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Schools Woo Students With Research Opportunities, Solid Curriculum

Jaret Matthews spent August on Mars--virtually. The Purdue University senior was one of 12 crewmembers assigned to a simulated Mars base located on Devon Island in the Canadian Arctic. As part of the crew, Matthews lived inside a two-story, 26-ft.-wide cylindrical "habitat" located on the edge of a large crater. The spaceship-looking habitat came complete with an airlock, and crewmembers donned spacesuits to go outside. More than 250 people applied to join the Mars Analog Research Station Project, but Matthews won out and took along an all-terrain vehicle he rebuilt.

Other colleges and universities in the U.S. and abroad also offer students opportunities to participate in cutting-edge research.

For example, at Tuskegee University in Alabama, students work alongside professors on broad-ranging programs. These include a contract from NASA's Advanced Life Support Program for extended lunar and Mars exploration. This project combines space and hydroponics research.

Cranfield University in the U.K. is conducting research on improving lift efficiencies of aircraft at low speeds, as well as new aircraft cabin emergency evacuation systems.

This autumn, students at Prairie View A&M University in Texas began



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writing software as part of a contract from Lockheed Martin Space Operations. The Consolidated Space Operations Contract (CSOC) program includes setting up a mentoring environment near the campus where students will be trained.

"The work will provide students with real-world corporate experience, but it also will generate substantial savings to NASA in software sustainment costs," explained Doug Tighe, CSOC program manager. "We hope that as a result of their exposure to this work, students will explore the career opportunities available in the space industry."



Smiths Industries was able to convince Amanda VandePol to go into the aerospace field following her internship from Calvin College.

The "storefronts," as the programs are known, are being developed in conjunction with Historically Black Colleges and Universities and Minority Educational Institutions.

BAE Systems North America has research projects underway at a variety of schools across the country, including the University of California-San Diego, where students and faculty are working together on applications of new technologies to business transformation and operation.

At the University of Southern California, aerospace research efforts include work in the field of remote imaging.

BAE Systems also is investing in a project at the College of William & Mary on how to forge the strongest possible relationships with colleges and students.

These types of opportunities are attracting more and more students to

engineering programs at institutions of higher learning around the world.

Funding for university and college aerospace/aviation research contracts comes from a combination of sources: the National Science Foundation, government agencies, corporations and even industry trade associations.

"We make the programs as broad as we can so that they are effective for the universities," explained Dale vonHaase, director of aerospace science at Lockheed Martin. "This gives our staff access to the faculty, and it gives us a way to audition potential graduate and undergraduate students. Currently, our research is focusing on integrated media systems, software, imaging, sound and data transmission."

In addition, Lockheed Martin, which spends nearly \$200 million on university-based programs, has the University of Puerto Rico performing research in subsurface imaging.

"The universities tend to think further into the future than a for-profit corporation can," noted vonHase. "If you are an engineer, you like to create things you can lay your hands on or software that executes. We have no idea where technology will be in 5-10 years, but for students who find something they really like, such as aviation, that is the secret."

However, aerospace research dollars are not just going to engineers. Georgia State University in Atlanta combines its aviation management program with public policy studies. Airline dollars are funding research on the cost of compliance, privatization of air traffic control and economic implications of avionics standardization.

Number of Graduates Static

This research is proving to be the carrot for aerospace and other engineering programs supporting the aviation and aerospace industries. Despite a growing need for all types of engineers, the ratio of engineering students to all college graduates remains about the same. In 1991, of 1 million U.S. college graduates, 6% were engineers. In 1995, 5% of the 1.1 million college graduates were engineers. And in 2000, the rate remained about the same.

During the 1990s, the distribution of engineering disciplines tended to shift, with aerospace declining while computer and software engineering grew. In 1991, 4.5% of engineering graduates specialized in aerospace; that dropped to 2% in 2000. During the same period,

computer engineering grads went from 7% of the total to better than 15%. Software engineering was not part of the degree scan conducted by the Engineering Workforce Commission in 1991, but it is among the most sought-after disciplines in 2001.

Is that bad news for the aerospace industry? Not when you consider that the most sought-after skills at many aerospace and aviation manufacturers today include software, systems and structural engineering.

"Engineers can develop software to support new Internet-based businesses. Or they can join aerospace, where they will be thinking about new frontiers or where their software will fly in orbit," said vonHaase.

Despite little change in the overall number of engineering graduates, several aerospace programs have increased enrollment, including Texas A&M, Embry-Riddle Aeronautical University, Purdue University and Georgia Institute of Technology. Purdue's enrollment is up 15% this year. Thomas N. Farris, a professor at the Indiana university's School of Aeronautics and Astronautics, said the primary goal now is to develop students "who can hit the ground running. Our hands-on approach makes this possible."

Georgia Tech's aerospace program swelled to 750 students this fall. The only program with a larger class at Georgia Tech is electrical engineering. "This is a real milestone for us," said Robert Loewy, chairman of the aerospace engineering program. "Enrollment for us is very sensitive to perceptions about the health of the industry."

