, safety, and security.

7.b. The Administration and Congress should fully fund air traffic control modernization efforts in fiscal year 2003 and beyond, and prioritize FAA and NASA research and development efforts that are the critical building blocks for the future.

Air transportation is so important to the nation that the Administration and the Congress need to make air traffic infrastructure modernization a top priority. The FAA OEP needs to be fully funded, and FAA and NASA need significant increases in R&D to start developing a new air transportation system for the nation. R&D investments should include a focus on security, high bandwidth communications, precision navigation and surveillance, ground and airborne control automation, advanced weather sensing, small aircraft transportation technologies, and noise and emissions reduction. In addition, new mechanisms and incentives need to be developed to accelerate the application of existing and new technologies and concepts into the marketplace.

For the fiscal year 2004 budget, the Administration and Congress should work together to fund a new R&D initiative to develop a new 21st Century air transportation system for the nation.

VI. Summary

This report is the second in a series of interim reports aimed at identifying issues the Commission believes are critical to the future of the U.S. aerospace industry and require immediate attention by the Administration and/or the Congress. The first report was issued on December 18, 2001, and focused on the need for the federal government to budget and fund aerospace activities as a sector. It is anticipated that the Commission will release other interim reports leading up to the release of its final report on November 19, 2002.

To support development of its findings and recommendations, the Commission has conducted two public meetings – on November 27, 2001, and February 12, 2002 – and has four more public meetings scheduled for this year: May 14th, August 22nd, September 17th, and October 23rd. The public is encouraged to attend these meetings, as well as to provide inputs directly to the Commission via its website at: www.aerospacecommission.gov or Mr. Paul F. Piscopo, Staff Director, Commission on the Future of the U.S. Aerospace Industry, Crystal Gateway 1, Suite 940, 1235 Jefferson Davis Highway, Arlington, Virginia 22202, via phone (703-602-1515), fax (703-602-1532), or e-mail (aerospace.commission@osd.pentagon.mil).

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Commission on the Future of the United States Aerospace Industry
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Tel: (703) 602-1515
Fax: (703) 602-1532

June 26, 2002

President George W. Bush
The White House
1600 Pennsylvania Avenue
Washington, DC 20500

Dear Mr. President:

The Commission is pleased to provide the enclosed third interim report, which was approved at its May 14, 2002, public meeting. This report provides preliminary findings and recommendations on three issues the Commission believes require immediate Administration and Congressional attention:

- Space Infrastructure. The U.S. government continues to maintain a large and aging infrastructure in spite of dramatically reduced demand for space launch. As a result, the government continues to spend scarce resources to maintain a large number of aging facilities instead of designing the infrastructure the nation will need in the future. The government needs to prioritize its infrastructure requirements and seek new ways to manage and operate them.

- Aerospace Industrial Base. Today's challenging business environment has jeopardized the nation's ability to sustain critical design and manufacturing capabilities and expertise, especially in high-performance aircraft, solid rocket booster systems and rotorcraft. The U.S. government, particularly its national security organizations, needs a process to identify and address industrial base issues.

- 21st Century Aerospace Workforce. As with many high-tech U.S. industries, the aerospace industry is having increasing difficulty attracting and retaining well-educated and skilled workers. This problem is complicated by the fact that the workforce is aging, technology innovation is accelerating and global competition is increasing. The aerospace sector is the victim of an education system that needs to be dramatically improved, especially in the science, math and engineering disciplines.

The Commission intends to make more sweeping recommendations in these areas in its final report. An identical letter has been sent to the Congress.

Respectfully yours,

Robert S. Walker
Chairman

Enclosure

Commission on the Future of the United States Aerospace Industry

www.aerospacecommission.gov

Interim Report #3

June 26, 2002

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I. Introduction

The Commission on the Future of the United States Aerospace Industry was established by Section 1092 of the Floyd D. Spence National Defense Authorization Act for fiscal year (FY) 2001, Public Law 106-398. It was formed to study the future of the U.S. aerospace industry in the global economy, particularly in relationship to U.S. national security; and to assess the future importance of the domestic aerospace industry for the economic and national security of the U.S.

This report is the third in a series of interim reports aimed at identifying issues the Commission believes are critical to the future of the U.S. aerospace industry and require immediate attention by the Administration and/or the Congress. The first report was issued on December 18, 2001, and focused on the need for the federal government to budget and fund aerospace activities as a sector. The second report was issued on March 20, 2002, and focused on the aerospace business environment, defense/dual-use exports and air transportation. The focus of this report is on space infrastructure, industrial base, and workforce issues. The Commission will issue a final report to the President and Congress in November 2002 (which will contain more sweeping recommendations in these and other areas).

A. Mission Statement

The Commission shall develop and recommend a series of public policy reforms that will permit the U.S. aerospace industry to create superior technology, excel in the global marketplace, profit from investments in human and financial capital, benefit from coordinated and integrated government decision-making, assure our national security, access modern infrastructure, and give the United States a capacity throughout the 21st Century to reach for the stars.

B. Congressional Mandate

The Commission was given a broad mandate to study:

- The adequacy of projected budgets of the federal departments and agencies for aerospace research and development and procurement;
- The adequacy of the current acquisition process of federal departments and agencies;
- The procedures for developing and fielding aerospace systems incorporating new technology in a timely fashion;
- The policies, procedures, and methods for the financing and payment of government contracts;
- Statutes and regulations governing international trade and the export of technology;
- Policies governing taxation, particularly with a view to assessing the impact of current tax laws and practices on the international competitiveness of the aerospace industry;
- Programs for the maintenance of the national space launch infrastructure; and
- Programs for the support of science and engineering education.

C. Commissioners

The Commission is composed of 12 members: six appointed by the President, two each by the House and Senate Majority Leaders, and one each by the House and Senate Minority Leaders. The Chairman is the Honorable Robert S. Walker, former Chairman, U.S. House of Representatives Committee on Science, and the Vice Chairman is the Honorable F. Whitten Peters, former Secretary of the Air Force.

The commissioners appointed by the White House are:

Dr. Buzz Aldrin
President, Starcraft Enterprises, Sharespace, Starbooster & Starcycler

Mr. Edward M. Bolen
President, General Aviation Manufacturers Association

The Honorable John W. Douglass
President, CEO and General Manager, Aerospace Industries Association

Dr. Neil de Grasse Tyson
Director, Hayden Planetarium

The Honorable Robert S. Walker
Chairman, Wexler & Walker Public Policy Associates

Ms. Heidi R. Wood
Executive Director, Morgan Stanley

The commissioners appointed by the Congress are:

Mr. R. Thomas Buffenbarger
President, International Association of Machinists & Aerospace Workers

The Honorable Tillie K. Fowler
Partner, Holland & Knight

The Honorable John J. Hamre
President & Chief Executive Officer, Center for Strategic & International Studies

The Honorable F. Whitten Peters
Partner, Williams & Connolly

The Honorable William Schneider
President, International Planning Services, Inc.

Mr. Robert J. Stevens
President and Chief Operating Officer, Lockheed Martin Corporation

II. Space Infrastructure

A. Establish Federal Spaceports

1. Issue

The National Aeronautics and Space Administration (NASA) and the United States Air Force (USAF) currently manage the space launch infrastructure at Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS) each according to its own distinct agency processes and procedures, even though both share the same infrastructure. A new paradigm to manage infrastructure is necessary to further increase efficiency and reduce cost.

2. Background/Findings

Significant strides have been made in unifying KSC and CCAFS through the Joint Base Support Contract and a joint planning and customer service office to coordinate customer space launch needs. Merging KSC and CCAFS into one facility, then creating a quasi-federal entity (QFE) to manage it, might well further improve efficiencies, reduce costs, and provide a simplified "single face" to the users of and suppliers supporting these two facilities. This would support both Government and commercial customers.

While the government could retain ownership of all land, the QFE could operate, maintain and upgrade the facility under the leadership of an executive director and Board of Directors comprised of the government owners of the facilities. The QFE should be allowed to operate more freely than traditional federal agencies through streamlined rules and regulations with respect to appropriations, real property and procurement. An appropriate model might be that of the Metropolitan Washington Airports Authority. The unified spaceport facility (KSC and CCAFS) would operate under a unified set of procedures rather than the two different sets of procedures (NASA and USAF) used today, incorporating the best practices of each. As tenants on a unified spaceport facility, NASA and the USAF could shed the direct responsibility for base operations in the expectation that this could result in more efficient operations and cost savings. Traditional government roles, such as range and airspace safety, could be left in the hands of NASA and the USAF, or transferred to other agencies, such as the Federal Aviation Administration (FAA).

Interim Report #3, Recommendation 1

NASA and the USAF should immediately begin a short-term study, to be completed prior to May 2003 to support the FY 2004 legislative process. The study should build on the recommendations from the February 2000 Interagency Working Group report "The Future Management and Use of the U.S. Space Launch Bases and Ranges." It should investigate the feasibility of establishing a national spaceport structure at KSC and CCAFS under a single management system. The study should identify the advantages of a common management for the national spaceport system, potential cost savings, and process improvements above and beyond the current level of cooperation. Recognizing that the USAF today provides a significant subsidy to other users of CCAFS and KSC, the study should also consider the economic feasibility of a quasi-federal corporation in light of the current economic climate for space launch in the event that the USAF subsidy was unavailable to support range operations. The study should include representatives from Edwards Air Force Base (AFB), the Dryden Flight Research Facility and other government agencies, as appropriate. The results of the study should be delivered to the Administration and the U.S. Congress.

B. Enhance Leasing Authority

1. Issue

Currently, NASA and the Department of Defense (DoD) have only a limited ability to lease real property and, in the few instances in which they can, the proceeds generally return to the U.S. Treasury. Thus, there are few incentives for NASA and DoD to lease their property. At the same time, NASA and DoD are having difficulty adequately maintaining their space operations infrastructure due to budget constraints and/or competing priority operations. NASA and DoD should have expanded leasing authority and retain the proceeds from these arrangements to reimburse the impacted organization for operations and maintenance costs.

2. Background/Findings

Real property is liberally defined as land (including undeveloped land), facilities, capabilities and other resources provided to NASA and DoD customers under an official lease agreement. Currently, lease proceeds/rents are deposited in the U.S. Treasury as miscellaneous receipts rather than returned to the agencies for costs attributable to the lease. This inhibits NASA and DoD from entering into long-term agreements with state and commercial entities that would result in substantial state and private investment.

In early calendar year 1999, NASA proposed enhanced leasing authority legislation for consideration in Congress. Subsequently, Senator Bob Graham (D-FL) introduced the "Commercial Space Partnership Act of 1999" in the U.S. Senate in March 2000. The Senate postponed action on the bill at the Office of Management and Budget's request to allow the General Services Administration (GSA) one year to investigate similar legislation for all agencies. However, GSA's umbrella legislation for all agencies was not approved that year.

Since KSC and CCAFS still saw great potential for this legislation, they redrafted legislation that was included in NASA's proposed FY 2003 Authorization Act. KSC's proposed legislation is supported by Senator Graham and Congressman Dave Weldon (R-FL) and is consistent with the original bill, with the following significant exceptions. It deletes the reference to the lease of personal property, increases the term for which a lease could be executed from five to 75 years, and adds new language on the flexibility of lease proceeds usage.

Interim Report #3, Recommendation 2

Congress should approve an Enhanced Leasing Authority bill that allows NASA and DoD to lease real property at fair market value and retain lease proceeds to cover the total costs incurred in supporting the development and operation of the KSC and CCASF facilities. This legislation should grant the individual organizations the widest and most flexible interpretation and authority.

C. Provide NASA Utility Privatization Authority

1. Issue

The electrical distribution infrastructure at KSC and CCAFS is 40 to 50 years old and frequently fails. There were 22 unscheduled outages last year alone. The current infrastructure is obsolete and many parts are no longer manufactured or available. The infrastructure should have been replaced 20 to 30 years ago but has not been upgraded due to lack of funding. Absent a new source of funding for upgrading the system, it is only a matter of time before a power failure delays a launch.

2. Background/Findings

Replacement of the electrical distribution infrastructure at KSC and CCAFS is long overdue but is now quite an expensive undertaking. There are 360 miles of primary and secondary electrical distribution lines. Some 170 miles of these lines are overhead/aerial and exposed to lightning strikes, which can propagate through the system causing extensive damage. It would cost $500,000 per mile or $85 million to relocate these lines underground in concrete-encased duct banks. An additional $17.7 million would be required to repair power cables on KSC. Replacing the power distribution on CCAFS and KSC would cost approximately $400 million. DoD and NASA budget priorities have precluded adequate maintenance and upgrade of the system. There is an urgent need for a new source of funding. In the commercial world, these upgrades would have been accomplished long ago (perhaps twice) through loans amortized over 30 years.

Congress enacted utility privatization legislation for DoD in 1994. The legislation authorized DoD to sell its utility systems, including electrical distribution and water and sewer to private companies. The USAF planned to sell its power and water utilities and had several bidders. If implemented, the companies would have owned, operated, and improved the systems, recovering the costs of operations and improvements from the CCAFS and KSC through monthly utility service charges. However, since CCAFS and KSC share the same electrical distribution system and NASA did not have the same legislative authorization, the USAF could not move forward with this plan until NASA received similar legislative authority, except at prohibitive expense to NASA.

Interim Report #3, Recommendation 3

Congress should grant NASA utility privatization authority. Privatization (whether to private, state or municipal utilities) holds great potential for NASA and DoD facilities (specifically KSC and CCAFS) to overcome the budget burdens associated with capital improvements to outdated infrastructure. This legislation should grant the individual organizations the widest and most flexible interpretation and authority. The legislation could also be a model for other government agencies.

III. Aerospace Industrial Base

A. Sustain Critical U.S. Industrial Base Capabilities

1. Issue

The aerospace industry has raised concerns regarding the lack of sustaining design and engineering for manned fighter aircraft (following completion of the Joint Strike Fighter in 2008) and for solid rocket boosters used in strategic missile systems and space launch systems.

The Commission recognizes the validity of industry's concerns and includes a more detailed description and assessment of these issues as appendices to this Interim Report. The Commission also recognizes that the past decade's dramatic shrinking and thinning of the overall aerospace industrial base and today's continuing challenging business environment leave a high probability that additional similar sub-sector problems exist or may arise in the future.

A broad assessment of the overall aerospace industrial base reveals the following:

Negative Conditions/Trends

- General reduction in the number and robustness of aerospace companies
- U.S. civil transport aircraft market share declining
- Overcapacity in launch industry
- Space Shuttle future replacement clouded
- Commercial/Military integration weak
- Overcapacity in satellite industry
- NASA, FAA research funding in decline
- No U.S. regional jet production
- U.S. export controls confining global access
- World Trade Organization (WTO) position on tax issues unfavorable to U.S. manufacturers
- Serious air traffic control challenges, airport saturation
- Financially weak airlines struggling with post 9/11 challenges
- Foreign government sponsored competitors
- NASA elimination of rotorcraft research funding

Positive Conditions/Trends

- Defense research, development, testing and evaluation increase helping
- Unmanned aerial vehicle developments emerging
- Overall general aviation aircraft sal are growing

The U.S. Government, particularly its national security organizations, must be alert to risks that arise from such an environment and be prepared to take action to avert serious damage to the aerospace industrial base. The establishment of this Commission shows that a degree of overall concern has been noted. The DoD does conduct ad hoc analyses of individual programs when particular concerns are raised, but performs no future-looking systematic assessment to identify potentially critical industrial base issues. In fact, DoD has recently asked the Congress to drop a requirement for annual reporting on the status of the U.S. defense industrial base.

2. Background/Findings

Highlighted findings from an overall view of the U.S. aerospace industrial base include the following:

- Several economic and international trade issues are hampering the U.S. aerospace industry. The challenge of reforming U.S. export control policy has been raised by this Commission. The effect of recent WTO rulings on tax issues is to hurt U.S. companies while helping international competition. Furthermore, the impending expiration of research and development (R&D) tax credits will inhibit needed investment and innovation.

- Given the failure of a robust commercial space business to emerge, there is a worldwide overcapacity in space launch. The U.S. space launch industry is also facing severe pressures from international competitors, many of whom are sponsored by their governments and therefore do not face the full consequences of the marketplace.

- Even with DoD budgetary increases, the overall trend for consolidation and thinning of the aerospace industry will likely continue in the absence of government intervention. The government currently has not clearly stated its policy as to whether it favors or discourages further consolidation as the appropriate means to address overcapacity. As a result, the business community is less able to proceed efficiently in coordination with the national interest in strategic planning and development.

- The government's current mechanisms for addressing broad industrial base issues are weak and uncoordinated. Such mechanisms fail to match medium- and long-term future requirements with current policies affecting the size and structure of the aerospace industrial base. The current mechanisms do not address the significant barriers to entry for defense-related industries. These barriers make a free market model highly unreliable for industries seeking to reenter the defense market.
    - For example, the anticipated gap in engineering design and development for manned fighter aircraft and solid rocket boosters is not clearly being addressed by the DoD. If these gaps do occur, reconstituting the engineering expertise needed for successful system

development will be extremely problematic, time consuming, and at high risk of losing lessons from past experience.

- The budget increases proposed for the DoD by the Administration will clearly help support the defense sector. However, stability of these budgets will be required for improvements to be maintained over the long term.

- The long-term cooperative efforts between NASA and the DoD in rotorcraft research are in serious turmoil. As NASA faces internal budget pressures, it has sought to eliminate all of its rotorcraft R&D activity unilaterally. In the face of a growing European rotorcraft industry, the future competitive U.S. capabilities in both military and commercial rotorcraft technology development is in serious jeopardy.

- The past year's recession and the effects of the September 11, 2001 terrorist attacks have severely impacted the U.S. aerospace industry. Airline traffic is down, aircraft orders have dropped, and 2001 saw fewer space launches than any year since 1963. The supplier base has been especially hard hit with the repercussions of slowing orders from prime contractors. A significant portion of government spending in the air transportation sector is being refocused to massive security responses, reducing the funding available for innovation and system efficiency improvements.

