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

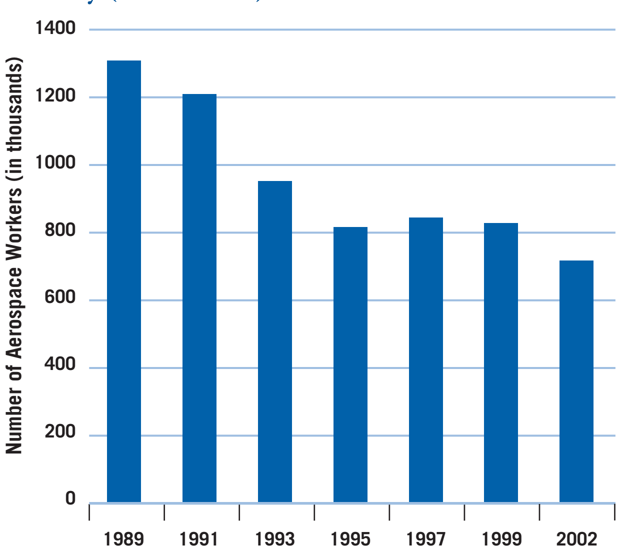
Clearly, there is a major workforce crisis in the aerospace industry. Our nation has lost over 600,000 scientific and technical aerospace jobs in the past 13 years.[1] These layoffs initially began as a result of reduced defense spending following the end of the Cold War. But subsequent contraction of 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]

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.

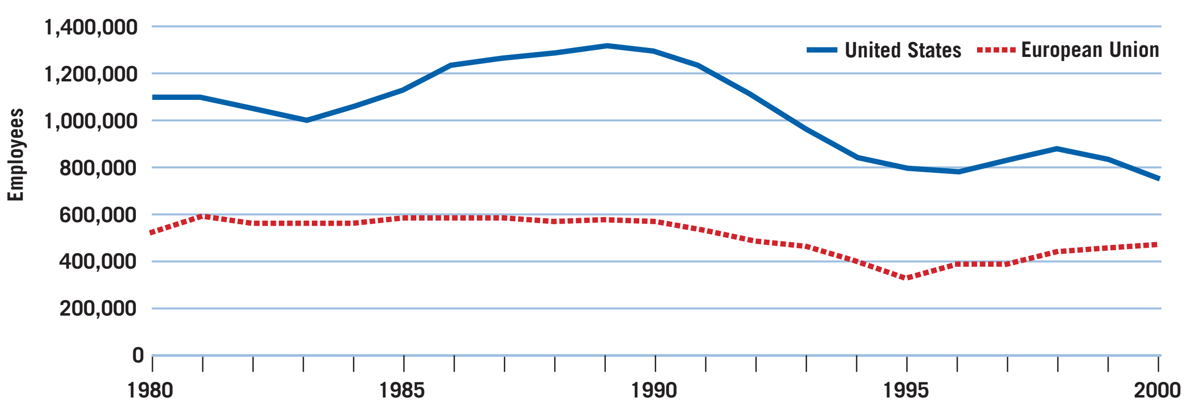
A CASE STUDY OF AEROSPACE WORKFORCE BARRIERS

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.

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.

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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

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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."