Loewy said attrition is just as important as recruiting is to enrollment. Georgia Tech offers an introduction to aerospace engineering course to freshmen to help clarify misperceptions about the industry. Field trips to aircraft production lines and airline operations centers augment the college's classroom content.

To keep students excited about what they are learning, Georgia Tech offers a conceptual design sequence.

"We are teaching conceptual design that involves highly mathematical analyses to predict performance, manufacturing cost and life-cycle costs," explained Loewy. "It helps students understand the financial and technological risks in new developments. This kind of design optimization is something Georgia Tech is a leader in," he added. The university recently opened a multimillion-dollar laboratory for propulsion and combustion, and continues to focus on development of

neural networks for aircraft and spacecraft controls.

Loewy said all of this is not enough. "One of the top challenges we face is getting all the material that everyone wants into a four-year curriculum. A second challenge is preparing students to enter a global industry. Finally, aircraft are dependent upon computer technology. The industry is only now learning the full breadth of what these new technologies will mean to future aircraft and spacecraft."

Embry-Riddle Aeronautical University (ERAU) expects more than 6,700 students this fall at its main campuses in Daytona Beach, Fla., and Prescott, Ariz. The university also operates other facilities throughout the world, pushing overall full- and part-time enrollment up to 16,000.

Barry Benedict, ERAU's new academic provost, said the university has long been known as a leading flight school. However, the academic program is notable, too, particularly after being named No. 1 by US News & World Report among non-Ph.D. aerospace schools. Benedict plans to create more opportunities for students by seeking research projects that do not duplicate ongoing work. "We will be finding areas that contribute to the industry but with which others are not involved. We are looking at an applied level that will be good for our students."

While universities worldwide modify programs to meet the growing demand for aviation and aerospace engineers, these schools also are introducing a variety of new initiatives to make engineering graduates stronger as employees.

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On-Campus Hiring Still a Focus of Aerospace

While many industries underwent layoffs and downsizing in 2000 and early 2001, the trend did not hit home in aerospace and aviation until mid-year. That is when the slowing economy resulted in diminished business travel, forcing airlines to adjust their hiring plans.

Even prior to the Sept. 11 terrorist attacks on the U.S., the sagging economy was eroding airline profits. Since that tragic day, Midway Airlines has shut down, other U.S. carriers slashed flight schedules by approximately 20%, and airlines worldwide announced major layoffs. U.S. industry leaders anticipate up to 100,000 jobs could be lost following the terrorist attacks.

The long-term response to terrorism is expected to result in increased defense spending. So even though the airlines will be hard-pressed to operate in the new, more challenging environment, military contractors may actually see an upturn in their business as the U.S. begins its long war against terrorism. And despite its impact on the aerospace industry, companies are expected to continue to try to safeguard their engineering talent, not wanting to risk repeating the mistakes of the early 1990s, when campus hiring nearly stopped and the drain on aerospace brainpower began.

One major, near-term military contract to be awarded by year-end is for the Joint Strike Fighter. The JSF program will create about 4,500 new engineering jobs for the winning team--both within the program itself and to "backfill" positions on other programs as engineers within participating companies are reassigned.

Although many aerospace companies continue to streamline manufacturing processes to drive down costs, resulting in the loss of some administrative and production jobs, most companies are



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closely guarding their engineering talent. The net result is that aerospace companies are expected to continue to seek new engineers, including recent college graduates.

Airline cutbacks will affect aircraft builders, but companies such as Fairchild Dornier need to retain engineers to keep projects such as the 728JET moving forward.

In total, aerospace companies were planning to hire well in excess of 5,000 new college graduates in 2001-2002.

In spring 2001, slightly more than 1,700 students graduated from U.S. schools with aerospace engineering degrees. And although aerospace companies will be hiring people from other fields to fill the need for engineers, there still are more aerospace engineering jobs than there are graduates to fill the industry's needs.

College Recruiting Is Continuous

Continuous college recruiting, regardless of a slowing economy or business decline, is common among consumer products companies, but less so for many engineering-dominated industries, according to Tracey Staley, corporate director of staffing services for Lockheed Martin.

"It is important in an advanced-technology world like ours to continuously replenish our workforce," said Susan Dong, vice president of human resources for BAE Systems North America. "Our workforce is aging, and we must make sure we have fresh ideas and talent available."

James F. Foley, manager of undergraduate recruiting at United Technologies Corp., said his job is to bring in the recently educated engineering talent "so they can integrate into the rest of our experience."

Bell Helicopter Textron faces an increasing number of retirements, and the helicopter manufacturer is heading back to college campuses to replace experienced workers.



"Our average age is shifting every year," said P.D. Shabay, Bell's executive

Cutting-edge projects help attract engineers to aerospace. Denise Kato, an engineer with Lockheed Martin Space Systems, is working on the Mars Odyssey spacecraft.

vice president for administration and human resources. "Over the past six months, we have had the first breathing room we have had in two years as far as having a bigger pool of candidates to choose from."