- As stated in the Commission's Second Interim Report, the limitations to air traffic capacity growth is a major challenge facing the nation. The effects will be felt in the near term. Traffic recovery from September 2001 is already underway and will continue with an economic recovery and success in preventing future terrorist incidents. Already, however, on time performance is dropping as traffic increases, highlighting the fact that the air traffic control (ATC) system is very near its effective capacity. New runway construction is a process that typically takes well over a decade to complete. NASA and FAA budgets aimed at air transportation's growth have been decreasing for a number of years. The long lead-time for increasing aviation capacity calls for immediate Administration and Congressional attention to address this major national need.

- At this time of severe air transportation challenges, the senior leadership of the FAA is in transition. The FAA Administrator's term expires in August of this year, the Deputy Administrator has indicated his intent to retire in the same time period, and the leader of the proposed Performance Based Organization for managing air traffic operations remains unnamed.

In previous interim reports, the Commission has recommended a number of actions for the Administration and Congress that would directly improve the condition of the U.S. aerospace industrial base. It is important to consider industrial base issues in its full context, and worth reiterating several previous Commission recommendations:

- Congress should fully fund the President's DoD budget request.
- Congress and the President should ensure full funding of the FAA's operations budget and its Operational Evolution Plan.
- Congress should adopt the National Foreign Trade Council (NFTC) unitary proposal to replace the Foreign Sales Corporation (FSC)/Ethical Trading Initiative (ETI) with changes to U.S. tax laws that would ensure the future competitiveness of current users of the FSC/ETI regime in the global marketplace.
- The Administration should negotiate changes in the WTO rules that would remove the inequity in treatment of direct and indirect taxes that led to the European Union's challenge of the FSC/ETI tax regime, and put in place an equitable resolution that would ensure that U.S. business interests receive the same level of tax relief as European businesses enjoy from their government systems.
- In the near term, Congress should revise the U.S. tax code to make the research and experimentation (R&E) tax credit permanent, and increase the alternative credit rates to achieve parity with the savings provided by the regular credit. In the longer term, Congress should enact structural changes to the R&E credit, including changes in the baseline period, increases in the rates for the Alternative Incremental Research Credit and other improvements that enhance its effectiveness in stimulating private sector investment in new technologies.

Recommendations

This Interim Report recommends the following additional actions be taken to address areas of concern during Congressional deliberations in the current budget cycle and Administration preparation for the FY 2004 budget.

Interim Report #3, Recommendation 4

The Secretary of Defense should task the Defense Science Board (DSB) to review and recommend overall DoD policy toward future industrial base consolidation including its policies toward mergers and acquisitions. In particular, as part of this review, the DSB should:

- Address the aerospace industry consolidation and workforce challenges resulting from today's diminishing number of system design programs.
- Assess approaches for aligning consolidation policies with procurement and budgeting policies.
- Consider specific measures of the health of defense contractors such as the magnitude and longevity of a contractor's production base and product development work.
- Assess the long-term sustainability of the nation's high performance aircraft and solid rocket booster design and development capabilities, including the potential of increasing/initiating high payoff technology development programs and/or continuing low rate production of strategic systems to bridge industry capabilities to a succeeding generation.

<u>Interim Report #3, Recommendation 5</u>

The Administration and Congress should direct NASA and the DoD to coordinate R&D efforts in areas of common need and provide the appropriate funding for joint programs. For example, funding for joint Army/NASA rotorcraft R&D efforts should be restored.

<u>Interim Report #3, Recommendation 6</u>

Congress should hold hearings to address:
- National challenges for future air traffic capacity needs cited in the Commission's Second Interim Report.
- Increases to NASA and FAA research and development funding needed to retain national leadership in aeronautics.

<u>Interim Report #3, Recommendation 7</u>

The Administration should ensure that a new FAA Administrator, Deputy Administrator and Chief Operating Officer of the new Performance Based Organization are recruited to fill important leadership vacancies without delay and assign each a mandate for substantial long-term ATC capacity growth.

B. Ensure DoD Program and Budget Stability

1. Issue

Because of overall DoD budget constraints in the past decade, DoD investments have been inadequate to fund planned programs. This funding shortfall has been exacerbated by the practice of decrementing the investment accounts to provide supplemental funding for increasing operations and support (O&S) costs, the costs of unforeseen contingency operations and unanticipated internal program changes. The resulting program funding instability contributed to increased weapon system costs and delays in military modernization. The current Administration seeks to resolve this issue by providing a significantly increased DoD budget top line that can accommodate fully the O&S accounts, including unplanned contingencies, and by budgeting more realistically for individual programs.

2. Background/Findings

Protecting Investment Funding

Stable and predictable funding levels for DoD procurement and R&D accounts are essential for effective management of programs and costs, as well as meeting requirements for military modernization. This must be balanced with achievable and realistic requirements and mature technologies, the lack of which also contribute to a program's failure to meet established baselines.

Ensuring adequate funding for both O&S and investment requirements would ameliorate some of the funding stability concerns for individual programs, and would help ensure adequate funding to complete and maintain the desired modernization and transformation of U.S. Armed Forces.

Realistic Cost Estimates

The competition for scarce resources, coupled with a desire to satisfy more requirements by having more programs ongoing than may be affordable, creates incentives and pressures on the Services and industry to be overly optimistic when estimating future system costs. As programs mature, actual costs are difficult to accommodate within the planned top line, leading to cost increases, delays, restructuring, or cancellation. Overly aggressive schedules and requirements also have a significant impact on program execution and delivery.

Requiring more realistic cost and schedule estimates will help reduce the tendency to include too many ultimately unaffordable programs within the FYDP and preclude both contractor and DoD investment in programs that realistically will not be completed.

Financing Flexibility

The current financial system requires detailed estimates of program costs years in advance of execution, and then allows only very limited flexibility, once the budget is finalized, to address changes and emerging needs as the program progresses through execution.

Greater flexibility to adjust funding requirements among programs, and within programs, would allow DoD to meet higher priority requirements as they arise, and solve problems discovered in testing during production or to provide support following production.

Multiyear Budgeting

While a weapon system's design and development program typically requires many years, often from five to ten, resources are requested and appropriated on an annual basis. Thus, while contracts span multiple years, program managers and contractors face uncertainty every year about the timely availability of adequate funding to do the next increment of work. As long as high priority programs are performing, Congress and DoD should recognize that funding reductions impact performance and should avoid funding perturbations resulting from undistributed cuts, disbursement lags, and other adjustments not related to program performance or funding requirements. Multiyear contracts for production offer a means of providing defense companies with stable revenue and cash flow, lowering unit costs due to economies of scale and supporting a more stable workforce.

Recommendations

Based on the need to adequately fund and manage investment in modernization and transformation, the Commission recommends that the Administration/DoD and Congress:

Interim Report #3, Recommendation 8

Establish and maintain a stable top line for DoD investment in the FYDP.

a. Establish and maintain an adequate long-term investment (procurement and R&D) budget in the FY 2004-2009 FYDP.
b. Establish and maintain an adequate O&S budget in the FY 2004-2009 FYDP.
c. Protect continuity of long-term investment funding by seeking to limit downward adjustments across the FYDP for other than economic reasons (i.e., inflation) and/or by limiting reprogramming into O&S or other accounts in year of execution.

Interim Report #3, Recommendation 9

Fully fund programs within the FYDP.

a. Industry should submit realistic cost and schedule information in all bid proposals.
b. DoD should provide sufficient funds in the FYDP based on realistic schedule and performance goals, using independent cost estimates as decided by the Milestone Decision Authority.
c. DoD and industry should jointly manage programs to ensure visibility and review of all requirements changes during program execution. If approved, funding will be adjusted for any such requirements.

Interim Report #3, Recommendation 10

Increase DoD's financial flexibility.

a. Support the Administration's proposal to provide authority for program managers to move funds from procurement to R&D in a program.
b. Double reprogramming thresholds to $20 million for procurement and operations and maintenance and $8 million for R&D.

Interim Report #3, Recommendation 11

Support multiyear, full-phase funding for both development and production programs.

a. Procurement Programs: Expand the use of multiyear procurement contracting and funding using existing criteria and by working to achieve the Secretary of Defense's (SECDEF) desired goals for multiyear contracts. SECDEF selected pilot programs with spiral development acquisition and multiyear funding will include mechanisms to allow insertion of technology enhancements without invalidating the advantages (cost savings and program stability) of multiyear contracting.

b. Development Programs: Develop baselines for selected development programs based on realistic cost, schedule and performance goals; establish and protect "milestone-to-milestone" budgets in the FYDP to provide full-phase funding from initiation to production, as long as acquisition program baseline goals are met. Enact legislation to provide "milestone" Congressional authorizations for the duration of each selected development program, and appropriate funds annually as required for each program so long as each program meets its baseline goals.

IV. 21st Century Aerospace Workforce

A. Develop and Maintain a 21st Century Workforce

1. Issue

The future of the U.S. aerospace industry depends on the ability of the industry to attract, develop and retain a properly skilled professional, scientific, engineering and production workforce. Contractions in the industry due to mergers and consolidations and a downturn in the economy have produced large layoffs and few opportunities for new jobs. This will result in a shortage of young and experienced talent as the aging workforce retires over the next decade.

2. Background/Findings

With the end of the cold war, the rise of global competition, industry consolidation, and growth in other sectors of the economy – particularly in the computer sciences – the U.S. aerospace industry has lost its premier status as the employer of choice for many types of professional, scientific, engineering, production and maintenance workers. At the same time, the average age in the workforce on the defense side of aerospace is over 50 years old. In the next six years, nearly half of the workforce is eligible to retire, leaving a gaping hole in skills and experience. According to retired USAF General Thomas Moorman, "The work force is the biggest issue facing the industry today. We are not attracting and retaining the best and the brightest."

The aerospace industry plays a major role in the health of the U.S. economy and in maintaining the strength of our nation's security. It provides jobs for hundreds of thousands of workers in aerospace and related industries. The industry is constantly developing sophisticated technologies that have widespread application in increasing the nation's productivity and in protecting our country from its enemies. The development of new technologies has also spurred the creation of other industries that have greatly contributed to our economy.

None of the great benefits that have been derived from the aerospace industry would have been possible without the availability of a highly skilled and dedicated workforce. Despite its importance, the aerospace workforce is dramatically declining. From a peak employment in December 1989 to March 2002, over 600,000 aerospace workers have lost their jobs. The impact of the recent use of commercial aircraft in attacks on the U.S. by terrorists and the current downturn in the business have led to further unplanned loss of aerospace jobs. Aerospace industry representatives have noted that the total announced layoffs since the September 11, 2001 terrorist attacks exceed 60,000 workers across the industry.

Recommendations

Given the necessity of the U.S. aerospace industry for economic and national security, the Commission makes these recommendations for stemming these losses with an overall objective of stabilizing and growing the U.S. aerospace workforce.

Interim Report #3, Recommendation 12

Interagency Workforce Task Force: The aerospace industry's workforce provides the skills, knowledge, and technical capabilities necessary to keep the U.S. in the leadership of production, sales, and marketing for the 21st century aerospace industry. To ensure leadership throughout the 21st century the Commission recommends that the Administration:

a. Through Executive Order, create an interagency Workforce Task Force to coordinate programs and initiatives composed of the Departments of Labor, Commerce, Education, and other agencies as appropriate to respond to industry workforce and training needs.
b. As part of the Workforce Task Force, establish an Industry-Based Aerospace Capability Network to develop public/private partnerships in which all key stakeholders – business, labor, government, and community groups – coordinate agency resources, the development of skill standards and certification programs, and provide information on occupations and job availability in order to foster the growth of the American aerospace economy and workforce.

Interim Report #3, Recommendation 13

Aerospace Industry Promotion (AIP): The Commission recommends that the Administration develop a national program to attract public attention to the importance and opportunities within the aerospace industry targeted to high schools, community colleges and universities with engineering schools. The AIP should be coordinated through the Aerospace Capability Network. Programs such as the National Aerospace Initiative or the Automotive Youth Educational Systems could be models for promotion in the aerospace industry.

Interim Report #3, Recommendation 14

Tax credits for apprenticeship and training: The Commission recommends the Administration and Congress consider targeted tax credits for employers who invest in the skills and training of the workforce for employees enrolled in registered apprenticeship programs and other short-term occupational training programs that meet the needs identified by industry.

Interim Report #3, Recommendation 15

Make long-term investments in education and training to keep America's highly skilled workforce "pipeline" filled. The Administration and Congress should:

a. Support recommendations of the National Commission on Mathematics and Science Teaching for the 21st Century on improving K-12 mathematics and science education.
b. Create programs to encourage more young people to study and work in the mathematics, science, and engineering fields, including scholarships and internships.
c. Make investments in vocational education to develop a workforce with the skills needed by industry.
d. Expand the use of registered apprenticeships for skilled and technical occupations.

Interim Report #3, Recommendation 16

U.S. Aerospace Workforce Stabilization: Since the tragedy of September 11, 2001, the current erosion of U.S. aerospace employment has accelerated. U.S. policy towards domestic aerospace employment must reaffirm the goal of stabilizing and increasing the number of good and decent jobs in the industry. The Administration and the Congress should consider the impact on U.S. aerospace employment of domestic and international policies.

V. Summary

To support development of its findings and recommendations, the Commission has conducted three public meetings – on November 27, 2001, February 12, 2002, and May 14, 2002 – and has three more public meetings scheduled for this year – August 22, September 17, and October 23. The public is encouraged to attend these meetings, as well as to provide inputs directly to the Commission via its website at: www.aerospacecommission.gov or to Mr. Paul F. Piscopo, Staff Director, Commission on the Future of the U.S. Aerospace Industry, Crystal Gateway 1, Suite 940, 1235 Jefferson Davis Highway, Arlington, Virginia 22202, via phone (703-602-1515), fax (703-602-1532), or e-mail (aerospace.commission@osd.pentagon.mil).

Appendix A: U.S. Solid Rocket Motor Technology and Production Capability

1. Issue

The United States solid propellant production programs for strategic missiles will end in 2008 with no follow-on development or production anticipated before 2015. Current trends indicate that civil and commercial markets beyond 2008 will not sustain the production base for solid rocket motors. The loss of the solid rocket motor industrial base would impede, if not prevent, the development and production of the next generation of U.S. strategic missiles.

2. Background

Our strategic, tactical and missile defense weapons depend on solid rocket motors for propulsion systems. Currently, the U.S. Navy is procuring Trident II D-5 Fleet Ballistic Missiles (FBM) and the U.S. Air Force is beginning a life extension program for 500 Minuteman III Intercontinental Ballistic Missiles (ICBM). Rocket motor production for these programs will end in 2008, and missile deployment is planned through 2020. For the first time in 50 years, no new strategic missile solid propulsion development or production program is on the horizon.

The defense industry is no longer the dominant solid rocket motor customer. In 1984 the $2.5 billion solid rocket motor market was two-thirds defense related and one-third commercial space related. By 1999, the market dropped to $1.2 billion: commercial space became the dominant customer with two-thirds of the market while defense made up only one-third of the market. Space launch customers using solid rocket motors include the NASA Space Shuttle, Air Force Titan IV and commercial Delta and Atlas vehicles. However, these customers plan to transition to liquid propulsion systems for their next generation vehicles. Potential reductions in strategic missiles will further dampen demand for solid rocket propulsion.

Future U.S. strategic missile development and production capability is now threatened. Inadequate solid propulsion markets could erode the U.S. ability to develop solid rocket boosters to meet future demands. Critical engineering design skills could be lost. Already the workforce is in decline: experienced engineers are retiring, and young talent is not entering the labor force. If there is ever a requirement for more advanced capabilities in strategic missiles, then we must continue to pursue related research and development. If we ever need to increase production of solid rocket motors in the future, then we must retain our production capability.

Appendix B: Design Capability for Advanced, High-Performance Aircraft

1. Issue

Based on current plans, by the end of the current decade, the United States will not be designing and developing a new advanced, high-performance aircraft. There will be no new fighter on the drawing boards to follow the Joint Strike Fighter. As a result, the U.S is at risk of losing its broad combat fighter aircraft design capability.

2. Background

There is concern over the declining design capability for advanced, high-performance aircraft in the U.S. aerospace industry. Over the past 50 years, the number of military manned aircraft design programs per decade has dropped 96% (1950s – 46 programs; 1960s – 16; 1970s – 12; 1980s – 7; 1990s – 6; 2000s – 2 [the Joint Strike Fighter (JSF), a manned aircraft, and the Uninhabited Combat Air Vehicle (UCAV), an as yet unproven concept]. This translates into a huge drop in the number of programs a technician, engineer, or manager will work on during a 40-year career. According to the RAND Corporation, declining experience levels have contributed to the problems observed in many recent military aircraft development programs. While experienced employees are retiring (54% are over 45 years of age, and 33% are eligible for retirement in 5 years), there are few, if any, high-tech aircraft programs on the horizon that would allow companies to attract and develop young talent, as well as maintain expertise throughout the workforce.

The JSF System Design and Development SDD will end in 2012. The UCAV program will complete its major design work by 2010. From that point forward, DoD plans leave a combat fighter aircraft design gap of 10 to 20 years, seriously impacting the capability of the U.S. to retain critical skills. Except for the possibility of a Long Range Strike Aircraft (B-2 replacement) or a possible National Aerospace Initiative hypersonic aircraft, there are no new military aircraft programs of any kind under consideration until 2024.