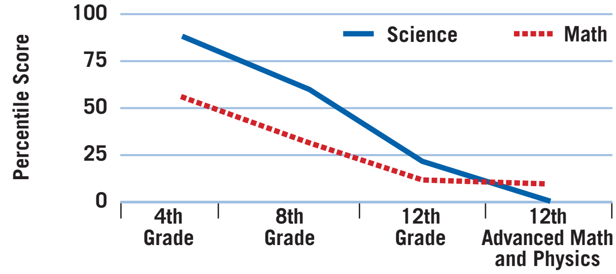
Road Map for National Security, 2001

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

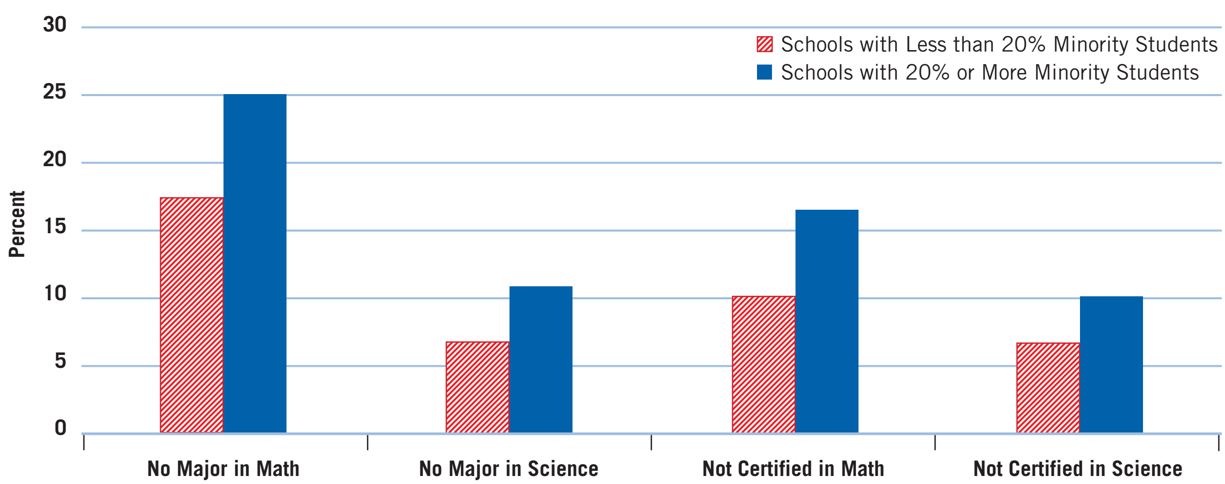


Source: Council on Competitiveness, U.S. Competitiveness 2001

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

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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.

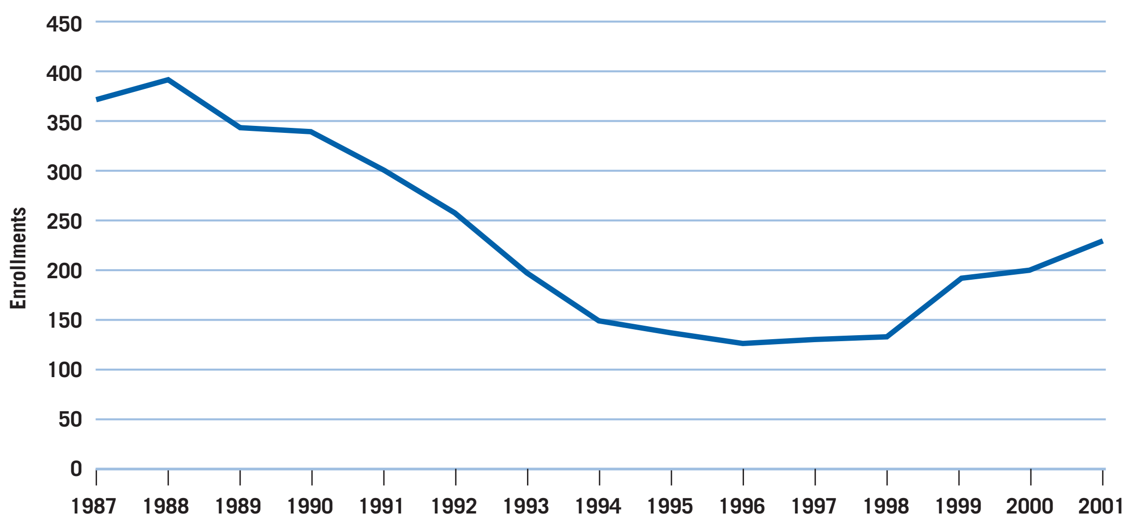
Higher Education in Aerospace Disciplines. From technician to Ph.D., the growth in technology, coupled with pending retirements, are driving a need for a well-educated, highly-skilled workforce.

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 1983, 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]

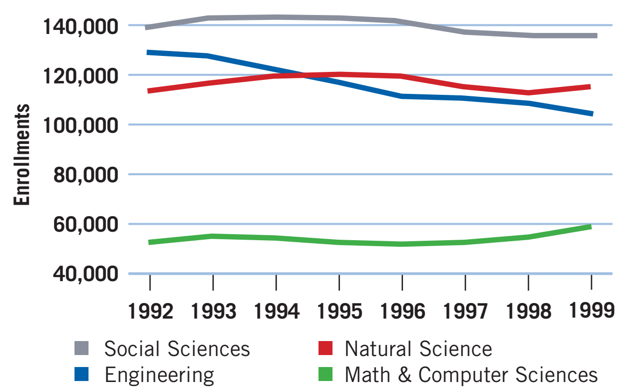
Within the United States, the number of aerospace engineering degrees awarded fell 47 percent from 1991 to 2000.[27] Although there has been a slight increase in undergraduate enrollment since 1997, it is not known whether this increase will continue. There has not been a corresponding increase in graduate 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 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.

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8 - 13