Situated in the Dallas/Fort Worth area, Bell faces stiff competition from software, microchip, telecommunications and other aerospace companies.

"We continue to work on retention, to make this a special place to work," added Shabay. Bell enjoys a 97% retention rate, which is more in line with the high rates of European companies than those in the U.S.

At Embraer, Jose Renator Oliveira Melo, director of engineering, said the Brazilian aircraft manufacturer continues to focus on recruiting flight control, environmental control, load and interior design engineers.

Melo said, "To overcome the shortage of engineers, we have just begun a new training program in which we hired more than 100 young engineers without experience in aviation and are giving them the proper training to fill future vacancies." Embraer typically allocates 10% of its new positions for new college graduates.

Fairchild Dornier plans to hire 500 more people in Germany (including new university graduates) by year-end after hiring 1,000 during the past 12 months.

"We hire for experience and expertise, but we also look for potential," said Rudolf Mueller, Fairchild Dornier's senior vice president for human resources. "We look for young people with limited experience but who have the mindset for this business, and then we educate them."

As Fairchild Dornier ramps up production of its 728JET, hiring of production workers also continues. "We just opened the final assembly line in Munich," added Mueller.

Bombardier Aerospace had planned to hire thousands of people this year. However, the company announced in late September that 3,800 employees in Canada, the U.S. and U.K. would be laid off by year-end. Company officials said another 2,700 could lose their jobs early next year if the markets do not "significantly recover within the next few months."

Schools Targeted by Aerospace firms

Companies choose the universities where they recruit for a variety of reasons. Schools in the Midwest are noted for producing graduates with a good work ethic. Other institutions are identified as top schools on the basis of research, diversity of opportunities for students, caliber of the faculty or the demographic makeup of the student body.

Boeing's senior vice president for engineering and technology/chief technology officer, David Swain, said the company recently completed a study of its campus recruiting history.

"We knew we wanted the best talent," said Swain. "We need to concentrate our energy. In the past, we have just been spread too thin."

Boeing evaluated each college on the basis of where it could hire the most engineers, how well the school's graduates have done at Boeing, the quality of the school's research, the demographics of its enrollment and its ranking in national polls of engineering schools.

"We like to recruit at Georgia Tech because of its program, but it also has the second-largest African-American graduating class of engineers in the country, behind Florida A&M," explained Lockheed Martin's Staley.

Aerospace companies also look to schools whose alumni already are employees. "If we have had success before, we want to go back," said Dong of BAE Systems.

Fairchild Dornier and Airbus Industrie are searching throughout Europe and beyond for new employees.

"Certain qualifications demand that we do," said Fairchild Dornier's Mueller. "The latest thinking on integrated product teams is coming

from North America, not Europe. We also are recruiting in Indonesia, where there are experienced aircraft engineers."

Erik Pillet, Airbus' senior vice president for human resources, said his company recruits primarily at specialized schools in France, the U.K., Spain and Germany.

"We encourage our engineers to speak at the universities and forge relationships with the students," said Pillet. "Many of our senior managers and engineers are involved in creating and improving courses that are needed in the universities."

Skills in High Demand

The greatest need for new talent in the aerospace industry is in five areas--software development, computer engineering, electrical engineering, systems integration and structures. People with degrees in these fields are being sought to fill these positions. However, that is not all the companies want.

"We need people with technical skills and strong communication, teamwork and leadership skills," said Robert Manigold, vice president of human resources and administration at Arinc. "We must bring products to market faster and more efficiently, so these abilities are very important."

David Ramsay, human resources director for Smiths Aerospace, said, "We continue to hire manufacturing/ industrial, design or mechanical, and software engineers," he said. The most dramatic shift in skills for engineers is the ability to work in a worldwide matrix, Ramsay said, adding, "Our business is spread across Canada, the U.K. and the U.S., so this is important to us."

Foley said UTC's most critical need is for computer, software, mechanical and electrical engineers.

Lockheed Martin is looking for people with skills in disciplines that can be applied to virtually all of the company's products, such as RF, software or electronic engineering, Staley said.

Bell Helicopter Textron seeks graduates from the Georgia Institute of Technology and the University of Maryland, both of which have programs dedicated to helicopters and vertical flight. Bell's Shabay said, "Software development, avionics, simulation and flight control development remain the hottest jobs here."

Among the top employers of engineers is the U.S. Air Force. The Materiel Command employs 8,600 civilian engineers and scientists. Bob Bunting, chief of resources for the Engineering and Technology Management Directorate, said 30-35% of its engineers will retire by 2007. Currently, one third of the engineers are 31-40 years old, so another surge in retirements is expected in about 20 years. The Air Force is operating at 70% of its military engineering manpower needs, and the push is on to recruit more pilots and engineers to work in aircraft development.