Appendix C

Aerospace Sector Breakout

Prepared by: Office of Management and Budget

Aerospace Sector Breakout

($ in millions)

	2001	2001	2001	2001	2001	2002	2002	2002	2002	2002	2003	2003	2003	2003	2003
	DoD	NASA	NOAA	FAA[6]	DOE	DoD	NASA	NOAA	FAA[6]	DOE	DoD	NASA	NOAA	FAA[6]	DOE
Space*	13,955	9,078.3	576.0	0.0	121.0	15,377.0	9,348.3	640.0	0.0	130.0	18,013.0	9,151.0	680.0	0.0	136.0
Spacecraft & User Equipment		4,603.4	576.0		121.0		4,586.3	640.0		130.0		4,330.7	680.0		136.0
R&D[1]		*2,070.4*	*117.0*		*55.0*		*1,983.3*	*210.0*		*63.0*		*1,785.7*	*233.0*		*55*
Flight Systems[2]		*1,134*	*356.0*		*66.0*		*630.5*	*315.0*		*67.0*		*500.6*	*290.0*		*81*
Operations[3]		*1,129.4*	*53.0*				*1,656.9*	*55.0*				*1,728.9*	*66.0*		
Ground Infrastructure[4]		*269.6*	*50.0*				*315.6*	*60.0*				*315.5*	*91.0*		
Space Transportation		4,474.9					4,762					4,820.3			
R&D[1]		*1,127.3*					*1,331.5*					*1,531.3*			
Flight Systems[2]		*50.9*					*117.5*					*16.5*			
Operations[3]		*2,914.1*					*2,978.6*					*2,928.6*			
Ground Infrastructure[4]		*382.6*					*334.4*					*343.9*			
Aircraft & Air Systems	25,786.0	585.1		2,837.5	68.0	26,495.0	611.4		3,203.0	75.0	29,628.0	541.4		3,107	63
R&D[1]	*6,587.0*	*572.6*		*186.5*	*68.0*	*6,149.0*	*599.4*		*195.0*	*75.0*	*6,808.0*	*531*		*126*	*63*
Flight Systems[2]	*19,199*					*20,346*					*22,820*				
Operations[3]															
Ground Infrastructure[4]		*12.5*		*2,651.0*			*12*		*3,008.0*			*10.4*		*2,981*	
Missiles	4,304.0					4,316.0					5,514.0				
R&D[1]	*1,137.0*					*1,128.0*					*1,232.0*				
Flight Systems[2]	*3,167.0*					*3,188.0*					*4,282.0*				
Missile Defense	5,362					7,772					7,763				
Non-Space	4,958					7,388					7,295				
R&D[1]	*4,518*					*6,623*					*6,608*				
Flight Systems[2]	*440*					*765*					*687*				
Space[5]	404					384					468				
R&D[1]	*404*					*384*					*468*				
Flight Systems[2]															
Basic Research[5]		2,011.8					2,101					2,376.7			
Total	49,407	11,675	576	2,838	189	53,960	12,061	640	3,203	205	60,918	12,069	680	3,107	199

* Additional details of DoD space spending are classified. Space funding excludes space-related missile defense (shown under missile defense).

[1] BA for Applied Research (e.g., 6.2 for DoD) and Development (e.g., 6.3 through 6.7 for DoD) specifically for new or improved systems.

[2] BA for the 'production' of systems.

[3] BA to operate, maintain and decommission systems after they have been purchased.

[4] BA for facilities/equipment/capabilities necessary to develop/test/operate systems.

[5] BA for Basic Research in aerospace that is not specifically related to any of the sector categories listed above (e.g. 6.1 for DoD).

[6] These numbers only represent the Research, Engineering and Development (i.e. R&D in table) and Facilities, Engineering and Development (i.e. Ground Infrastructure in table) portions of FAA's total budget, which were $12.9 for FY2001, $13.7 for FY2002 and $14.0 billion (requested) for FY2003.

Appendix D

Scoping Aerospace

Prepared by: RAND

Full report available at www.ita.doc.gov/aerospace/aerospacecommission

RAND

Scoping "Aerospace"

Donna Fossum, Dana Johnson, Lawrence Painter, Emile Ettedgui

DRR-2878

September 2002

Prepared for the Aerospace Commission

National Defense Research Institute

Unpublished RAND research and analysis of federal aerospace procurements and personnel expenditures for the past ten years were conducted in support of Aerospace Commission deliberations by Dr. Donna Fossum and Mr. Lawrence Painter in 2001."

Notes:

The following table shows federal aerospace procurement and personnel expenditures for FY 1993 through FY 2001. All amounts are "Obligations" in actual dollars. The table presents the data in the aerospace sectoral categories agreed to by the Commission staff and the White House Office of Management and Budget (OMB), which are as follows:

- Air Systems
  - Aircraft
  - Infrastructure
- Missile Systems
  - Missiles
  - Infrastructure
- Space Systems
  - Space Systems
  - Infrastructure
- Research and Development (Conduct only)
- Personnel

Data on aerospace procurements is from the Federal Procurement Data System (FPDS), maintained by the General Services Administration. The FPDS tracks all contracts awarded by all federal agencies that exceed the "small purchase" threshold by the type of "Product and/or Service" procured. To determine which procurements were categorized as "Aerospace," the "Product and Service Code" (PSC) numbers from the FPDS were used for each contract awarded by the federal government. The description of each "Product and Service Code" is provided in the left-hand columns of the table, along with the PSC number(s). The personnel information was taken directly from the "Budget of the United States Government" for the relevant fiscal years. All caveats regarding the data in the table are provided in the "Comments" column of the chart.

The second table shows federal department and agency aerospace procurement spending only and does not include personnel costs.

Federal Aerospace Procurement and Personnel Expenditures (8/19/02)

		EY 1994	EY 1995	EY 1996	EY 1997	EY 1998	EY 1999	EY 2000	EY 2001	COMMENTS
	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	
AIR SYSTEMS	28,568,746	30,398,592	23,838,569	30,307,043	20,308,985	22,562,710	20,996,822	19,148,971	18,533,676	
Aircraft	23,717,669	25,214,611	19,170,302	25,297,023	15,693,028	18,464,131	17,493,276	15,501,968	15,166,566	
Aircraft and airframe structural components	15,831,848	17,000,762	11,210,247	17,918,694	9,534,548	11,841,679	10,520,968	7,364,503	8,019,037	
Fixed wing (1510)	12,402,534	14,963,824	9,280,293	15,985,957	8,450,863	10,840,118	8,721,091	5,248,959	5,726,696	
Rotary wing (1520)	2,221,620	835,846	880,700	1,134,482	569,754	952,511	798,408	961,692	1,056,206	
Gliders (1540)	0	29	381	0	0	0	1,251	0	669	
Drones (1550)	208,732	159,377	126,685	36,746	9,794	28,818	61,552	94,621	86,210	
Airframe structural components (1560)	998,962	1,041,686	922,188	761,509	504,137	820,232	938,656	1,059,231	1,149,412	
Aircraft components and accessories (non structural)	1,684,168	1,364,527	1,659,575	1,635,502	1,217,621	1,509,372	1,516,327	2,190,003	2,026,339	
Aircraft propellers and components (1610)	55,651	50,467	51,406	46,215	28,062	114,375	12,520	16,101	22,031	
Helicopter rotor blades, drive mechanisms, and components (1615)	303,615	315,551	298,156	421,371	212,384	382,109	392,934	445,409	388,044	
Aircraft landing gear components (1620)	40,145	46,275	67,064	55,898	52,774	80,655	80,676	110,458	92,949	
Aircraft wheels and brake systems (1630)	30,903	53,941	49,265	72,107	52,970	58,729	78,292	168,468	214,500	
Aircraft hydraulic, vacuum, and de-icing system components (1650)	80,830	90,608	101,035	125,909	112,182	120,817	171,639	121,937	143,344	
Aircraft air conditioning, heating, and pressurizing equipment (1660)	63,060	60,578	53,253	74,932	52,059	68,780	47,341	38,287	57,203	
Parachutes/Aerial pickup, delivery, & recovery systems/Cargo tie down equip. (1670)	41,535	78,749	71,184	49,262	31,876	36,223	78,095	56,666	55,547	
Miscellaneous aircraft accessories and components (1680)	1,063,429	666,358	968,212	789,788	675,314	641,684	655,430	1,232,677	1,052,721	
Aircraft launching, landing, and ground handling equipment	101,455	55,263	72,245	62,927	78,804	122,945	62,057	95,658	78,461	
Aircraft landing equipment (1710)	40,111	7,280	12,076	18,349	20,942	49,799	20,448	23,966	27,612	
Aircraft launching equipment (1720)	22,023	32,696	36,981	33,137	38,784	55,595	23,678	56,184	39,691	
Airfield specialized trucks and trailers (1740)	39,321	15,287	23,188	11,441	19,078	17,251	17,931	15,508	11,158	
Aircraft tires and tubes/pneumatic (2620)	26,178	24,488	35,245	40,342	37,438	39,801	56,634	45,886	40,901	
Communication, detection and coherent radiation equipment	864,386	1,327,175	1,286,895	794,260	1,047,567	884,955	574,669	583,214	406,772	
Radio and television communication equipment/airborne (5821)	142,891	287,284	371,792	173,170	261,038	274,570	148,736	247,925	134,107	
Radio navigation equipment/airborne (5826)	145,784	118,348	76,885	66,260	65,538	67,103	32,074	31,373	34,437	
Intercommunication and public address systems/airborne (5831)	983	2,821	4,408	4,828	7,778	1,446	1,324	1,966	2,587	
Radar equipment/airborne (5841)	574,728	918,722	833,710	550,002	713,213	541,836	392,535	301,950	235,641	
Engines, turbines, and components	3,657,030	3,835,185	3,050,905	3,101,600	2,308,854	2,488,913	2,954,048	3,042,212	2,750,932	
Gasoline reciprocating engines and components/aircraft prime movers (2810)	922	2,748	806	1,060	45	428	784	637	340	
Gas turbines and jet engines and components/aircraft prime movers (2840)	2,881,815	3,264,710	2,566,795	2,689,250	2,233,628	2,429,997	2,894,116	3,001,821	2,727,020	
Rocket engines and components (2845)	774,293	567,727	483,304	411,275	75,181	58,488	59,148	39,754	23,572	
Engine accessories	122,424	115,885	118,960	106,311	95,997	177,014	232,045	238,608	138,691	
Engine fuel system components/aircraft and missile prime movers (2915)	55,568	62,035	73,069	46,020	48,004	101,386	113,582	89,335	71,788	
Engine electrical system components/aircraft prime movers (2925)	14,001	15,215	9,735	16,563	14,641	24,269	12,909	18,356	12,138	
Engine cooling system components/aircraft prime movers (2935)	3,888	1,640	3,135	2,257	3,317	7,189	2,639	1,409	3,220	
Engine air and oil filters/cleaners/aircraft prime movers (2945)	1,403	1,217	1,428	2,321	2,232	2,384	3,165	2,244	2,299	
Miscellaneous engine accessories/aircraft (2995)	47,564	35,778	31,593	39,150	27,903	41,806	99,750	127,244	49,246	
Fire control equipment	243,667	171,909	388,190	113,096	140,585	132,793	83,196	174,127	76,674	
Aircraft gunnery fire control components (1270)	165,421	146,990	340,446	95,947	95,383	125,384	65,456	137,033	53,720	
Aircraft bombing fire control components (1280)	78,246	24,919	47,744	17,149	45,202	7,409	17,740	37,094	22,954	
Fuels, lubricants, and oils	na	na	na	na	na	na	na	na	na	Unable to separate "aircraft" use from all other uses
Instruments (6340, 66__)	83,548	116,919	152,229	130,992	99,102	70,029	107,153	118,433	90,545	
Rockets, rocket ammunition, and rocket components (1340)	106,369	5,734	150,875	80,387	125,152	172,281	248,467	333,093	220,361	
Weapons	35,801	22,463	8,440	70,285	95,369	22,688	57,697	124,399	176,893	
Launchers/Torpedo and depth charge (1045)	3,101	881	1,029	957	1,182	9,579	18,720	4,733	695	
Launchers/rocket and pyrotechnic (1055)	32,647	21,582	7,411	69,328	94,187	13,109	38,977	119,666	176,198	
Nuclear bombs (1105)	53	0	0	0	0	0	0	0	0	
Other (including federal personnel)	954,795	1,174,301	1,030,496	1,242,622	911,992	1,001,661	1,080,025	1,191,832	1,139,910	
Aerial fertilization/spraying (F001)	5,402	5,844	12,331	9,331	4,025	3,817	2,584	1,706	4,448	
Aerial photography (T009)	9,376	16,109	12,588	8,570	9,773	18,746	14,918	6,707	20,695	
Aerial seeding (F002)	694	193	1,541	379	485	119	23	281	893	
Aeronautic/Space studies (B539)	4,010	15,665	22,104	24,206	20,252	18,906	19,025	23,409	43,842	
Air freight (V111)	16,114	9,725	2,872	4,392	24,060	25,083	9,983	5,611	5,112	
Air passenger (V211)	43,199	59,925	11,663	10,877	15,290	23,894	6,919	43,847	8,374	
Aircraft salvage (P200)	0	0	0	0	29	7,174	208	5,194	899	
Construction of airfield, communication, & missile facilities-- A&E services (C111)	173,624	174,577	240,564	350,951	90,959	110,638	148,725	224,948	363,088	
Freight transport -- Air charter (V121)	185,404	206,224	73,990	342,417	289,504	41,048	94,318	96,409	39,308	
Navigational aid and pilotage services (V227)	0	0	0	80	73	385	346	2,525	3,695	
Passenger air charter (V221)	516,972	686,048	652,843	491,419	446,438	751,051	782,976	781,135	649,757	

Federal Aerospace Procurement and Personnel Expenditures (8/19/02)

		FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	COMMENTS
	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	
Infrastructure	4,851,077	5,183,981	4,668,267	5,010,020	4,615,956	4,098,579	3,503,546	3,647,003	3,368,110	
Aircraft carriers (subset of Combat ships and landing vessels) (subset of 1905)	0	111	0	0	0	0	0	0	0	
Aircraft ground servicing equipment (1730)	93,788	94,865	54,772	79,795	81,730	52,629	101,467	88,544	79,130	
Aircraft maintenance and repair shop specialized equipment (4920)	222,478	246,472	186,565	160,980	176,371	299,064	240,984	249,594	183,095	
Construction of air system facilities –	465,382	715,807	516,297	339,912	523,712	302,707	271,744	399,942	294,000	
Air traffic control towers (Y121)	57,547	96,493	141,288	31,745	59,677	54,859	25,485	28,908	16,091	
Air traffic control training facilities (Y122)	2,349	8,383	40,408	4,631	10,876	2,466	12,987	959	2,550	
Radar and navigational facilities (Y123)	77,155	74,666	65,133	13,416	33,810	96,106	30,251	5,773	13,448	
Airport runways (Y124)	15,225	86,247	26,415	34,530	18,366	10,476	32,365	37,600	37,871	
Airport terminals (Y125)	10,676	4,030	9,212	1,380	2,851	14,062	150	36	481	
Electronic and communications facilities (Y127)	73,427	93,148	61,639	53,591	37,849	15,375	17,247	5,350	13,260	
Other aerospace structures (Y129)	229,003	352,840	170,112	200,614	360,293	109,373	153,259	321,316	210,319	
Equipment and materials testing	161,214	42,855	36,057	17,855	19,665	21,824	7,095	4,803	3,725	
Aircraft and airframe structural components (H215)	148,624	29,976	3,586	7,208	364	-201	0	0	0	
Aircraft components and accessories (H216)	12,590	12,879	32,471	10,507	19,301	21,997	7,095	4,803	3,729	
Aircraft launching, landing, and ground handling equipment (H217)	0	0	0	0	0	28	0	0	0	
Engines, turbines, and components (H228 Aircraft Only)	0	0	0	0	0	0	0	0	0	
Inspection services	1,374	224	0	495	1,438	1,987	2,954	1,009	1,679	
Aircraft and airframe structural components (H315)	1,091	0	0	495	1,314	1,987	2,954	1,009	1,246	
Aircraft components and accessories (H316)	283	224	0	0	124	0	0	0	0	
Aircraft launching, landing, and ground handling equipment (H317)	0	0	0	0	0	0	0	0	433	
Engines, turbines, and components (H328 Aircraft Only)	0	0	0	0	0	0	0	0	0	
Installation of equipment	24,734	63,796	111,430	340,643	203,626	21,506	35,569	12,371	2,575	
Aircraft and airframe structural components (N015)	67	0	0	45	62	924	30	3,626	2,606	
Aircraft components and accessories (N016)	24,621	9,739	15,507	25,012	1,206	0	6,620	5,591	0	
Aircraft launching, landing, and ground handling equipment (N017)	46	57	39	541	664	35	0	99	-69	
Engines, turbines, and components (N028 Aircraft Only)	0	54,000	95,884	315,045	201,694	20,547	28,919	3,055	0	
Lease or rental of air system facilities–	1,694	3,537	2,474	1,110	1,870	3,011	2,795	2,842	1,516	
Air traffic control towers (X121)	0	214	0	0	0	0	0	27	39	
Air traffic control training facilities (X122)	0	0	0	0	32	0	0	0	0	
Radar and navigational facilities (X123)	0	0	0	0	0	0	0	0	0	
Airport runways (X124)	52	101	3	1	0	0	0	6	0	
Airport terminals (X125)	3	59	118	15	30	47	0	16	0	
Electronic and communications facilities (X127)	544	1,204	570	35	43	731	282	591	352	
Other aerospace structures (X129)	1,095	1,959	1,783	1,059	1,765	2,233	2,513	2,202	1,125	
Lease or rental of facilities	9,949	21,910	29,328	43,950	32,230	16,877	8,553	20,317	32,984	
Aircraft and airframe structural components (W015)	9,949	21,864	29,203	43,871	31,818	16,039	7,816	20,317	32,958	
Aircraft components and accessories (W016)	0	46	125	0	0	0	0	0	0	
Aircraft launching, landing, and ground handling equipment (W017)	0	0	0	79	412	838	737	0	26	
Engines, turbines, and components (W028 Aircraft Only)	0	0	0	0	0	0	0	0	0	
Maintenance, repair, and rebuilding of equipment	1,970,194	2,194,004	2,046,200	2,179,800	1,906,009	1,772,043	1,483,073	1,670,716	1,352,120	
Aircraft and airframe structural components (J015)	1,558,041	1,672,352	1,452,719	1,424,929	1,278,347	1,175,769	843,939	1,175,013	890,120	
Aircraft components and accessories (J016)	282,430	426,076	435,132	328,767	356,218	352,513	352,532	191,840	144,924	
Aircraft launching, landing, and ground handling equipment (J017)	19,091	17,001	18,190	8,581	2,518	4,768	4,653	6,096	17,160	
Engines, turbines, and components (J028 Aircraft Only)	110,632	78,575	140,150	417,523	268,926	238,993	281,949	297,767	299,916	
Maintenance, repair, or alteration of air system facilities –	306,859	297,312	294,594	322,173	299,408	235,828	249,260	228,706	282,823	
Air traffic control towers (Z121)	10,106	20,643	14,306	10,460	11,503	9,179	5,311	9,753	11,979	
Air traffic control training facilities (Z122)	10,105	7,631	7,374	7,764	6,904	11,145	3,508	7,096	7,673	
Radar and navigational facilities (Z123)	22,295	27,364	18,738	20,439	46,966	16,188	10,390	10,626	7,012	
Airport runways (Z124)	91,779	80,277	96,986	81,474	55,878	67,388	84,119	67,250	150,484	
Airport terminals (Z125)	2,195	3,657	5,498	12,286	9,238	5,856	6,844	5,514	1,724	
Electronic and communications facilities (Z127)	47,006	47,415	38,722	58,548	28,539	19,661	14,514	23,929	16,832	
Other aerospace structures (Z129)	123,373	115,325	112,970	133,202	140,382	106,411	124,574	104,538	87,119	
Modification of equipment	843,615	706,077	595,753	778,038	613,229	623,804	559,546	415,615	513,144	
Aircraft and airframe structural components (K015)	694,644	562,088	403,366	567,074	406,863	368,632	354,536	211,311	254,539	
Aircraft components and accessories (K016)	118,469	130,618	187,464	200,504	205,180	255,209	204,847	204,350	258,605	
Aircraft launching, landing, and ground handling equipment (K017)	629	111	77	0	0	0	0	0	0	
Engines, turbines, and components (K028 Aircraft Only)	29,873	12,260	4,846	10,460	1,186	-37	163	-46	0	
Operation of government-owned air system facilities –	612,776	673,247	679,156	621,935	629,198	620,404	457,900	463,903	493,401	
Air traffic control towers (M121)	2,698	5,845	5,517	2,422	3,331	3,560	4,864	1,579	363	
Air traffic control training facilities (M122)	0	0	0	0	0	0	0	0	0	