The U.S. Navy is in the same position. According to Lt. Stephen Johnson at the Naval Recruiting Command in Memphis, the service only has recruited about 116 of a planned 278 naval flight officers for 2002. Not only are pilots needed, but so are the engineers who become pilots and test and develop new aircraft. "The installment of the baccalaureate-degree completion program has helped bring in more aviators over the last year," Johnson reported.

Pilots' prospects for employment with passenger-carrying airlines are dimming. With the market for business aircraft softening (despite continued growth of fractional aircraft programs and a surge in charter activity after the terrorist attacks), the need for civilian pilots will be depressed for the near future.

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Several Paths Available for Aviation Candidates

For those seeking a career as a pilot or aviation manager, there are several paths to take:

- Enroll in a flight operations certification program.
- Enter an ab initio program at a flight school that is aligned with a major or regional airline.
- Earn a four-year college or university degree that combines aviation management or flight operations with another discipline.

Georgia State University (Atlanta) launched its aviation education program 25 years ago at the urging of Delta Air Lines. The Aviation and Transportation Studies program is part of GSU's Public Policy Studies degree.

"We elected to do it this way because it created a stronger market for our students," said Rick Charles, associate professor and coordinator of the aviation and transportation studies program. "Public policy is very relevant to the aviation industry."

About 40% of GSU's students are not pilots. The remainder take advantage of the ab initio program at the school, which is affiliated with Atlanta Southeast Airlines (ASA), a Delta regional carrier. After completing GSU courses, graduates have accumulated hours in high-performance aircraft and are prepared to move right into the cockpit of an ASA aircraft.

Administrators at Dowling College in Shirley, N.Y., are touting the virtues of their program, which combines flight operations and management with a liberal arts education. "This combination is unique," said Martin M. Holley, the new dean of the school of aviation. "Liberal arts education is about situational awareness, something essential in the cockpit. It works. We are graduating people who think."

Holley said Dowling's program has undergone a massive transformation in the past nine months. "We knew we had to move our program to a new level," he said. It includes bringing the flight-training portion of the program in-house. Dowling is acquiring its own aircraft, beginning with six Piper single-engine airplanes. Two simulators are being installed for the school at Brookhaven Airport, where there also will be a dedicated flight line and 12 newly wired classrooms. Working with the Dowling business faculty, the college

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also will offer an MBA in aviation management.

The College of Aeronautics in New York City has 1,300 students this year, with about 55% of those in its aviation maintenance program. The college has established an Aviation Training Institute for maintenance and flight training. The institute realigns the class schedule from an academic calendar to an accelerated option that allows students to complete their airframe and powerplant (A&P) courses in 16 months. Scott Monroe is the head of the institute, while Herb Armstrong continues to lead the academic program. Those who complete the A&P program can enter the associate of applied science or B.S. programs to earn academic degrees, Armstrong said.

The College of Aeronautics also has established an associate's degree in airport management in response to a need expressed by the Port Authority of New York and New Jersey.

"We will offer the program this year for Port Authority employees and tenants at JFK [John F. Kennedy International Airport] to meet a career development need."

Armstrong added the college hopes to bring its flight training program in-house, a move that will serve the students who are enrolled in the flight training and maintenance programs.

Aviation educators said it is difficult to recruit maintenance students, in part because A&Ps are viewed as low-tech employees.

"Nothing could be further from the truth," said Alan Davis, director of aviation programs at Cochise College in Douglas, Ariz. "When you're going out to fix a Boeing 777, you take a laptop, not just a wrench."

The FAA estimates the aviation industry will require 15,000 new maintenance technicians every year for the next seven years. At best, U.S. colleges and universities will produce 8,000-9,000 graduates annually.

"Obviously, we need to do something differently," said Davis. The College of Aeronautics' Armstrong agrees, indicating that the school has 100% placement for graduates.

Davis proposes that aerospace industry leaders work with aviation schools to attract students, but also to fund their education through a payback contract of some sort.

At the same time, Cochise College is working to make its aviation education program more responsive to the industry. The school has added a more in-depth course in helicopter maintenance and repair, as well as a course in composite materials. "These make the students more marketable," Davis declared.

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The Well-Rounded Engineer

Among the most desired engineering graduates are those who can engineer, analyze financial implications, and speak and write well.

"Companies are increasingly concerned about the character of the people they hire," said David Herrelko, the New Engineering Leadership professor at the University of Dayton. "We are working to produce graduates who are ready for work, but also are ready for life. Engineers normally emerge from college so focused on being the very best in a very tough discipline that they are not picking up all the life skills they need to be completely effective."

Herrelko said engineers need interpersonal skills, an appreciation of the humanities, ethics and an ability to cope with difficult people--"the real business of living."

What Herrelko and others in engineering education are reluctant to do is add to the heavy academic load already being carried by students.

"We, as a society, need people who can work beyond the bench or the cube," he said. The University of Dayton is responding by offering non-credit workshops, social gatherings and civic involvement events. "Our students are helping kids learn to fix their bikes and learn about bike safety. We have a course in engineering ethics that is a cooperative effort with our business program."

Engineering Enrollment – Comparison by Discipline
1991, 1995 & 2000

	1991		1995		2000	
	Enrollment	% of Total	Enrollment	% of Total	Enrollment	% of Total
Aerospace	2,898	4.50%	1,789	2.76%	1,274	2.00%
Architectural	355	0.50%	563	0.87%	557	0.88%
Biomedical	665	1.00%	831	1.28%	1,172	1.84%
Chemical	3,612	5.60%	6,153	9.50%	6,044	9.50%
Civil	7,748	12.00%	10,267	15.86%	8,750	13.75%
Computer	4,447	6.90%	4,897	7.56%	9,816	15.43%
Electrical/Electronic	19,858	31.00%	14,966	23.11%	12,643	19.87%
Industrial/Mfg	4,295	6.70%	3,520	5.44%	3,783	5.94%
Mechanical	14,626	22.80%	15,293	23.62%	12,989	20.41%
Nuclear	261	0.40%	258	0.40%	130	0.20%
Petroleum	235	0.30%	281	0.43%	250	0.39%
Systems	368	0.50%	400	0.62%	413	0.65%

* Totals will not equal 100% because all engineering disciplines are not included

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While the number of engineering students overall has remained relatively stable, the number of aerospace engineering students has declined since 1991.

Schools also are pushing their cooperative work/learning programs to bring new value. E-mail communities keep students in touch with their universities and faculty to ensure coordination between colleges and employers. Universities in Europe are extending their work programs to a full year. It is good preparation for college students who eventually take year-round, full-time jobs.

"We look for students who have a good technical background, but who also have skills in languages," said Erik Pillet, Airbus' vice president for human resources. High-potential new college graduates rotate through jobs at various locations throughout Europe, and they conduct business the Airbus way--using English as the corporate language. Graduates also are encouraged to understand technical information in their native tongues, an additional European language, as well as English.

To help meet the increasing demand for workers at Airbus, the U.K.'s Cranfield University has redesigned some of its programs. The College of Aeronautics and School of Mechanical Engineering merged in December 2000 to form the School of Engineering. This move combined the teaching staff and research capabilities that previously spanned four different schools. Cranfield offers an MBA in aeronautical management, and the program is ranked as the best of its kind in the U.K by The Financial Times.

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JSF Employment Could Peak at More Than 6,000

While two teams await word about the award of the Joint Strike Fighter (JSF) contract, leaders at the competing companies have a common concern: how to add new staff effectively should their company win the contract.

Tom Burbage, executive vice president/general manager for Lockheed Martin Aeronautics Co.'s JSF team, said, "It is the kind of challenge you like to have. It is a chance to revitalize your workforce, to open up new opportunities and attract all-new talent."

However, just as important as marketing the employment opportunities is the manner in which people join the team. Burbage calls this the "on-boarding process," a critical opportunity to set the personality and tempo of the team. The Lockheed Martin Aeronautics Co. approach is to offer a four-week training process to bring on new team members, followed by more-specific, two-week training periods.

Timing is everything, according to Burbage. "You cannot afford to staff at a high rate until the contract is awarded." For now, each of the prime development teams has approximately 500 employees--people who have shifted from other programs or joined the company to fill entirely new positions. With the culmination of flight demonstrations, some employees have moved on to new assignments.

Once the contract is awarded, however, integrated product team leaders will move into place, and more than 60 new employees will sign on every week for the next year. Peak hiring for the primes will involve adding about 4,500 workers, with team partners bringing on an additional 1,000-2,000 employees each.



Winning the Joint Strike Fighter contract, which is scheduled to be awarded by year-end, would boost employment substantially at Lockheed Martin Aeronautics Co.

Peter Shaw, leader of the Northrop Grumman Air Combat Systems

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portion of the Lockheed Martin JSF team, said a contract win would allow his team of 60 to swell to as many as 1,500. Some of the hiring will be to "backfill" positions vacated by experienced employees transferred to the JSF project.

Northrop Grumman learned the value of retraining individuals two years ago when it applied the practice to its production employees. Shaw said retraining would be provided to engineers, varying by discipline and tailored to JSF's new tools and processes.

Burbage said Lockheed Martin Aeronautics Co. has set a goal of getting 40% of its new hires from college and university campuses.

Today's graduates "are trained a lot differently than we were," Burbage pointed out. "They are much more general practitioners instead of specialists. Our operations were set up in the past so that you were assigned to be, say, a stress engineer. You worked in that little box. Because today's graduates have much broader computer skills, they have the capability to do a variety of tasks that in the past might have involved two to three people."

The JSF program also presents an opportunity to implement new business methods. Burbage said in the case of Lockheed Martin, it would initially involve more responsibility for systems engineers. Once the aircraft's systems and requirements are fully defined, specialty engineering disciplines will be applied. In addition, he believes much more "virtual" work will be involved--individual contributors linked via satellite to locations.