Federal Aerospace Procurement and Personnel Expenditures (8/19/02)

		FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	COMMENTS
	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	
Radar and navigational facilities (M123)	154,442	125,375	167,709	137,915	126,022	129,184	133,323	163,309	173,625	
Airport runways (M124)	822	358	1,127	2,006	281	0	764	1,927	138	
Airport terminals (M125)	30,708	64,457	31,791	32,859	34,666	43,996	28,042	35,481	12,826	
Electronic and communications facilities (M127)	392,665	457,415	443,773	429,032	428,967	422,787	271,866	245,380	289,774	
Other aerospace structures (M129)	31,501	19,797	29,241	17,702	35,931	20,875	19,041	16,627	16,675	
Other quality control,testing, and inspection services	4,005	1,101	0	0	1,102	2,481	1,870	2,586	315	
Aircraft and airframe structural components (H915)	3,757	1,101	0	0	490	1,871	461	0	315	
Aircraft components and accessories (H916)	248	0	0	0	612	526	1,409	2,586	0	
Aircraft launching, landing, and ground handling equipment (H917)	0	0	0	0	0	84	0	0	0	
Engines, turbines, and components (H928 Aircraft Only)	0	0	0	0	0	0	0	0	0	
Purchase of air system facilities	223	100	83	0	0	0	0	0	109	
Air traffic control towers (E121)	0	0	0	0	0	0	0	0	0	
Air traffic control training facilities (E122)	0	100	0	0	0	0	0	0	0	
Radar and navigational facilities (E123)	0	0	0	0	0	0	0	0	0	
Airport runways (E124)	0	0	0	0	0	0	0	0	0	
Airport terminals (E125)	0	0	0	0	0	0	0	0	0	
Electronic and communications facilities (E127)	30	0	83	0	0	0	0	0	69	
Other aerospace structures (F129)	193	0	0	0	0	0	0	0	40	
Quality control services	0	0	191	52	0	0	1,837	1,620	1,876	
Aircraft and airframe structural components (H115)	0	0	0	0	0	0	209	0	0	
Aircraft components and accessories (H116)	0	0	191	52	0	0	0	0	94	
Aircraft launching, landing, and ground handling equipment (H117)	0	0	0	0	0	0	1,628	1,620	1,782	
Engines, turbines, and components (H128 Aircraft Only)	0	0	0	0	0	0	0	0	0	
Rocket maintenance, repair, and checkout specialized equipment (4927)	107	178	81	726	606	0	92	37	0	
Technical representation services	132,685	123,387	115,284	122,556	125,762	124,414	76,807	84,398	125,606	
Aircraft and airframe structural components (L015)	80,626	78,400	68,827	65,271	33,884	64,767	21,574	19,550	7,827	
Aircraft components and accessories (L016)	48,511	40,800	43,797	53,779	78,547	46,690	43,870	53,233	107,946	
Aircraft launching, landing, and ground handling equipment (L017)	3,548	4,187	2,660	3,506	13,331	12,957	13,363	11,615	9,833	
Engines, turbines, and components (L028 Aircraft Only)	0	0	0	0	0	0	0	0	0	
MISSILE SYSTEMS (including Ballistic Missiles)	7,426,739	5,767,743	5,071,118	4,514,413	4,062,356	4,930,011	4,684,612	4,959,099	3,713,593	
Missiles	5,790,291	4,660,048	4,472,581	3,854,942	3,473,401	4,180,078	3,527,112	3,634,406	2,826,889	
Guided missiles (excluding warheads and explosive components)	5,673,816	4,619,653	4,374,142	3,684,584	3,446,973	4,159,788	3,513,710	3,623,758	2,821,088	
Guided missiles (1410)	2,261,199	2,409,996	2,069,269	2,108,199	1,891,141	1,154,552	976,956	1,759,467	909,855	
Components (excluding propulsion units and components) (1420)	765,011	965,609	955,555	758,115	756,030	1,066,386	384,665	540,136	920,309	
Systems/complete (1425)	1,498,802	501,419	250,002	104,061	113,180	237,474	965,598	489,534	220,087	
Subsystems (1427)	422,417	142,440	309,328	243,115	311,778	723,053	791,614	584,260	608,968	
Remote control systems (1430)	304,401	166,743	106,004	89,058	88,609	43,109	96,002	70,075	66,962	
Launchers (1440)	421,985	433,446	683,924	381,436	286,145	915,214	298,875	180,296	94,907	
Guided missile warheads and explosive components (1336)	105,698	28,610	97,971	58,993	1,324	18,554	13,402	11,012	5,768	
Nuclear warheads and warhead sections (1115)	1,637	462	0	0	188	0	0	82	33	
Guided missile explosive propulsion units and components/solid fuel (1337)	0	0	0	30	0	0	0	0	0	
Guided missile inert propulsion units and components/solid fuel (1338)	9,141	11,323	468	111,335	24,891	1,736	0	446	0	
Nuclear rockets (including ballistic missiles) (1127)	0	0	0	0	25	0	0	0	0	
Infrastructure	1,636,448	1,107,695	598,537	659,471	588,955	749,933	1,157,500	1,324,693	886,704	
Construction of missile system facilities (Y126)	16,874	6,329	11,862	5,262	32,197	11,919	4,952	577	28,920	
Equipment and materials testing (H214)	9,518	43,351	8,448	2,739	162	53	-267	50	74	
Guided missile maintenance, repair, and checkout specialized equipment (4935)	40,141	75,658	40,677	28,844	10,764	11,648	7,377	4,994	6,814	
Inspection services (H314)	0	0	0	0	0	0	0	0	0	
Installation of equipment (N014)	0	0	0	0	0	86	0	0	0	
Lease or rental of missile system facilities (X126)	0	0	0	0	0	0	0	0	0	
Lease or rental of equipment (W014)	0	0	0	0	0	0	0	0	0	
Maintenance, repair, and rebuilding of equipment (J014)	221,513	193,858	178,854	180,533	158,583	95,905	42,838	29,777	125,977	
Maintenance, repair, or alteration of missile system facilities (Z126)	18,616	26,263	21,690	21,028	18,795	19,047	21,713	14,752	20,888	
Missile handling and servicing equipment (1450)	896,979	398,973	79,078	117,953	166,581	189,792	132,173	96,544	11,440	
Modification of equipment (K014)	61,564	57,125	6,570	72,473	8,224	1,783	408,937	38,943	1,537	
Operation of government owned missile system facilities (M126)	329	10,858	6,457	9,790	11,063	83,135	54,222	24,057	23,462	
Other quality control,testing, and inspection services (H914)	0	0	377	447	0	26	0	1,906	7,082	
Purchase of missile system facilities (E126)	0	0	0	29	0	0	0	0	0	
Quality control services (H114)	197,360	17,428	14,385	7,434	6,276	6,252	70	44	823	
Technical representation services (L014)	269,554	287,762	230,339	212,939	176,310	330,287	485,485	1,112,959	659,687	

Federal Aerospace Procurement and Personnel Expenditures (8/19/02)

		FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	COMMENTS
	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	Obligations (000's)	
SPACE SYSTEMS	3,207,982	3,184,764	3,024,625	3,823,579	2,123,776	2,264,885	1,888,153	1,776,434	1,741,634	
Space systems	2,024,033	1,926,562	1,869,228	2,014,130	1,931,212	2,003,750	1,643,306	1,550,019	1,324,471	
Space vehicles (including satellites)	1,745,993	1,640,600	1,503,765	1,519,560	1,385,635	1,423,476	1,237,197	1,063,898	1,289,233	
Space vehicles (1810)	834,066	894,203	570,226	753,075	829,227	798,373	694,180	486,141	505,376	
Space vehicle components (1820)	317,065	235,480	382,927	222,571	63,728	154,397	85,979	152,388	367,544	
Space vehicle remote control systems (1830)	46,513	8,027	2,513	57,593	32,601	55,285	11,222	24,996	6,734	
Space vehicle launchers (1840)	548,070	502,778	547,886	486,296	459,079	409,249	439,877	395,568	404,262	
Space survival equipment (1860)	279	112	154	25	400	6,192	5,939	4,805	5,317	
Space vehicle explosive propulsion units and components/solid fuel (1337)	7,595	18,405	7,709	34,476	35,645	31,892	10,770	9,703	7,495	
Space vehicle inert propulsion units and components/solid fuel (1338)	270,445	267,557	357,814	460,094	509,932	548,382	395,929	476,418	27,743	
Infrastructure	1,183,949	1,258,202	1,155,397	1,809,449	192,564	261,135	244,757	226,415	417,163	
Construction of space system facilities (Y___ Space Systems Only)	0	0	0	0	0	0	0	0	0	
Engines, turbines, and components (J028 Space Systems Only)	0	0	0	0	46	0	0	0	0	
Equipment and materials testing (H218) (H228 Space Systems Only)	13,003	12,636	59,836	26,511	22,012	25,091	16,611	24,279	20,175	
Freight transport – Space transportation and launch services (V126)	36,551	40,937	65,472	71,061	67,536	70,649	53,358	32,512	143,321	
Inspection services (H318) (H328 Space Systems Only)	0	0	0	0	0	0	0	49	8,979	
Installation of equipment (N018) (N028 Space Systems Only)	0	0	0	0	0	0	0	0	0	
Lease or rental of space system facilities (X___ Space Systems Only)	0	0	0	0	0	0	0	0	0	
Lease or rental of facilities (W018) (W028 Space Systems Only)	0	0	0	0	0	0	0	0	0	
Maintenance, repair, and rebuilding of equipment (J018)	970,840	1,040,792	864,531	1,579,927	-6,981	43,387	24,446	18,937	20,041	
Maintenance, repair, or alteration of space system facilities (Z___ Space Systems Only)	0	0	0	0	0	0	0	0	0	
Modification of equipment (K018) (K028 Space Systems Only)	1,715	8,293	2,153	3,082	4,022	0	0	11,000	91,866	
Other quality control,testing, and inspection services (H918) (H928 Space Systems Only)	38,270	30,406	31,077	45,299	47,655	48,090	54,371	55,260	44,966	
Purchase of space system facilities (E___ Space Systems Only)	0	0	0	0	0	0	0	0	0	
Quality control services (H118) (H128 Space Systems Only)	82,535	73,721	71,400	39,126	29,673	24,865	36,969	7,403	41,824	
Space vehicle handling and servicing equipment (1850)	418	0	4,821	1,885	1,717	787	679	1,364	3,562	
Space vehicle maintenance, repair, and checkout specialized equipment (4960)	256	290	823	290	479	21,023	31,948	47,194	44,027	
Technical representation services (L018) (L028 Space Systems Only)	46,361	50,127	58,284	42,278	26,391	27,243	26,375	28,417	498	
RESEARCH AND DEVELOPMENT (Conduct of Basic Research, Applied Research &Development)	15,305,714	18,189,050	16,673,776	15,163,755	11,674,723	13,188,662	10,813,683	8,282,561	8,267,695	Does NOT include R&D grants and In-House R&D activities.
Aeronautic and space technology (AR1_)	1,105,288	886,466	615,324	548,934	500,501	529,637	452,244	352,752	287,095	
Aerospace navigation and navigational aids (AT3_)	9,196	4,454	2,042	3,761	3,137	1,499	1,482	1,499	933	
Air transportation (AS1_)	3,121	4,267	12,549	16,246	33,646	14,683	3,813	1,219	427	
Aircraft (Defense) (AC1_)	5,251,154	6,081,766	6,873,178	5,227,075	3,773,776	4,824,900	4,077,450	3,060,837	3,209,946	
General science and technology R&D	169,369	189,467	175,041	164,690	146,646	162,947	156,415	126,075	126,091	
Physical sciences (AJ1_)	153,184	168,553	152,741	143,472	118,534	107,386	87,841	86,560	90,514	DOD/AF, NASA, and DOT/FAA ONLY
Mathematical and computer sciences (AJ2_)	3,146	4,039	6,558	3,882	4,848	32,569	39,430	5,729	7,297	DOD/AF, NASA, and DOT/FAA ONLY
Environmental sciences (AJ3_)	473	799	2,450	5,877	6,134	3,989	9,445	21,340	20,731	DOD/AF, NASA, and DOT/FAA ONLY
Engineering (AJ4_)	12,069	11,277	9,563	7,225	10,015	12,341	14,304	8,375	5,450	DOD/AF, NASA, and DOT/FAA ONLY
Life sciences (AJ5_)	148	500	1,246	731	836	1,496	821	312	480	DOD/AF, NASA, and DOT/FAA ONLY
Psychological sciences (AJ6_)	0	0	0	0	0	0	0	27	46	DOD/AF, NASA, and DOT/FAA ONLY
Social sciences (AJ7_)	0	0	0	0	0	0	0	0	0	DOD/AF, NASA, and DOT/FAA ONLY
Other (AJ9_)	347	3,699	2,483	3,503	6,279	5,166	4,574	3,732	1,573	DOD/AF, NASA, and DOT/FAA ONLY
Missiles and space systems (Defense) (AC2_)	4,213,621	6,299,412	4,806,067	4,876,084	3,504,109	3,561,989	2,942,326	1,875,554	1,808,743	
Space flight (AR2_)	2,068,028	2,083,195	784,114	671,540	607,802	1,191,565	793,863	504,116	606,072	
Space operations (tracking and data acquisition) (AR4_)	316,855	249,383	226,771	157,195	91,340	87,974	98,495	101,964	87,154	
Space science and applications (AR3_)	920,180	750,728	1,021,436	1,020,189	544,084	564,372	377,052	292,051	607,516	
Space and terrestrial (AR5)	0	0	0	0	0	0	416	0	9,832	
Space Station (AR6)	555,297	1,123,634	1,406,847	1,563,411	1,606,816	1,420,378	1,162,789	1,236,741	759,422	
Commercial space programs (AR7)	19,309	15,205	33,853	15,390	12,524	7,439	16,587	15,802	8,742	
Other space R&D (AR9)	674,296	891,073	714,564	907,229	850,342	801,279	730,751	713,951	655,722	
PERSONNEL	23,725,985	22,801,947	25,064,000	25,576,000	25,761,000	25,970,000	26,591,000	27,564,000	29,724,000	Includes costs of In-House R&D personnel.
DOD/Air Force (All Non-Reserve)	18,559,634	17,538,972	20,746,000	20,302,000	20,318,000	20,313,000	20,551,000	21,116,000	22,409,000	Includes benefits
DOD/Air Force (Military/Non-reserve) (11.7, 12.2)	14,828,786	13,669,200	16,713,000	16,420,000	16,293,000	16,104,000	16,277,000	16,786,000	17,415,000	Includes benefits
DOD/Air Force (Civilian O&M) (11.9, 12.1)	3,306,884	3,531,772	3,578,000	3,534,000	3,622,000	3,708,000	3,879,000	4,003,000	4,601,000	Includes benefits
DOD/Air Force (Civilian RDTE) (11.9, 12.1)	424,004	419,000	455,000	348,000	403,000	501,000	395,000	327,000	393,000	Includes benefits
DOT/FAA	3,625,810	3,683,407	3,677,000	3,763,000	3,923,000	4,138,000	4,502,000	4,824,000	5,488,000	Includes benefits
DOT/FAA Operations (11.9, 12.1)	3,430,107	3,479,183	3,465,000	3,538,000	3,695,000	3,911,000	4,239,000	4,541,000	5,174,000	Includes benefits
DOT/FAA Facilities and Equipment (11.9, 12.1)	149,920	157,209	168,000	176,000	177,000	174,000	232,000	244,000	274,000	Includes benefits
DOT/FAA Research, Engineering, and Development (11.9, 12.1)	45,783	47,010	44,000	49,000	51,000	53,000	31,000	39,000	40,000	Includes benefits
NASA (11.9, 12.1)	1,540,541	1,579,568	1,541,000	1,511,000	1,520,000	1,519,000	1,538,000	1,618,000	1,827,000	Includes benefits

Federal Aerospace Procurement Spending by Agency (6/10/02)
Table 2

Agency Name	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000
DOD	45,572,025,000	48,263,958,000	40,408,716,000	44,865,174,000	32,339,107,000	37,174,234,000	32,930,021,000	28,863,318,000
NASA	8,306,292,000	8,572,857,000	7,342,178,000	8,199,925,000	5,246,091,000	5,149,294,000	4,950,582,000	4,594,896,000
DOT	258,350,000	349,563,000	387,663,000	193,860,000	226,865,000	310,065,000	152,792,000	125,649,000
GSA	90,896,000	86,101,000	120,311,000	104,445,000	33,047,000	37,648,000	45,404,000	157,550,000
STATE	31,025,000	22,187,000	33,775,000	152,715,000	23,938,000	22,456,000	47,447,000	93,297,000
TREA	99,006,000	69,416,000	84,563,000	76,627,000	69,107,000	56,233,000	60,584,000	76,516,000
DOJ	27,701,000	43,986,000	34,872,000	27,184,000	104,880,000	44,965,000	44,459,000	86,578,000
DOI	56,907,000	64,958,000	30,106,000	75,661,000	50,796,000	54,992,000	56,120,000	69,116,000
DOE	9,216,000	10,384,000	18,917,000	30,065,000	16,690,000	46,858,000	44,016,000	43,630,000
USDA	17,253,000	21,247,000	27,781,000	30,318,000	21,478,000	20,210,000	18,048,000	27,726,000
DOC	17,534,000	17,846,000	52,930,000	15,945,000	24,648,000	14,539,000	14,191,000	7,465,000
HHS	17,051,000	8,658,000	42,938,000	17,007,000	7,371,000	8,579,000	10,651,000	13,026,000
TVA	1,874,000	3,853,000	13,500,000	4,447,000	2,818,000	4,343,000	2,730,000	3,866,000
DVA	2,086,000	1,695,000	3,475,000	3,615,000	1,070,000	1,431,000	826,000	3,617,000

Appendix E

U.S. Aerospace and Aviation Industry: A State-by-State Analysis

Prepared by: Content First

Full report available at: www.ita.doc.gov/aerospace/aerospacecommission


U.S. Aerospace and Aviation Industry:
A State-by-State Analysis
Commission on the Future of the United States Aerospace Industry
October 2002

The Economic Impact of the U.S. Aerospace and Aviation Industry

The Commission on the Future of the United States Aerospace Industry commissioned a study to examine the economic impact of the aerospace and aviation industry at the national, state, and local level. This report provides comprehensive and objective statistics on the U.S. aerospace and aviation industry.

The U.S. Aerospace and Aviation Industry: A State-by-State Analysis, shows the economic importance of the aerospace and aviation industry on the U.S. economy using such key indicators as employment and wages. The first section of this report also includes an analysis of what the aerospace and aviation industry means for all 50 states, the District of Columbia, and Puerto Rico.

The second section of the report, gives objective, comparative economic data for the top ten aerospace and aviation metropolitan areas in the United States. These top aerospace and aviation metropolitan areas include Atlanta, Boston, Los Angeles, and Seattle.

Key U.S. Aerospace and Aviation Industry Findings

More than 2 million workers are directly employed by the nation's civilian and commercial aerospace and aviation industry, based on the U.S. government data analyzed in the report, *The U.S. Aerospace and Aviation Industry: A State-by-State Analysis*. These employees earned an average wage of $47,700 annually, or 35 percent more than the U.S. average.

Other key U.S. findings contained in the report include:

- U.S. aerospace and aviation industry employment jumped by 7 percent between 1996 and 2001, with the addition of 138,200 jobs.
- Most of the job gains since 1996 were concentrated in the air transportation industry.
- Overall employment declined in such key aerospace segments as guided missiles and space manufacturing and space research and technology between 1996 and 2001.
- Employment in the nation's aircraft and parts manufacturing industry was nearly unchanged from 1996.

Key State Aerospace and Aviation Industry Findings

The Commission also wanted to understand the economic impact of the aerospace and aviation industry on the nation's state economies. The report covers the aerospace and aviation industry in every state, the District of Columbia, and Puerto Rico.

The major state findings showed:

- California, with nearly 300,000 employees, was the nation's aerospace and aviation industry leader.
- Texas and Washington ranked near the top by most of the metrics examined.
- Texas ranked first nationwide in aerospace and aviation job creation between 1996 and 2001, adding 15,600 jobs to its economic base.
- When controlling for population size, Washington led the nation with 44 aerospace and aviation industry jobs per 1,000 workers in 2001, when controlling for population size.

Also, the state-by-state economic metrics demonstrated that states like Alabama, Arizona, and Kansas are home to strong aerospace and aviation industry clusters.

Key Metropolitan Aerospace and Aviation Industry Findings

The second section of the report examined the ten leading metropolitan areas by aerospace industry employment, wages, payroll, and establishments. The ten metropolitan areas examined in the study were Atlanta, Boston, Chicago, Dallas, Fort Worth, Los Angeles, New York, Phoenix, Seattle, and Wichita.

The major metropolitan area findings revealed:

- Los Angeles was the nation's leading metropolitan area with 137,100 workers employed by the aerospace and aviation industry.
- Other leading metropolitan areas by aerospace and aviation industry employment were Seattle, Chicago, Atlanta, and Fort Worth.
- The highest concentration of aerospace and aviation industry jobs was in the Wichita metro area, accounting for one out of every five jobs in 2001.
- Seattle ranked second with one out of every 10 jobs in the aerospace and aviation industry in 2001.

Appendix F

Federal Departments and Agencies with Aerospace Responsibilities

Agencies of the Executive Office of the President

- Central Intelligence Agency (e.g., communications, intelligence)
- Council of Economic Advisors
- Council on Environmental Quality
- Domestic Policy Council
- National Economic Council
- National Security Council
- Office of Management and Budget
- Office of Science and Technology Policy
  - National Science & Technology Council
  - President's Advisory Council on Science & Technology
- Office of the U.S. Trade Representative

Executive Departments

- Department of Agriculture (e.g., remote sensing for agricultural, rangeland and forestry resources; precision farming using GPS; positive train control for expedited shipment of crops to market)
- Department of Commerce (e.g., weather services, trade promotion, telecommunication and information administration)
  - National Oceanic and Atmospheric Administration
- Department of Defense (e.g., space support, force enhancement, space control, force applications)
  - Office of the Secretary
    - Defense Advanced Research Projects Agency
    - Missile Defense Agency
    - National Reconnaissance Office
    - National Security Agency
  - Joint Chiefs of Staff
    - U.S. Strategic Command
  - U.S. Air Force
  - U.S. Army
  - U.S. Marine Corps
  - U.S. Navy
- Department of Education (e.g., distance learning, individualized instruction)
- Department of Energy (e.g., non-proliferation, nuclear energy, energy and material sciences, space radiation effects on human and materials)
- Health and Human Services (e.g., distance medicine, research on new medicines and drugs)
- Housing and Urban Development (e.g., regional and urban planning)
- Department of Interior (e.g., geodetics, fish and wildlife preservation, mining reclamation and enforcement, national park surveys)
  - U.S. Geological Survey

- Department of Justice (e.g., law enforcement, immigration, border patrol)
- Department of Labor (e.g., aerospace apprenticeship programs)
- Department of State (e.g., international treaty and standards development, transportation of foreign service professionals and dignitaries)
- Department of Transportation (e.g., civil air navigation, commercial space transportation, ground and sea transportation applications, law enforcement)
  – Federal Aviation Administration
  – Federal Highway Administration (e.g., intelligent transportation system)
  – Federal Motor Carrier Safety Administration (e.g., truck safety)
  – Federal Railroad Administration (e.g., positive train control)
  – Federal Transit Administration (e.g., intelligent transportation system)
  – Maritime Administration (e.g., maritime commerce)
  – National Highway Traffic Safety Administration (e.g., automobile safety)
  – Research and Special Programs Administration (e.g. pipelines and hazardous material safety)
  – Transportation Security Administration (e.g., security, law enforcement)
  – U.S. Coast Guard (e.g., search and rescue, law enforcement)
- Department of Treasury (e.g., customs, secret service)
- Department of Veteran Affairs (e.g., telecommunication)

Independent Agencies

- Environmental Protection Agency (e.g., environmental monitoring for developing regulations and for enforcement)
- Federal Emergency Management Agency (e.g., emergency response)
- General Services Administration (e.g., government aircraft services)
- NASA (e.g., space science, space transportation, aeronautics research and development)
- National Science Foundation (e.g., aerospace-related research)
- Tennessee Valley Authority (e.g., flood control, river way management, environmental research, forestry and wildlife management)

Appendix G

Congressional Committees with Aerospace Responsibilities

Full Committees of the Senate

Appropriations

Armed Services

- Aeronautical and space activities peculiar to development of weapon systems or military operations
- Departments of the Army, Navy, Air Force
- Military Research and Development

Banking, Housing, and Urban Affairs

- Economic stabilization and defense production
- Export and Foreign Trade
- Export Controls
- Financial aid to commerce and industry
- Renegotiation of government contracts

Budget

Commerce, Science and Transportation

- Interstate commerce
- Non-military aeronautical and space sciences
- Oceans, weather and atmospheric activities
- Regulation of interstate common carriers, including civil aviation
- Science, Engineering, Technology research, development, and policy
- Transportation

Energy and Natural Resources

- Energy research and development
- Nuclear energy
- Solar energy

Environment and Public Works

- Air pollution
- Noise pollution
- Regional Economic Development

Finance

- Customs and ports of entry
- Reciprocal trade agreements
- Tariffs and import quotas
- Transportation of dutiable goods

Foreign Relations

- Measures to foster commercial intercourse with foreign nations and to safeguard American business interests abroad

Governmental Affairs

- Census and collection of statistics, including economic statistics
- Intergovernmental relations
- Organization of the Executive Branch
- Government efficiency, economy, effectiveness
- Relationships between the US, states, and municipalities

Health, Education and Labor

- Measures relating to education and labor
- Labor standards and statistics
- Labor disputes
- Pension plans
- Student loans

Judiciary

- Patents, trademarks and copyrights
- Protection of trade and commerce against unlawful restraint and monopolies

Small Business and Entrepreneurship

Select Committees of the Senate

Intelligence

Full Committees of the House of Representatives

Appropriations

Armed Services

- Army, Navy, Air Force generally
- Intelligence related activities of DoD
- Scientific research and development pertaining to the military

Budget

Energy and Commerce

- Interstate and foreign commerce
- Energy generally
- Travel and tourism

Education and the Workforce

- Labor
- Education
- Mediation of disputes

Financial Services

- Economic stabilization and defense production
- Financial aid to commerce and industry [other than transportation]

Government Reform

- Government management and accounting generally
- Economy and efficiency of government
- Transportation of mail
- Public information and records
- Organization of the Executive Branch

International Relations

- Export controls and trading with the enemy
- Commercial intercourse abroad and safeguarding American business interests abroad
- International economic policy

Judiciary

- Patents, trademarks and copyrights
- Protection of trade and commerce against unlawful restraints and monopolies

Science

- Energy research
- Astronautical research and development, including resources, personnel, equipment, and facilities; Outer space exploration and control
- Civil aviation research and development
- Environmental research and development
- NASA
- National Space Council
- National Science Foundation
- National Weather Service
- Science scholarships
- Scientific research and development, demonstrations and projects

Small Business

Transportation and Infrastructure

- Public works in support of navigation
- Transportation, including civil aviation, safety and infrastructure
- Transportation regulatory agencies

Ways and Means

- Customs and ports of entry
- Reciprocal trade agreements
- Transportation of dutiable goods

Appendix H

Acronyms

ATA	Air Transport Association
AIR-21	Aviation Investment and Reform Act for the 21st Century
ADS-B	Automatic Dependent Surveillance-Broadcast
AFB	Air Force Base
ASCM	Agreement on Subsidies and Countervailing Measures
ATC	Air Traffic Control
ATM	Air Traffic Management
ATOS	Air Transportation Oversight System
CBO	Congressional Budget Office
CCAFS	Cape Canaveral Air Force Station
CIS	Commonwealth of Independent States
CNS	Communications, Navigation and Surveillance
COCOM	Coordinating Committee of NATO
CPFF	Cost Plus Fixed Fee
CRV	Current Replacement Value
DARPA	Defense Advanced Research Projects Agency
dB	Decibel
DELG	Defense Export Loan Guarantee
DISC	Domestic International Sales Corporation
DNL	Day-Night Level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DSB	Defense Science Board
DSR	Display System Replacement
DWCF	Defense Working Capital Fund
EADS	European Aeronautic Defense and Space Company
EC	European Commission
ECA	Export Credit Agency
EELV	Evolved Expendable Launch Vehicle
ELV	Expendable Launch Vehicle
EPA	Environmental Protection Agency
ETI	Extra Territorial Income
EU	European Union
Ex-Im Bank	Export-Import Bank
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
	Federal Accounting Regulations
	Federal Acquisition Regulations
FMS	Foreign Military Sales
FP	Framework Program
FSC	Foreign Sales Corporation
FTM	Freight and Express Ton Miles
FY	Fiscal Year
FYDP	Future Year Defense Program
GAO	Government Accounting Office
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GPRA	Government Performance and Results Act
GPS	Global Positioning System
GSA	General Services Administration
HPCC	High Performance Computing and Communications
IAM	International Association of Machinists
ICAO	International Civil Aviation Organization
ICGS	International Coast Guard System
INAS	International Airspace System
IR&D	Independent Research and Development
IRS	Internal Revenue Service
ISS	International Space Station
ISSA	Inter-Service Support Agreement
ITAR	International Traffic in Arms Regulations
JSF	Joint Strike Fighter

JTIDS	Joint Tactical Information Distribution System
K-12	Kindergarten through Twelfth Grade
KSC	Kennedy Space Center
LCA	Large Civil Aircraft
LEO	Low Earth Orbit
LOI	Letter of Intent
MEO	Medium Earth Orbit
NAI	National Aerospace Initiative
NATO	North Atlantic Treaty Organization
NASA	National Aeronautics and Space Administration
NEO	Near-Earth Object
NFTC	National Foreign Trade Council
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxide
NSC	National Security Council
NSF	National Science Foundation
O&S	Operations and Support
OECD	Organization for Economic Cooperation and Development
OEP	Operational Evolution Plan
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
PCC	Policy Coordinating Counsel
PFC	Passenger Facility Charge
P.L.	Public Law
POC	Percent of Completion
PPBS	Planning, Programming and Budgeting System
QRE	Qualified Research Expenditure
R&D	Research and Development
R&D	Research and Experimentation
RDT&E	Research, Development, Test and Evaluation
RLV	Reusable Launch Vehicle
RNP	Required Navigation Performance
RPM	Revenue Passenger Miles
S&T	Science and Technology
SLI	Space Launch Initiative
SSAs	Special Security Agreements
S&P	Standard and Poors
STARS	Standard Terminal Automation Replacement System
UK	United Kingdom
UN	United Nations
U.S.	United States
USAF	U.S. Air Force
USC	U.S. Code
USML	U.S. Munitions List
VAATE	Versatile, Affordable, Advanced Turbine Engine Program
VAT	Value-Added Tax
WTO	World Trade Organization

Airport Acronyms

ATL	Hartsfield Atlanta International Airport
BWI	Baltimore-Washington International Airport
CLT	Charlotte/Douglas International Airport
DEN	Denver International Airport
DFW	Dallas-Ft. Worth International Airport
DTW	Detroit Metropolitan Wayne County Airport
EWR	Newark International Airport
IAD	Washington Dulles International Airport
JFK	New York John F. Kennedy International Airport
LAS	Las Vegas McCarran International Airport
LAX	Los Angeles International Airport

LGA	New York LaGuardia Airport
MEM	Memphis International Airport
MSP	Minneapolis-St. Paul International Airport
ORD	Chicago O'Hare International Airport
PHL	Philadelphia International Airport
PHX	Phoenix Sky Harbor International Airport
PIT	Greater Pittsburgh International Airport
SEA	Seattle-Tacoma International Airport
SFO	San Francisco International Airport
SLC	Salt lake City International Airport
STL	Lambert St. Louis International Airport

Appendix I

Summary of Commission Activities and Contacts

During the period from September 2001 through November 2002, the Commission: held six (6) public hearings and nine (9) administrative/preparatory meetings; conducted fact-finding trips to the Kennedy Space Center and Cape Canaveral Air Force Station, various U.S. aerospace companies, Europe, and Asia; received informational briefings and issue papers from over 100 companies, government organizations, and aerospace interest groups; heard testimony from over 60 witnesses; met with over 50 government and industry organizations from seven (7) foreign countries; briefed over 45 groups on Commission activities and progress; and had over 150,000 "hits" on the Commission's website. Based on the extensive inputs received from these activities and contacts, the Commission issued three (3) Interim Reports and its Final Report to the President and the Congress. A listing of these contacts is provided, by category, below:

I. INFORMATIONAL BRIEFINGS/DISCUSSIONS/MEETINGS IN THE U.S.

A. U.S. Aerospace Industry and Financial Organizations

Aerospace Corporation
Analytical Graphics International
The Boeing Company
Cessna
Credit Suisse First Boston
Eclipse Aviation
General Electric Company
Honeywell
Kistler Aerospace Corporation
Lockheed Martin Corporation
Microcosm
Morgan Stanley
Northrop Grumman
Orbital Science Corporation
Raytheon
Rolls-Royce North America
Spectrum Astro
The Teal Group
TRW
Vought
United Technologies Corporation

B. Federal and State Government Organizations

California Space Authority
Central Intelligence Agency (CIA)
Department of Commerce (DOC)
Department of Defense (DoD)
– Acquisition Reform
– Ballistic Missile Defense Organization (BMDO)
– Defense Advanced Research Projects Agency (DARPA)
– Defense Intelligence Agency (DIA)
– Defense Science Board (DSB)
– Defense Technology Security Agency (DTSA)
– Director, Defense Research and Engineering (DDR&E)
– Industrial Affairs
– Joint Aeronautical Commanders Group (JACG)
– Joint Strike Fighter (JSF) Program Office
– National Reconnaissance Office (NRO)