"Aerospace used to be a very nomadic industry, with people following new opportunities," Burbage said. "People do not like to move anymore. We are fortunate to have the tools needed for people to work from remote sites. I foresee a roomful of people sitting in Marietta [Ga.], each working on different integrated product teams here in Fort Worth.

"We have a poster that says JSF is another legend in the making--it is an opportunity to work on a really exciting, very advanced technology airplane. It is a unique situation, no matter which team wins," Burbage concluded.

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Is the 21st Century Workforce Diverse?

The question of diversity in the aerospace/aviation industry inevitably is part of any discussion about attracting and retaining the brightest, most-talented people.

"Two things have really changed during the last 10 years. First, there are more women going to school and in the workforce," said Linda Gooden, president of Lockheed Martin Information Support Services. "Second, the demand for qualified engineers and computer science graduates greatly exceeds the number of available people. This has opened the door to females and minorities--doors that might not have been opened as readily if the business imperative was not there."

In Europe the situation differs dramatically from that of the U.S. Fairchild Dornier looks upon itself as a start-up and for that reason can build an organization in which richness of diversity is a given and valued part of the corporate culture.

Airbus Industrie is an amalgamation of cultures by definition. "We are not a German company or a French company that went international," explained Erik Pillet, senior vice president for human resources. "We are an international company. We are developing multi-cultural employees. In 2001, we took more than 100 non-national graduates to work in a country other than their own.

"We also recruit in the U.S.--in Boston and Chicago and next year in San Francisco," added Pillet. "We are keen to get U.S. citizens, but we often find French or German students in America who want to join this international company."

The average age of aerospace industry employees is a key factor in the growing diversity of the workforce. Ten years ago, the average age of aerospace workers was in the low- to mid-30s. Today, the average age exceeds 40 at many companies. So while hiring of college graduates has continued, the workforce continues to age. Most companies claim there is a bubble that was brought on by the layoffs of the past decade. Companies learned the hard way that they would have trouble hiring college graduates in the wake of headlines about mass layoffs in aerospace. As a result, most set annual hiring goals for university campuses, even in times of corporate downsizing.

The American Institute of Aeronautics and Astronautics (AIAA) has tracked gender and minority graduation rates during the past 10 years. The percentage of women in the aerospace engineering workforce rose

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from 14% to 18% during the decade. During the same period, female representation among all engineering graduates increased from 15% to 20%. The rate of minority engineering graduates increased from 17% to 23%, with 2% increases among African-Americans, Hispanics and Asians. The only minority group tracked by AIAA that did not increase during the period was American Indian.

The data indicates that there has been some measurable improvement--perhaps not enough--in the hiring of minority workers. In addition, the statistics show that aerospace engineering is increasing diverse representation at a rate slightly lower than that of the overall engineering profession.

Schools such as Tuskegee University are reaching out to the traditionally minority rural communities surrounding their campuses. The College of Aeronautics in New York is historically a Hispanic institution.

"As we expand, a central component of our agenda is to continue to attract Hispanic and other minority students," said Herb Armstrong, head of the college's academic program.

Georgia Tech and Purdue University continue to increase enrollments of minority and female students, but admit the numbers still need to grow.

Companies, however, concede the competition is so high for college graduates that they must develop and maintain strong relationships with professional organizations.

Susan Dong, vice president of human resources at BAE Systems North America, said affiliations with organizations such as the Society of Women in Engineering, the National Society of Black Engineers, Mexican-American Engineers and the Society of Hispanic Engineers are important.

United Technologies Corp. (UTC) undergraduate recruiting manager James F. Foley said his company's long-standing relationship with the National Society of Black Engineers and key sponsorship of that organization's national conference in March resulted in UTC hiring 13 people during that annual meeting.

Many aerospace companies now have a director of workforce diversity. A new twist this year, however, is that UTC appointed an engineer--R.G. Reed--to the position.

Lockheed Martin's Gooden points to anecdotal evidence that change in minority representation is occurring.

"With the business climate being what it is today, opportunities do open up," she said. "We find talent that was there all the time but we would not have identified before because we would not have looked. Our organization is made up of 40% females, and it is a very successful business."

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Written By:
Carole R. Hedden

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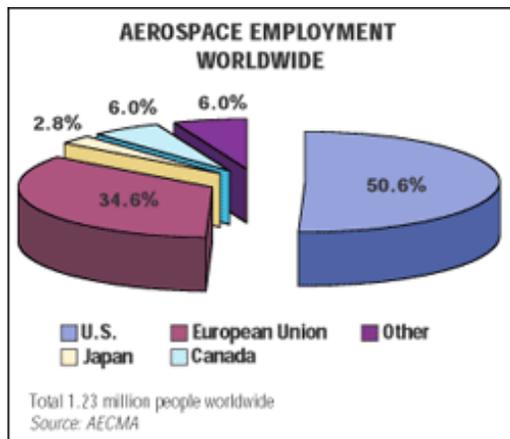
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Half of the world's aerospace workers are employed in the U.S., while a third of the people in the industry work in Europe.