- National Security Space Architect (NSSA)
- Office of Net Assessment
- Operational Test and Evaluation (OT&E)
- U.S. Army
- U.S. Navy
- U.S. Air Force

Department of State (DOS)
Federal Aviation Administration (FAA)
National Aeronautics and Space Administration (NASA)
National Oceanic and Atmospheric Administration (NOAA)
National Research Council (NRC) Aerospace Roundtable
Office of Management and Budget (OMB) (the White House)
Spaceport Florida Authority
Texas Aerospace Commission
U.S. Congress

- House of Representatives Members/Staffs
- Senate Members/Staffs

C. Foreign Governments And Industry
Airbus Industries
Arianespace
CNES (French Space Agency)
European Aerospace Defense Systems (EADS)
European Commission
French Embassy
International Civil Aviation Organization (ICAO)
NAV Canada
UK Ministry of Defence

D. Labor And Industry Organizations
Aerospace Industries Association (AIA)
Advisory Group on Electronic Devices (AGED)
Aircraft Electronics Association
Aircraft Owners and Pilots Association (AOPA)
Air Transportation Association (ATA)
General Aviation Manufacturers Association (GAMA)
International Association of Machinists and Aerospace Workers (IAM&AW)
National Air Transportation Association (NATA)
National Business Aircraft Association (NBAA)

National Center for Advanced Technologies (NCAT)
National Defense Industry Association (NDIA)
National Science Teachers Association (NSTA)
Radio Technical Commission for Aeronautics, Inc. (RTCA)
Space Transportation Association (STA)
Space Foundation

E. Academia
George Mason University
Industrial College of the Armed Forces (IDAF)/National Defense University (NDU)
Massachusetts Institute of Technology (MIT)

F. The Media
Aviation Week
Defense News
Space News

G. Professional Societies
American Helicopter Society (AHS)
American Institute of Aeronautics and Astronautics (AIAA)
American Society of Mechanical Engineers (ASME)
Society of Automotive Engineers (SAE)

H. Others
Booz-Allen & Hamilton
Centennial of Flight Commission
Content First
Center for Strategic & International Studies (CSIS)
Institute for Creative Technologies
Institute for Defense Analyses (IDA)
Jet Propulsion Laboratory (JPL)
JSA Associates
Lunar Exploration, Inc
NASA Aero Support Team
Eric Newsom
Jim Oberg
Rand Corporation
Science Applications International Corporation (SAIC)

Synthesis Partners
Team Vision Corporation
Will Trafton
CEF Mission Aerospace

II. INTERNATIONAL BRIEFINGS/DISCUSSIONS/MEETINGS ABROAD

A Belgium
European Commission
Euro-Control
Foreign NATO Representatives
U.S. Ambassador to NATO

B. China
American Chamber of Commerce Aerospace Forum
Aviation Industry Corporation I
Aviation Industry Corporation II
Civil Aviation Administration of China
China National Aero-Technology Import and Export Corporation
Commission on Science and Technology for National Defense
U.S. Embassy

C. France
Arianespace
Centre National d'Etudes Spatiales (CNES)
European Aerospace Defense Systems (EADS)
European Space Agency (ESA)
French Transport Minister
Groupement Des Industries Francaises Aeronautiques et Spatiales (GIFAS)
U.S. Embassy

D. Japan
American Chamber of Commerce in Japan
Council for Science and Technology Policy
Japanese Association of Defense Industries
Japanese Defense Agency
Ministry of Economy, Trade and Industry
Ministry of Education, Culture, Sports, Science and Technology
Ministry of Land, Infrastructure and Transport

Ministry of Public Management, Home Affairs, Posts and Telecommunications
Space Activities Commission
Society of Japanese Aerospace Companies
Technical Research & Development Institute
U.S. Embassy

E. Russia
American Chamber of Commerce in Russia
Aviation and Space Agency (Rosaviakosmos)
Boeing Engineering Design Center
Khrunichev Research and Production Center
National Investment Council (NIC)
Star City Astronaut Training Center
U.S. Embassy

F. United Kingdom
BAE Systems
Civil Aviation Authority
Defense Procurement Agency
Department of Transport
The Economist Technology/Defense Writers
European Association of Aerospace Industries
Foreign Office (Aviation Section)
National Air Traffic Services (NATS)
Treasury Office (Defense, Diplomacy and Intelligence)
U.S. Embassy

III. PUBLIC TESTIMONY

A. Public Hearing November 27, 2001

1. Administration Testimony
Dr. John H. Marburger, III, Director, OSTP, Executive Office of the President
2. Congressional Testimony
The Honorable Dave Weldon (R-FL)
3. Executive Branch Testimony
Joseph Bogosian, Deputy Assistant Secretary (Transportation and Machinery), Commerce Department
Ralph Braibanti, Director, Office of Space and Advanced Technology, State Department

The Honorable Edward C. "Pete" Aldridge, Jr., Under Secretary of Defense (Acquisition Technology & Logistics), Department of Defense

Samuel L. Venneri, Associate Administrator, Office of Aerospace Technology, NASA

Steven Zaidman, Associate Administrator for Research and Acquisitions, FAA

B. Public Hearing February 12, 2002

1. Air Transportation Capacity/Infrastructure Discussions

Mr. Charles Keegan, Operational Evolution Plan Program Manager, FAA

Mr. Charles Barclay, Executive Director, American Association of Airport Executives

Dr. Linton Wells, Principal Deputy to the Assistant Secretary of Defense (Command, Control, Communications and Intelligence)

Mr. Vern Raburn, President, Eclipse Aviation

Mr. John Hayhurst, President, Boeing ATM

2. Export Control Discussions

Government

Matthew Borman, Deputy Assistant Secretary (Export Administration), Commerce Department

Gregory Suchan, Principal Deputy Assistant Secretary (Political-Military Affairs), State Department

Lisa Bronson, Deputy Under Secretary (Defense for Technology Security Policy and Counter Proliferation), DoD

Industry

LGEN (ret.) Larry Farrell, President & CEO, NDIA

Hon. David McCurdy, President, Electronic Industries Alliance

Robert Bauerlein, Chairman, International Council, AIA

C. Public Hearing May 14, 2002

1. Space Discussions

The Hon. Sean O'Keefe (NASA)

The Hon. Peter Teets (Under Secretary of the Air Force-NRO)

GEN Ed Eberhart, USAF, CINCSPACECOM

The Hon. Ron Sega (DoD/DDR&E)

GEN (ret.) Tom Moorman, Space Industrial Base

The Hon. Bill Nelson (D-FL)

2. Space Vision for 2050

Mr. W. David Thompson, President & CEO, Spectrum Astro

Dr. Wesley Huntress, Director, Geophysical Laboratory, Carnegie Institute of Washington

The Hon. Tidal McCoy, Chairman of the Board, Space Transportation Association

Mr. Martin P. Kress, Chair, Public Policy Committee, AIAA

Ms. Lori Garver, President, American Astronautical Society

Dr. John Lewis, Professor of Planetary Science, University of Arizona

3. Industrial Base Discussions

   The Hon. Norm Dicks (D-WA)

   Jeff Foote, President, ATK Aerospace

   Dain Hancock, President, Lockheed Martin Aerospace Co

   Jerry Daniels, President & CEO, Military Aircraft & Missile Systems, Boeing

4. 21st Century Aerospace Workforce Discussions

   Labor Panel

   Dr. Jeff Faux, Economic Policy Institute

   Dr. Tom Kochan, MIT/Sloan School of Management

   Government Panel

   Dr. John Bailey, Director of Education Technology, Department of Education

   Emily DeRocco, Assistant Secretary for Employment and Training Administration, Department of Labor

   GEN (ret.) Sam Armstrong, NASA

   Educators Panel

   Dr. Bernard Grossman, Exec. Dir., Aerospace Department Chairman's Association

   Dr. Albert Koller, Exec. Dir., Aerospace Programs at Brevard Community College

   Dr. Abe Nisanci, Program Director for Engineering, Division of Undergraduate Education, National Science Foundation

   Student Panel

   Ms. Sandra Goins, Apprentice, Seattle, WA

   Mr. Denny Reyes, Aviation High School, New York

   Ms. Annalisa Weigel (Ph.D. Candidate, Aerospace Engineering), MIT

D. Public Hearing August 22, 2002

   1. Aviation (Airlines, Pilots, Controllers) Discussions

      Duane Woerth, President, Airline Pilots Association

      John Olcott, President, National Business Aircraft Association

      John Carr, President, National Air Traffic Controllers

      Mac Armstrong, Executive VP, Air Transportation Assoc. of America

   2. Aeronautics and Space Engineering Board (National Academy of Science)

      GEN (ret.) Ronald R. Fogleman, Chairman, Committee on Aeronautics Research and Technology

   3. Suppliers Discussions

      Ms. Judy Northup, Vice President, Vought Aircraft Industries

      Mr. Mike Grosso, CEO, DynaBil Industries

      Mr. Joe Murphy, Chairman of the Board, Ferco Tech Corporation

Mr. Peter Rettaliata, President, Air Industries Machining Corp.

4. Space/Planetary Discussions

   Thomas F. Rogers, Chairman, The Sophron Foundation

   BGEN Simon "Pete" Worden, Deputy Director of Operations, US Space Command

5. RDT&E Infrastructure Discussions

   David Swain, Senior VP of Engineering and Chief Technology Officer, Boeing

   Philip Coyle, former Director, Operational Test & Evaluation, DoD

   James Beggs, former NASA Administrator

   Thomas Christie, Director, Operational Test & Evaluation, DoD

   General Lester L. Lyles, Commander, Air Force Materiel Command

IV. BRIEFINGS BY COMMISSIONERS AND STAFF

A. Federal/State Government

Air Force Aeronautical Systems Center Corporate Board

AST Forecast Conference

DOC Aerospace Industry Sector Advisory Committee

FAA Commercial Space Transportation Conference

National Academies Space Studies Board

National Academies Air and Space Engineering Board

National Security Council

NAASC Air Surveillance Data Sharing Working Group

NASA Administrator Sean O'Keefe

NASA Project Management Shared Experience Program

NRO/AIAA Forum

Ohio Aerospace and Defense Advisory Council

PEO/Systems Command Commanders' Conference

Small Payload Rideshare Conference

Transportation Research Board/FAA Forecasting Workshop

Tri-Service Turbine Engine Technology Symposium

U.S. Space Command

U.S. Congress (Members and Staff)

Vice President Richard Cheney

White House Office of Science & Technology Policy (Dr. Marburger)

White House Staff

B. Labor/Industry Organizations

AIA Annual Fall Conference (Commission Panel)

AIA Compensation Practices Committee

AIA Communications Council
AIA Space Council
AIA Annual Spring Conference (Commission Panel)
IAM&AW
Space Foundation (Commission Panel)

C. Professional Groups/Societies
AHS Chapter Meeting
AIAA Aerospace Sciences Meeting Fast-Track Tutorial
AIAA Congressional Visits Day
AIAA Global Air & Space 2002 Symposium
AIAA Speakers Day
Air Traffic Controllers Association Conference
ASME International Workshop
ASME Inter-Council Committee on Federal R&D
California Space Authority
International Space University 7th Annual Symposium
International Space Group
Maryland Space Business Roundtable
National Space Club – Florida Chapter
National Space Society Governors Meeting
Small Launch Vehicle Consortium
Society of Satellite Professionals International Meeting
Space Foundation Symposia
Space Transportation Association
U.S. Chamber Workshop (Market Opportunities in Space: The Near-Term Roadmap)
U.S. Chamber Space Enterprise Council
Washington Space Business Roundtable
Western Ohio Senior Executives Association
Women and Aerospace Symposium

D. U.S. Industry
Aerospace Corporation
SAIC Managers Meeting
Schafer Corporation Innovations in Space Symposium

E. The Media

Atlantic Monthly

Aviation News Today (TV Show)Business Week

Flight Daily International

IEEE USA Policy Perspectives

McGraw-Hill Editorial Board

Newsweek

Popular Science

St. Louis Post-Dispatch

USA Today

Washington Post

F. Academia

MIT

Appendix J

Aerospace-related Websites—Partial List

Academia

Website Addresses

U.S. Colleges & Universities

Arizona State University – College of Engineering & Applied Science	http://www.eas.asu.edu
Auburn University – Department of Aerospace Engineering	http://www.eng.auburn.edu/aero
Brown University – Center for Fluid Mechanics, Turbulence and Computation	http://www.cfm.brown.edu/
California Institute of Technology	http://www.caltech.edu
California Institute of Technology – Graduate Aeronautical Laboratories	http://www.galcit.caltech.edu
California State Polytechnic University, Pomona – Aerospace Engineering	http://www.aro.csupomona.edu
Case Western Reserve University – Department of Mechanical & Aerospace Engineering	http://mae1.cwru.edu/mae/
Columbia University – School of Engineering and Applied Sciences	http://www.columbia.edu/cu/mechanical
Cornell University – Sibley School of Mechanical & Aerospace Engineering	http://www.mae.cornell.edu
Embry-Riddle (Arizona)	http://www.pr.erau.edu/
Embry-Riddle (Florida)	http://www.db.erau.edu
Florida Institute of Technology – Division of Engineering Sciences	http://www.fit.edu/AcadRes/engsci/
George Mason University	http://www.gmu.edu
Georgia Institute of Technology – School of Aerospace Engineering	http://www.ae.gatech.edu
Harvard University – Division of Engineering & Applied Sciences	http://www.deas.harvard.edu
Iowa State University – Department of Aerospace Engineering and Engineering Mechanics	http://www.aeem.iastate.edu
John Hopkins University – School of Engineering	http://www.wse.jhu.edu
Lansing Community College – Aviation Center	http://alpha.lansing.cc.mi.us/~whitehead/avmaint.html
Louisiana Tech – Department of Professional Aviation	http://www.aviation.latech.edu/
Massachusetts Institute of Technology – Department of Aeronautics and Astronautics	http://web.mit.edu/aeroastro/www/
Massachusetts Institute of Technology – School of Engineering	http://web.mit.edu/engineering/
Mississippi State University – Engineering Research Center	http://www.erc.msstate.edu
North Carolina State University – Mechanical & Aerospace Engineering	http://www.mae.ncsu.edu

Ohio State University – Department of Aerospace Engineering & Aviation	**http://www.aerospace.ohio-state.edu/**
Old Dominion University – College of Engineering & Technology	**http://www.odu.edu**
Penn State University – Aerospace Engineering	**http://www.aero.psu.edu**
Polytechnic University – Department of Mechanical Engineering	**http://media.poly.edu/mechanical/page/template/HomeBody.cfm**
Princeton University – Mechanical & Aerospace Engineering	**http://www.princeton.edu**
Purdue University – School of Aeronautical and Astronautical Engineering	**http://roger.ecn.purdue.edu/AAE/**
San Diego State University – Department of Aerospace Engineering	**http://www.engineering.sdsu.edu/aerospace**
San Jose State University – College of Engineering	**http://www.engr.sjsu.edu/**
Stanford University- Department of Aeronautics and Astronautics	**http://aa.stanford.edu**
State University of New York – Farmingdale	**http://www.farmingdale.edu**
Texas A&M University – Department of Engineering	**http://aggieengineer.tamu.edu/**
United States Naval Academy	**http://www.usna.navy.mil**
United States Air Force Academy	**http://www.usafa.af.mil**
University of Akron – School of Engineering	**http://www.ecgf.uakron.edu**
University of Alabama – Aerospace Engineering & Mechanics	**http://aem.eng.ua.edu/**
University of Alaska, Anchorage – Aviation Technology Division	**http://www.uaa.alaska.edu/aviation/**
University of Arizona – Department of Aerospace & Mechanical Engineering	**http://www.ame.arizona.edu**
University of California, Berkeley – Mechanical Engineering	**http://www.me.berkeley.edu**
University of California, Irvine – Henry Samueli School of Engineering	**http://mae.eng.uci.edu**
University of California, San Diego – Department of Mechanical & Aerospace Engineering	**http://maeweb.ucsd.edu/index.html**
University of Cincinnati – Aerospace Engineering & Engineering Mechanics	**http://www.ase.uc.edu**
University of Colorado at Boulder – Aerospace Engineering Sciences	**http://aerospace.colorado.edu**

University of Illinois (Urbana-Champaign) – Dept. of Aeronautical & Astronautical Engineering	http://www.aae.uiuc.edu
University of Kansas – School of Engineering	http://www.engr.ku.edu
University of Maryland – Department of Aerospace Engineering	http://www.enae.umd.edu
University of Michigan – College of Engineering	http://www.engin.umich.edu
University of Minnesota – Department of Aerospace Engineering & Mechanics	http://www.aem.umn.edu
University of Missouri-Rolla – Mechanical & Aerospace Engineering and Engineering Mechanics	http://web.umr.edu/~maeem/
University of North Dakota – School of Aerospace Sciences	http://www.aero.und.edu/
University of Notre Dame – Aerospace and Mechanical Engineering	http://www.nd.edu
University of Southern California – Department of Aerospace & Mechanical Engineering	http://ae-www.usc.edu/
University of Texas – Aerospace Engineering & Engineering Mechanics	http://www.ae.utexas.edu
University of Texas, Arlington – Department of Mechanical & Aerospace Engineering	http://www-mae.uta.edu
University of Washington – Department of Aeronautics and Astronautics	http://www.aa.washington.edu
Virginia Tech – Department of Aerospace and Ocean Engineering	http://www.aoe.vt.edu/
Wichita State University – Department of Aerospace Engineering	http://www.engr.twsu.edu/ae

Foreign Colleges & Universities

Australia – Royal Melbourne Institute of Technology – Department of Aerospace Engineering	http://www.aero.rmit.edu.au
Australia – University of New South Wales – School of Mechanical & Manufacturing Engineering	http://www.eng.unsw.edu.au/research/schools/mech.htm
Australia – University of Queensland – Department of Mechanical Engineering	htpp://www.uq.edu.au/mecheng/
Australia – University of Sydney – Aerospace, Mechanical & Mechatronic Engineering	http://www.ae.su.oz.au
Belgium – Katholieke Universiteit Leuven	http://www.mech.kuleuven.ac.be/default_en.phtml
Belgium – Universite de Liege – Aerodynamics Group	http://www.ulg.ac.be/aerodyn/

Canada – Carleton University – Department of Mechanical & Aerospace Engineering	http://www.mae.carleton.ca
Canada – Ryerson University	http://www.ryerson.ca
Canada – University of Toronto – Institute for Aerospace Studies	http://www.utias.utoronto.ca
Finland – Helsinki University of Technology – Aeronautical Engineering	http://www.aeronautics.hut.fi/
France – ENSICA	http://www.ensica.fr/index2fr.htm
France – International Space University	http://www.isunet.edu
France – SUPAERO	http://www.supaero.fr/
Germany – Institut fur Luft- und Raumfahr	http://keynes.fb12.tu-berlin.de
Germany – University of Stuttgart – Institute for Statics & Dynamics	http://www.isd.uni-stuttgart.de/
Japan – Civil Aviation College	http://www.kouku-dai.ac.jp/
Japan – Tokyo Metropolitan College of Aeronautical Engineering	http://www.kouku-k.ac.jp/index_e.html
Netherlands – Delft University of Technology – Aerospace Engineering	http://www.delftaerospace.com
Sweden – Chalmers University – Department of Thermo & Fluid Dynamics	http://www.tfd.chalmers.se/
Sweden – Lulea University of Technology – Division of Fluid Mechanics	http://www.luth.se/depts/mt/strl/
Sweden – Royal Institute of Technology – Department of Aeronautics	http://www.flyg.kth.se/
Turkey – Middle East Technical University	http://www.metu.edu.tr/
UK – Bristol University – Department of Aerospace Engineering	http://www.aer.bris.ac.uk/
UK – Cambridge University – Department of Engineering	http://www.eng.cam.ac.uk
UK – Cranfield University – Computational Fluid Dynamics	http://www.cranfield.ac.uk/sme/cfd/
UK – Imperial College of Science, Technology, and Medicine – Department of Aeronautics	http://www.ae.ic.ac.uk/
UK – Loughborough University – Department of Aeronautical and Automotive Engineering	http://info.lut.ac.uk/departments/tt/index.html
UK – University of Glasgow – Department of Aerospace Engineering	http://www.aero.gla.ac.uk/

The National Academies

Aeronautics and Space Engineering Board	http://www7.nationalacademies.org/aseb/
National Academy of Engineering	http://www.nae.edu/

National Academy of Sciences	http://www4.nationalacademies.org/nas/nashome.nsf
National Research Council	http://www.nas.edu/nrc/
Space Studies Board	http://www.nas.edu/ssb/ssb.html
Transportation Research Board	http://www.nas.edu/trb/

Air Carriers and Airports	Website Address
Air Carriers & Airports – Aerolink Directory	http://www.aerolink.com/catairports.html

Associations & Societies	Website Addresses
Aeronautical Repair Station Association	http://www.arsa.org/
Aerospace Department Chairman's Association	http://www.princeton.edu/~asmits/ADCA/adca.html
Aerospace Industries Association of America	http://www.aia-aerospace.org/
Aerospace Industries Association of Canada	http://www.aiac.ca/
Air Force Association	http://www.afa.org/
Air Line Pilots Association	https://www.alpa.org/home/index.html
Air Traffic Control Association	http://www.atca.org/
Air Transport Association	http://www.air-transport.org
Aircraft Electronics Association	http://www.aea.net/
Aircraft Owners and Pilots Association	http://www.aopa.org/
Airline Dispatchers Federation	http://www.dispatcher.org/
Airports Council International	http://www.aci-na.org
American Association for the Advancement of Science	http://www.aaas.org/
American Association of Airport Executives	http://www.airportnet.org/Index.htm
American Astronautical Society	http://www.astronautical.org/
American Bar Association	http://www.abanet.org/scitech/home.html
American Helicopter Society, International	http://www.vtol.org/
American Institute of Aeronautics and Astronautics	http://www.aiaa.org/
American Museum of Natural History – Rose Center for Earth & Space	http://www.amnh.org/rose
American Society of Mechanical Engineers, International	http://www.asme.org/offices.shtml
American Society of Travel Agents	http://www.astanet.com/
Army Aviation Association of America	http://www.quad-a.org/
Association for Women in Aviation Maintenance	http://www.awam.org/
Aviation Distributors and Manufacturers Association	http://www.adma.org/
Business Executives for National Security	http://www.bens.org/

Canadian Aeronautics and Space Institute	http://www.casi.ca/
Electronic Industries Alliance	http://www.eia.org
European Association of Aerospace Industries (AECMA)	http://www.aecma.org
FAA Council of African American Employees	http://www.faa.gov/acr/cae.htm
FAA National Coalition of Federal Aviation Employees with Disabilities	http://www.faa.gov/acr/ncfaed.htm
FAA National Native American/Alaska Native Coalition of Federal Aviation Employees	http://www.faa.gov/acr/naan.htm
FAA Technical Women's Organization	http://two.faa.gov
Federal Managers Association	http://www.fedmanagers.org/
Federation of American Scientists	http://www.fas.org/
Flight Safety Foundation	http://www.flightsafety.org/home.html
General Aviation Manufacturers Association	http://www.generalaviation.org/main.shtml
Helicopter Association International	http://www.rotor.com/
Institute of Electrical and Electronics Engineers	http://www.ieee.org/
International Air Transport Association	http://www.iata.org
International Association of Machinists and Aerospace Workers	http://www.iamaw.org
International Civil Aviation Organization (ICAO)	http://www.icao.org
International Council of Aircraft Owner and Pilot Association	http://www.iaopa.org/
International Council of the Aeronautical Sciences	http://www.icas.org
International Society of Women Airline Pilots	http://www.iswap.org/
National Aeronautic Association	http://www.naa-usa.org/website/
National Agricultural Aviation Association	http://www.agaviation.org/
National Air Traffic Controllers Association	http://www.natcadc.org/
National Air Transportation Association	http://www.nata-online.org/
National Association of Air Traffic Specialists	http://www.naats.org/
National Association of Flight Instructors	http://www.nafinet.org/who/contactus.html
National Association of State Aviation Officials	http://www.nasao.org
National Business Aviation Association	http://www.nbaa.org/
National Center for Advanced Technologies	http://www.ncat.com
National Council for Science and the Environment	http://www.cnie.org/NLE/
National Defense Industrial Association	http://www.adpa.org/
National Education Association	http://www.nea.org/
National Hispanic Coalition of Federal Aviation Employees	http://www.nhcfae.com/
National Science Teachers Association	http://www.nsta.org/
Navy League of the United States	http://www.navyleague.org/index_flash.php

Professional Airways Systems Specialists	http://www.passnational.org
Professional Women Controllers, Inc.	http://www.pwcinc.org
Radio Technical Commission for Aeronautics	http://www.rtca.org/
Regional Airline Association	http://www.raa.org/
Royal Aeronautical Society	http://www.raes.org.uk/
Smithsonian Institution – National Air & Space Museum	http://www.nasm.si.edu/
Society of Airway Pioneers	http://www.airwaypioneers.com/
Society of Automotive Engineers, International	http://www.sae.org/servlets/index
Society of Women Engineers	http://www.swe.org/
Space Foundatioon	http://www.spaceconnection.org
Space Frontier Foundation	http://www.space-frontier.org
Space Transporation Association	http://www.spacetransportation.org
Women in Aviation	http://www.womeninaviation.com
World Air Sports Federation (Federation Aeronautique International)	http://www.fai.org

Directories	Website Addresses
AERADE Aerospace and Defense Resources	http://www.aerade.cranfield.ac.uk
Aero Images Military Library	http://www.aeroimages.com/imagmili.htm
Aerolink – the Internet's Commercial Aviation Directory	http://www.aerolink.com
Aeroseek – Aviation Search Engine	http://www.aeroseek.com
Astronomical Pictures & Animation	http://graffiti.u-bordeaux.fr/MAPBX/roussel/astro.html
Astronomy.com	http://www.astronomy.com
Aviation Image Archives	http://www.landings.com/_landings/pages/images.html
Dictionary of Technical Terms	http://roland.lerc.nasa.gov/~dglover/dictionary//content.html
Embry Riddle Virtual Libraries	http://www.erau.edu/libraries/virtual/Aerospace/
Federal Agencies Directory	http://www.lib.lsu.edu/gov/fedgov
Gateway to U.S. Government Science & Technology Websites	http://www.scitech.gov
Great Aviation Quotes	http://www.skygod.com/quotes/index.html
International Aviation Directory	http://www.infomart.net/av/
Internet Aerospace Links	http://www.alumni.caltech.edu/~padam/htmls/AeroLinks.html
Jane's Information Group	http://www.janes.com
Landings Pages database	http://www.landings.com
Library of Congress	http://lcweb.loc.gov
Russian Space Science Internet	http://www.rssi.ru/

Science, Technology & Engineering – Kennedy Space Center	http://ftp.ksc.nasa.gov
Space Jobs, Inc.	http://www.spacejobs.com
U.S. Space Walk of Fame	http://www.spacewalkoffame.com
WWW Virtual Library of Logistics	http://www.logisticsworld.com/logistics

Foreign Governments, Agencies, and Multinational Organizations	Website Addresses
Aeronautics for Europe	http://europa.eu.int/comm/research/growth/aeronautics/en
Australia – Defense Science & Technology Organization	http://www.dsto.defence.gov.au/
Belgium – Office of Scientific, Technical and Cultural Affairs	http://www.belspo.be
Brasil National Institute for Space Research	http://www.inpe.br/english
Canadian Herzberg Institute of Astrophysics	http://cadcwww.dao.nrc.ca
Canadian Space Agency	http://www.space.gc.ca/
China National Space Administration	http://www.cnsa.gov.cn
CNES – Centre National d'Etudes Spatiales	http://www.cnes.fr
CSIRO Australia – Scientific & Industrial Research Organization	http://www.csiro.au
Euroconsult	http://www.euroconsult-ec.com
European Aeronautic Defence and Space Company (EADS)	http://www.eads.com/eads/index_nof.htm
European Commission	http://europa.eu.int
European Space Agency	http://www.esa.int
GIFAS – Groupement Des Industries Francaises Aeronautiques et Spatiales	http://www.gifas.asso.fr
Indian Space Research Organization	http://www.isro.org
International Astronautical Federation	http://www.iafastro.com
International Civil Aviation Organization	http://www.icao.int
National Space Development Agency of Japan	http://www.nasda.go.jp/index_e.html
North Atlantic Treaty Organization (NATO)	http://www.nato.int/
NATO Research & Technology Organization	http://www.rta.nato.int/
Netherlands – National Aerospace Laboratory	http://www.nlr.nl
Russian Aviation Page	http://aeroweb.lucia.it/~agretch/RAP.html
Russian Space Agency	http://www.rosaviakosmos.ru/english/eindex.htm
Russian Space Research Institute	http://www.iki.rssi.ru
UK Ministry of Defence	http://www.mod.uk

United Nations	http://www.un.int/
International Telecommunications Union	http://www.itu.int/home/index.html
World Meteorological Organization	http://www.wmo.ch/index-en.html
von Karmen Institute for Fluid Dynamics	http://www.vki.ac.be

News and Print Media	Website Addresses
Aerospace Online – Marketplace for Industry Professionals	http://www.aerospaceonline.com/
AeroSpaceNews	http://www.aerospacenews.com/
Aerotech News and Review	http://www.aerotechnews.com/
AeroWorldNet – Daily Aerospace Magazine on the Internet	http://www.aeroworldnet.com/
Air & Space Smithsonian Magazine	http://www.airspacemag.com/
Aviation Today	http://www.aviationtoday.com/index.html
Aviation Week and Space Technology	http://www.awgnet.com/aviation
Aviation Week's AviationNow	http://www.aviationnow.com/
Avweb	http://www.avweb.com/
Defence Systems Daily	http://www.defence-data.com/index2/index2.shtml
Defense News	http://www.defensenews.com
DoD DefenseLINK News	http://www.defenselink.mil/news/
Financial Times News and Analysis	http://news.ft.com/home/us/
Global Defence Review	http://www.global-defence.com
GlobalAir.com – Connecting the Aviation Industry	http://www.globalair.com/
Key Publishing, Ltd.	http://www.keypublishing.com/flash.html
Space News	http://www.space.com/spacenews/
Space.com	http://www.space.com/
World Spaceflight News	http://members.aol.com/wsnspace/index.htm

U.S. Industry	Website Addresses
AAI Corporation	http://www.aaicorp.com
Aerojet	http://www.aerojet.com
Aerospace Corporation	http://www.aero.org
AeroVironment, Inc.	http://www.aerovironment.com
Aircraft Technical Publishers	http://www.atp.com
Airtechnics, Inc.	http://www.airtechnics.com
Alaska Aerospace Development Corporation	http://www.akaerospace.com
Alliant Techsystems Incorporated	http://www.atk.com
American Pacific Corporation	http://american-pacific-corp.com
Analytical Graphics International	http://www.analyticalgraphics.com

Andrews Space and Technology	http://www.spaceandtech.com
Arete Associates	http://www.arete.com
Argo-Rech Corporation	http://www.aero-tech.com
AstroVision International, Incorporated	http://www.astrovision.com
ATK-Thiokol	http://www.thiokol.com
Atlantic Research Corporation	http://www.atlantic-research.com
Aviall Incorporated	http://www.aviall.com
Avidyne Corporation	http://www.avidyne.com
AXA Space	http://www.axa.com
B.H. Aircraft Company, Incorporated	http://www.bhaircraft.com
B/E Aerospace	http://www.beaerospace.com
BAE Systems, North America Incorporated	http://www.na.baesystems.com
Ball Aerospace & Technologies Corporation	http://www.ball.com/aerospace
Barnes Aerospace	http://www.barnesaero.com
Battelle	http://www.battelle.org/
BF Goodrich Aerospace	http://www.goodrich.com
Boeing	http://www.boeing.com
Boeing Business Jets	http://www.boeing.com/commercial/bbj
Bombardier Learjet, Inc.	http://www.aerospace.bombardier.com
CAE SunyFlite Training International, Inc.	http://www.simuflite.com
Century Flight Systems	http://www.centuryflight.com
Cessna	http://www.cessna.com
Commander Aircraft Company	http://www.commanderair.com
Computer Sciences Corporation	http://www.csc.com
Cordiem, LLC	http://www.cordiem.com
Crane Aerospace	http://www.craneaerospace.com
Cubic Corporation	http://www.cts-nordic.dk
Curtiss-Wright Corporation	http://www.curtisswright.com
Dassault Falcon Jet Corporation	http://www.dassaultfalcon.com
DeCrane Aircraft Holdings, Inc.	http://www.decraneaircraft.com
DRS Technologies, Incorporated	http://www.drs.com
Ducommun Incorporated	http://www.ducommun.com
Dukes Aerospace	http://www.dukesaerospace.com
Dupont Company	http://www.dupont.com
Eclipse Aviation	http://www.eclipseaviation.com
EDO Corporation	http://www.edocorp.com
EFW Incorporated	http://www.efw.com
Embraer Aircraft Holding, Incorporated	http://www.embraer.com

ESIS Incorporated	http://www.esis.com
Esterline Technologies	http://www.esterline.com
Exostar LLC	http://www.exostar.com
Fairchild Corporation	http://www.fairchildcorp.com
FlightSafety International	http://www.flightsafety.com
GARMIN International	http://www.garmin.com/
General Atomics Aeronautical Systems Incorporated	http://www.ga.com/asi/aero.html
General Dynamics Corporation	http://www.generaldynamics.com
General Electric – Aircraft Engines	http://www.geae.com
GKN Aerospace Services	http://www.aero.gknpic.com
Goodrich Corporation	http://www.aerospace.goodrich.com
Groen Brothers Aviation, Incorporated	http://www.gbagyro.com
Gulfstream Aerospace Corporation	http://www.gulfstream.com
Hamilton-Sundstrand Corporation	http://www.hamiltonsundstrand.com
Harris Corporation	http://www.harris.com
Hartzell Propeller, Inc.	http://www.hartzellprop.com
HEICO Corporation	http://www.heicocorp.com
Hexcel Corporation	http://www.hexcel.com
Honeywell	http://www.honeywell.com
Hughes	http://www.hughes.com
i2 Technologies	http://www.i2.com
ITT Industries Defense Electronics & Services	http://www.ittind.com/business
Jeppesen	http://www.jeppesen.com
KAMAN Aerospace Corporation	http://www.kamanaero.com
Kelly Aerospace	http://www.kellyaerospace.com
Kistler Aerospace Corporation	http://www.kistleraerospace.com
L-3 Communications	http://www.l-3com.com
Lockheed Martin	http://www.lockheedmartin.com
Lockheed Martin Space Systems	http://lmms.external.lmco.com
Martin-Baker America Incorporated	http://www.martin-baker.com
MatrixOne Incorporated	http://www.matrix-one.com
MD Helicopters, Incorporated	http://www.mdhelicopters.com
Meggitt Avionics/S-TEC	http://www.s-tec.com
Microcosm, Inc.	http://www.smad.com
MOOG Incorporated	http://www.moog.com
Northrop Grumman Corporation	http://www.northgrum.com/
Omega Air, Incorporated	http://www.omegaair.ie
Omega Airline Software	http://www.omegaair.ca