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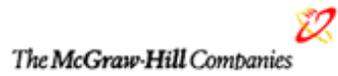
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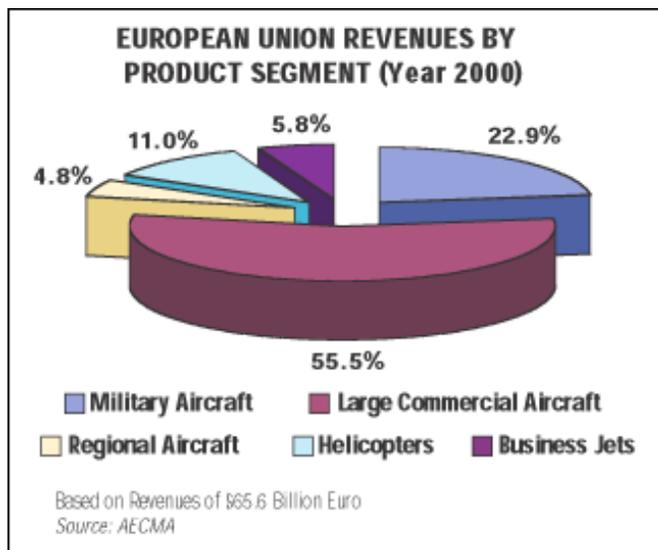
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U.S. Aerospace-Related Employment Annual Average in Thousands —All Workers

Year	Total Aerospace Employment	Aircraft	Engines & Engine Parts	Other Aircraft Parts	Guided Missiles, Space Vehicles & Parts	All Other Aerospace-Related Employment
1986	1,241	338.9	153.6	163.2	199.5	386
1990	1,302	381.0	151.7	179.5	185.1	405
1995	796	243.6	93.0	113.9	98.2	248
1999	846	254.3	100.0	140.7	88.1	263
2000	793	230.9	95.3	132.1	87.8	246

Source: U.S. Bureau of Labor Statistics and Aerospace Industries Assn. estimates

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Hiring Forecast for Select Aerospace Employers

Company	Hiring Plans	Critical Skills Needed
The Boeing Co.	8,000-9,000	Software, aerodynamics, manufacturing
Bell Helicopter	300	Software, manufacturing, skilled manufacturing and information technology design.
The Nordam Group	950	Manufacturing, structural, aerodynamic and thermodynamic engineering; skilled cabinetmakers and technicians.
Northrop Grumman	3,700	Software, structural engineering for Air Combat Systems, Electronic Sensors & Systems and Logicon Inc.
Rockwell Collins	1,000	Systems, software, hardware engineers, financial, business development, strategic planning, manufacturing, human resources.
TRW	TBD	Electrical, digital, RF and mechanical engineering and telecommunications.
Airbus Industrie	3,000	Design, systems, manufacturing and software engineering; production.
Raytheon	7,000	Electrical, software, systems and mechanical engineering; finance, contracts and information technology.
Northwest Airlines	525	Pilots and flight operations.
FedEx	1,000	Pilots, aviation maintenance technicians.
Gulfstream Aerospace	100	General, electrical and avionics engineering.

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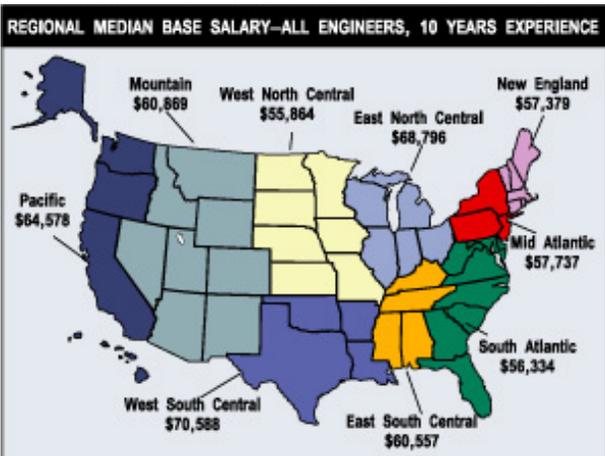
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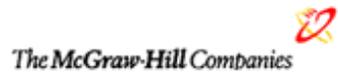
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Midpoint Salaries of Engineers By Highest Degree

Years since B.S.	9-10 Years	11-12 Years	13-16 Years	17-20 Years	21-25 Years	26-30 Years	31-35 Years	35+ Years
B.S.								
Non-supervisory	\$64,188	\$69,188	\$70,888	\$73,307	\$85,077	\$90,277	\$123,790	\$100,000
Supervisory	\$84,700	\$86,700	\$86,700	\$90,500	\$92,000	\$94,000	\$100,000	\$100,000
M.S.								
Non-supervisory	\$81,250	\$75,650	\$80,150	\$87,050	\$85,950	\$88,500	\$90,500	\$104,000
Supervisory	\$90,000	\$93,000	\$98,600	\$99,600	\$103,600	\$108,600	\$115,000	\$115,000