Orbital Sciences Corporation	http://www.orbital.com
Parker Aerospace	http://www.parker.com/ag
Parker Hannifin Corporation	http://www.parker.com
PerkinElmer Fluid Sciences	http://wwwl.perkinelmer.com
PPG Industries Aerospace	http://www.ppg.com
Pratt & Whitney	http://www.pratt-whitney.com/
Precision Aerospace Corporation	http://www.prec-aero.com
Raytheon	http://www.raytheon.com
Raytheon Aircraft Company	http://www.raytheon.com/rac
Remmele Engineeering, Incorporated	http://www.remmele.com
Rockwell Collins, Inc.	http://www.collins.rockwell.com
Rockwell International	http://www.rockwell.com
Rolls-Royce North America	http://www.rolls-royce.com
Sabreliner Corporation	http://www.sabreliner.com
Safe Flight Instrument Corporation	http://www.safeflight.com
Sea Launch Company LLC	http://www.sea-launch.com
Sikorsky Aircraft	http://www.sikorsky.com
Silicon Graphics, Incorporated	http://www.sgi.com
Smiths Aerospace	http://www.smiths-aerospace.com
Smiths Aerospace Actuation Systems – Yakima	http://www.dowty.com
Smiths Group Actuation Systems	http://www.si-act-sys.com
Space Systems/Loral	http://www.ssloral.com
Spectrum Astro	http://www.specastro.com
Spirent Systems Wichita, Inc.	http://www.spirent-systems.com
Stellex Aerostructures, Incorporated	http://www.stellex.com
Teledyne Continental Motors	http://www.tcmlink.com
Teledyne Technologies	http://www.teledyne.com
Teleflex Incorporated	http://www.telflex.com
Textron Lycoming	http://www.lycoming.textron.com
The Aerostructures Corporation	http://www.theaerocorp.com
The New Piper Aircraft, Inc.	http://www.newpiper.com
The NORDAM Group	http://www.nordam.com
The Purdy Corporation	http://www.purdycorp.com
Triumph Group, Incorporated	http://www.triumphgroup.com
TRW Incorporated	http://www.trw.com
Unison Industries	http://www.unisonindustries.com
United Defense	http://www.uniteddefense.com
United Technologies Corporation	http://www.utc.com/index1.htm

Universal Avionics Systems	http://www.uasc.com
UPS Aviation Technologies, Inc.	http://www.upsat.com
Vertical Aeronautics International	http://www.heliports.com
Vought Aircraft Industries	http://www.vought.com/
Vought Aircraft Industries	http://www.vought.com/
W.L. Gore & Associates, Incorporated	http://www.wlgore.com
Williams International	http://www.williams-int.com/
Woodward Governor Company	http://www.woodward.com

U.S. Government — Website Addresses

Agencies of the Executive Office of the President

Central Intelligence Agency	http://www.odci.gov/
Council of Economic Advisors	http://www.whitehouse.gov/cea
Council on Environmental Quality	http://www.whitehouse.gov/ceq
National Economic Council	http://www.whitehouse.gov/nec/
National Security Council	http://www.whitehouse.gov/nsc/
Office of Management and Budget	http://www.whitehouse.gov/omb/budget
Office of Science and Technology Policy	http://www.ostp.gov/
National Science & Technology Council	http://www.ostp.gov/NSTC/html/NSTC_Home.html
President's Advisory Council on Science & Technology	http://www.ostp.gov/pcast/pcast.html
Office of the U.S. Trade Representative	http://www.ustr.gov

Executive Branch Departments

Department of Agriculture	http://www.usda.gov
Department of Commerce	http://www.commerce.gov
International Trade Administration	http://www.ita.doc.gov
National Oceanic & Atmospheric Administration – Satellites	http://www.noaa.gov/satellites.html
Critical Infrastructure Assurance Office	http://www.ciao.gov/
Department of Defense	http://www.dod.mil/
Secretary & Deputy Secretary of Defense	http://www.defenselink.mil/osd/topleaders.html
Under Secretary of Defense (Acquisition, Technology & Logistics)	http://www.acq.osd.mil/
Deputy Undersecretary of Defense, Acquisition Reform	http://www.acq.osd.mil/ar/
Deputy Undersecretary of Defense, Industrial Affairs	http://www.acq.osd.mil/ia/
Director, Defense Research and Engineering	http://www.dod.mil/ddre/

Director, Operational Test and Evaluation	http://www.dote.osd.mil/
Director, Defense Procurement	http://www.acq.osd.mil/dp/
National Security Space Architect	http://www.acq.osd.mil/nssa/
Under Secretary of Defense (Comptroller)	http://www.dtic.mil/comptroller/
Assistant Secretary of Defense (Command, Control, Communications & Intelligence)	http://www.c3i.osd.mil/
Assistant Secretary of Defense (C3I) Space Policy Director	http://www.c3i.osd.mil/org/c3is/spacepol/
Under Secretary of Defense (Policy)	http://www.defenselink.mil/policy
Assistant Secretary of Defense (International Security Affairs)	http://www.defenselink.mil/policy/isa/
Defense Technology Security Administration	http://www.dtra.mil/
Advisory Committees	
Advisory Committee to Assess Domestic Response to Terrorism Involving WMD – Charter	http://www.odam.osd.mil/omp/pdf/5277.pdf
Ballistic Missile Defense Advisory Committee – Charter	http://www.odam.osd.mil/omp/pdf/2.pdf
Defense Policy Board Advisory Committee – Charter	http://www.odam.osd.mil/omp/pdf/412.pdf
Defense Science Board	http://www.acq.osd.mil/dsb
Defense Agencies	
Missile Defense Agency	http://www.acq.osd.mil/bmdo/
National Imagery & Mapping Agency	http://www.nima.mil/
Defense Intelligence Agency	http://www.dia.mil/
Defense Advanced Research Projects Agency	http://www.arpa.mil/
DARPA Tactical Technology Office	http://www.darpa.mil/tto/
National Security Agency	http://www.nsa.gov/
National Reconnaissance Office	http://www.nro.gov/
Joint Service Schools	
National Defense University	http://www.ndu.edu
Joint Chiefs of Staff	http://www.dtic.mil/jcs/
Joint Vision 2020	http://www.dtic.mil/jv2020/
Program Executive Offices	
Joint Strike Fighter Program Office	http://www.jast.mil/IEFrames.htm
Unified Commands	
United States Strategic Command	http://www.stratcom.mil/
United States Transportation Command	http://www.transcom.mil/

United States Air Force	http://www.af.mil/
US Air Force Vision 2020	http://www.af.mil/vision/
Office of the Secretary of the Air Force – Acquisition (SAF/AQ)	http://www.safaq.hq.af.mil/
Assistant Secretary of the Air Force – Space Operations (SAF/USI)	http://www.asaf.space.hq.af.mil/
Air Force Scientific Advisory Board – Charter	http://www.odam.osd.mil/omp/pdf/439.pdf
Office of Scientific Research	http://www.afosr.af.mil
Air Combat Command	http://www.af.mil/sites/acc.shtml
Air Education and Training Command	http://www.aetc.randolph.af.mil/
Air Force Space Command Headquarters	http://www.spacecom.af.mil/hqafspc/Default2.asp
Air Force Link – Library	http://www.af.mil/lib_af/index.shtml
Air Force Research Laboratory	http://www.afrl.af.mil
Arnold Engineering Development Center	http://www.arnold.af.mil/
Air National Guard	http://www.ang.af.mil/
Air War College	http://www.au.af.mil/au/awc/awchome.htm
Air Force Institute of Technology	http://www.afit.edu
US Air Force – Thunderbirds	http://www.airforce.com/thunderbirds/
United States Army	http://www.army.mil/
US Army Vision	http://www.army.mil/vision/default.htm
US Army Science Board – Charter	http://www.odam.osd.mil/omp/pdf/389.pdf
US Army Materiel Command	http://www.amc.army.mil/
US Army Parachute Team	http://www.usarec.army.mil/hq/goldenknights/
United States Navy	http://www.navy.mil/
US Navy Vision – From the Sea	http://www.chinfo.navy.mil/navpalib/policy/fromsea/forward.txt
CNO Executive Panel – Charter	http://www.odam.osd.mil/omp/pdf/401.pdf
CNO Space, Information Warfare, Command & Control Directorate (N6)	http://cno-n6.hq.navy.mil
Office of Naval Research	http://www.onr.navy.mil/
Naval Research Laboratory	http://www.nrl.navy.mil/
Naval Research Advisory Council – Charter	http://www.odam.osd.mil/omp/pdf/425.pdf
Naval Air Systems Command	http://www.navair.navy.mil/
Naval Air Warfare Center – Aircraft Division	http://www.nawcad.navy.mil/
Naval Air Warfare Center – Weapons Division	http://www.nawcwpns.navy.mil/

US Navy – Flight Test	http://flighttest.navair.navy.mil/
Naval Center for Space Technology	http://www.ncst.nrl.navy.mil/
Naval Facilities Engineering Command	http://www.navfac.navy.mil/
Naval Network & Space Operations Command	http://www.nnsoc.navy.mil
Naval Sea Systems Command	http://www.navsea.navy.mil/
Space & Naval Warfare Systems Command	http://enterprise.spawar.navy.mil/spawarpublicsite/
Naval Test Pilot School	http://www.usntps.navy.mil/
Naval Postgraduate School	http://www.nps.navy.mil
US Navy – Blue Angels	http://www.navy.com/blueangels/index.jsp?hasFlash=true
US Navy – Leap Frogs	http://www.sealchallenge.navy.mil/leapfrogs.htm
United States Marine Corps	http://www.usmc.mil/
USMC Vision	http://www.usmc.mil/templateml.nsf/25241abbb036b230852569c4004eff0e/$FILE/strategy.pdf
Department of Education	http://www.ed.gov/index.jsp
Department of Energy	http://www.energy.gov/
National Nuclear Security Administration	http://www.nnsa.doe.gov/
National Security	http://www.energy.gov/security/index.html
Office of Defense Nuclear Non-Proliferation	http://www.nnsa.doe.gov/na-20/
National Laboratories	http://www.energy.gov/aboutus/org/natlabs.html
Ames Laboratory	http://www.ameslab.gov/
Argonne National Laboratory	http://www.anl.gov/
Brookhaven National Laboratory	http://www.bnl.gov/world/
Ernest Orlando Lawrence Berkeley National Laboratory	http://www.lbl.gov/
Fermi National Accelerator Laboratory	http://www.fnal.gov/
Idaho National Engineering & Environmental Laboratory	http://www.inel.gov/
Lawrence Livermore National Laboratory	http://www.llnl.gov/
Los Alamos National Laboratory	http://www.lanl.gov/worldview
National Energy Technology Laboratory	http://www.netl.doe.gov/
National Renewable Energy Laboratory	http://www.nrel.gov/
Oak Ridge National Laboratory	http://www.ornl.gov/
Princeton Plasma Physics Laboratory	http://www.pppl.gov/
Sandia National Laboratory	http://www.sandia.gov
Stanford Linear Accelerator Center	http://www.slac.stanford.edu/
Department of Health and Human Services	http://www.hhs.gov
Centers for Disease Control & Prevention	http://www.cdc.gov/

National Institute for Occupational Safety & Health	http://www.cdc.gov/niosh/homepage.html
Department of Housing and Urban Development	http://www.hud.gov
Department of Interior	http://www.doi.gov
U.S. Geological Survey	http://www.usgs.gov
Department of Justice	http://www.usdoj.gov/ag/index.html
Department of Labor	http://www.dol.gov/
Department of State	http://www.state.gov/
Bureau of Political-Military Affairs	http://www.state.gov/t/pm/
Department of Transportation	http://www.dot.gov
Assistant Secretary for Aviation & International Affairs	http://ostpxweb.dot.gov/aviation/
Office of Intermodalism	http://www.dot.gov/intermodal/
Transportation Science & Technology	http://scitech.dot.gov/
Federal Aviation Administration	http://www.faa.gov/
FAA Associate Administrator for Research and Acquisitions (ARA)	http://www.faa.gov/ARA/INDEX.htm
FAA Office of Aviation Research (AAR)	http://research.faa.gov/aar/
FAA Office of Intelligence & Security (OIS)	http://152.122.41.10/
FAA William J. Hughes Technical Center	http://www.tc.faa.gov/
FAA Air Traffic Services (ATS)	http://www.faa.gov/ats/
FAA Associate Administrator for Commercial Space Transportation	http://ast.faa.gov/
FAA Civil Aviation Security	http://cas.faa.gov/
FAA Office of Airports	http://www.faa.gov/arp/arphome.htm
FAA Office of Regulation and Certification (AVR)	http://www.faa.gov/avr/index.cfm
Federal Highway Administration	http://www.fhwa.dot.gov
Federal Railroad Administration	http://www.fra.dot.gov/site/index.htm
Federal Transit Administration	http://www.fta.dot.gov/
Research and Special Programs Administration	http://www.rspa.dot.gov
Volpe National Transportation Systems Center	http://www.volpe.dot.gov
Transportation Security Administration	http://www.tsa.dot.gov
United States Coast Guard	http://www.uscg.mil/uscg.shtm
US Coast Guard – Vision 2020	http://www.uscg.mil/Commandant/2020/contents.htm
Department of the Treasury	http://www.ustreas.gov/
Department of Veteran Affairs	http://www.va.gov

Executive Branch Independent Agencies

Environmental Protection Agency	http://www.epa.gov/
Federal Emergency Management Agency	http://www.fema.gov/
General Services Administration	http://www.gsa.gov/
National Aeronautics and Space Administration	http://www.nasa.gov/
NASA Headquarters	http://www.hq.nasa.gov/
NASA Technology Plan	http://technologyplan.nasa.gov/default.cfm?id=frontend
NASA Centers	http://www.nasa.gov/hqpao/nasa_centers.html
NASA Ames Research Center	http://www.arc.nasa.gov/
NASA Dryden Flight Research Center	http://www.dfrc.nasa.gov/
NASA Glenn Research Center	http://www.lerc.nasa.gov/
NASA Goddard Institute for Space Studies	http://www.giss.nasa.gov/
NASA Goddard Space Flight Center	http://www.gsfc.nasa.gov/
NASA Independent Verification & Validation Facility	http://www.ivv.nasa.gov/index.shtml
NASA Jet Propulsion Laboratory	http://www.jpl.nasa.gov/
NASA John C. Stennis Space Center	http://www.ssc.nasa.gov/
NASA Johnson Space Center	http://www.jsc.nasa.gov/
NASA Kennedy Space Center	http://www.ksc.nasa.gov
NASA Langley Research Center	http://www.larc.nasa.gov/
NASA Marshall Space Flight Center	http://www1.msfc.nasa.gov/
NASA Wallops Island Flight Test Facility	http://www.wff.nasa.gov
NASA White Sands Test Facility	http://www.wstf.nasa.gov/
Center for AeroSpace Information	http://www.sti.nasa.gov/RECONselect.html
NASA Library Documents	http://www.aero-space.nasa.gov/library/index.htm
Technical Briefs	http://www.nasatech.com/
Great Images in NASA	http://grin.hq.nasa.gov
National Science Foundation	http://www.nsf.gov/
National Transportation Safety Board	http://www.ntsb.gov/
Tennessee Valley Authority	http://www.tva.gov

Congress

United States Senate	http://www.senate.gov
Senate Committee on Appropriations	http://appropriations.senate.gov/
Senate Committee on Armed Services	http://www.senate.gov/~armed_services/
Senate Committee on Banking, Housing & Urban Affairs	http://www.senate.gov/~banking/
Senate Committee on Commerce, Science & Transportation	http://www.senate.gov/~commerce/

Senate Committee on Energy & Natural Resources	http://www.senate.gov/~energy/
Senate Committee on Environment & Public Works	http://www.senate.gov/~epw/
Senate Committee on Finance	http://www.senate.gov/~finance/
Senate Committee on Foreign Relations	http://www.senate.gov/~foreign/
Senate Committee on Governmental Affairs	http://www.senate.gov/~gov_affairs/
Senate Committee on Health, Education, Labor & Pensions	http://www.senate.gov/~labor/
Senate Committee on Small Business & Entrepreneurship	http://sbc.senate.gov/
Senate Committee on the Budget	http://www.senate.gov/~budget/
Senate Committee on the Judiciary	http://www.senate.gov/~judiciary/
Senate Select Committee on Intelligence	http://intelligence.senate.gov
United States House of Representatives	http://www.house.gov
House Committee on Appropriations	http://www.house.gov/appropriations
House Committee on Armed Services	http://www.house.gov/hasc
House Committee on Education and the Workforce	http://edworkforce.house.gov/
House Committee on Energy and Commerce	http://www.house.gov/commerce/
House Committee on Financial Services	http://www.house.gov/financialservices/
House Committee on Government Reform	http://www.house.gov/reform/
House Committee on International Relations	http://www.house.gov/international_relations/
House Committee on Science	http://www.house.gov/science/welcome.htm
House Committee on Small Business	http://www.house.gov/smbiz/
House Committee on the Budget	http://www.house.gov/budget/
House Committee on the Judiciary	http://www.house.gov/judiciary/
House Committee on Transportation & Infrastructure	http://www.house.gov/transportation
House Committee on Ways and Means	http://waysandmeans.house.gov/

Joint Committees, Offices and Agencies of Congress

Congressional Budget Office	http://www.cbo.gov
General Accounting Office	http://www.gao.gov
Government Printing Office	http://www.access.gpo.gov/
Library of Congress	http://www.loc.gov/

Commissions and Reports

Centennial of Flight Commission	http://www.centennialofflight.gov
Commission on Domestic Response to Terrorism Involving Weapons of Mass Destruction	http://www.rand.org/nsrd/terrpanel/
Commission on National Security in the 21st Century	http://www.nssg.gov
Commission on the Future of the U.S. Aerospace Industry	http://www.ita.doc.gov/aerospace/aerospacecommission
Commission on United States National Security Space Management & Organization	http://www.defenselink.mil/pubs/spaceabout.html

State Government

California Department of Transportation – Division of Aeronautics	http://www.dot.ca.gov/hq/planning/aeronaut/
California Space Authority	http://www.californiaspaceauthority.org
Florida Spaceport Authority	http://www.spaceportflorida.com/
Texas Aerospace Commission	http://www.tac.state.tx.us
Virginia Space Flight Center	http://www.vaspace.org

Appendix K

Acknowledgements and Commission Staff

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