Source: Aviation Week Careers Special Report Salary Survey

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Annual Average Airline Pilot Base Pay				
Position	2nd/1st Officer	1st Officer	Captain	Captain
Yr.	Entry	5	10	Max
Alaska	\$39,228	\$77,208	\$146,556	\$148,320
America West	36,552	77,220	125,832	132,504
American	27,792	92,400	143,976	201,384
Continental	30,000	95,184	147,420	193,656
Delta	33,720	97,896	157,152	248,040
Northwest	30,180	94,416	142,992	207,372
Southwest	37,212	84,528	144,624	147,804
TWA	30,000	58,452	98,940	109,776
United	32,076	102,324	148,464	216,048
US Airways	36,000	87,792	140,532	180,744
Airborne Express	26,268	79,356	134,508	164,388
DHL	26,796	72,180	122,352	143,388
FedEx	46,284	96,972	156,228	191,436
UPS	26,004	101,892	192,732	196,560
Average Annual Pay	32,724	87,732	143,652	178,800

Source: AIR Inc.

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Airline Pilot Pay				
Position	2nd/1st Officer	1st Officer	Captain	Captain
Yr.	Entry	5	10	Max
Major Airlines Annual Average Pay	\$32,724	\$87,732	\$143,652	\$178,800
National & Jet Operators Annual Average Pay	\$26,256	\$43,392	\$79,912	\$89,016

Source: AIR Inc.

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Airline	Starting Hourly Pay
Delta	\$15.27
Southwest	\$16.70
US Airways	\$16.65
Continental	\$13.11
American	\$14.18
Northwest	\$15.61
United	\$15.17
Alaska	\$14.35
TWA	\$13.82
America West	\$14.79
UPS	\$13.40
FedEx	\$16.71
Airborne Express	\$16.00
Aloha	\$16.71
American Trans Air	\$10.71
Hawaiian	\$15.02

Source: Aircraft Mechanics Fraternal Assn.

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CAREERS 2001: Global Trends

Companies Demand Technical Skills, Search for the Right Attitude

"We hire for attitude and train for skills," declared Lorraine Grubbs-West, director of field employment for Southwest Airlines. "We ask questions such as 'When was the last time you laughed at yourself and why?'"

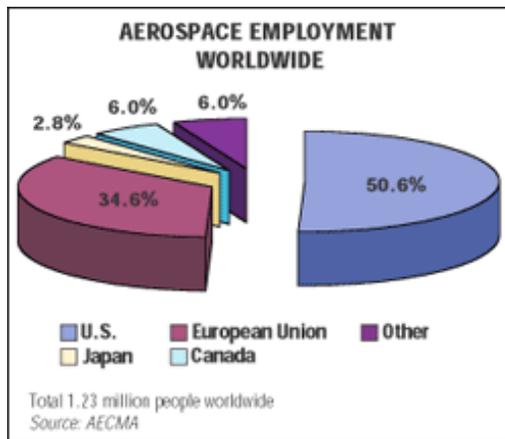
Such questions are designed to determine if job seekers will "fit" with the company. For although the tight labor market has airlines and aerospace companies looking high and low for people who have know-how, these companies want to ensure that new hires also will be compatible with their corporate cultures.

David Vaughan, president of Irvine, Calif.-based Vaughan & Co., an executive search firm, said despite stiff competition for aerospace engineers, particularly in software and electrical engineering, some companies are not hiring otherwise qualified job candidates due to "fit" issues. "The applicant may be technically competent and what a company needs, but [companies are asking] 'Is that person going to be a part of our team?' I am seeing companies pass on people who don't fit, regardless of their experience."

Dwight Streit, vice president and executive director of TRW Space & Electronics Group's advanced semiconductor business in Redondo Beach, Calif., said, "Obviously, we focus a great deal on hiring people with the appropriate skill sets, but they also have to be the kind of people we believe will build their careers here."

To help identify "fit," Rockwell Collins has adopted a team interview process in which candidates are selected based on skill and then interviewed for behaviors consistent with the company's values, explained Ian Davis, the company's human resources manager.

"We want people who have the ability to work in an environment where there are many unknowns and where the requirements shift,"



Half of the world's aerospace workers are employed in the U.S., while a third of the people in the industry work in Europe.

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said Davis. "They must also have demonstrated the ability to learn new skills and have a record of creating something from scratch. We probe to see what people have done, how they have handled things when they were successful and also when they were not."

General Electric also targets people who have the skills and the right values. If one or the other is missing, the company works with the individual to develop the missing attribute. The worst-case scenario is an individual who has the skills and can make the numbers, but never develops values consistent with GE's. Eventually, such people leave the company.

Delta Air Lines officials say they have a single-digit employee turnover rate because most of their workers share the company's values.

According to Dana J. Dalton, Delta's system manager of employment, "We seek people who align with our corporate values of safety, customer-focused professionalism, world-class performance, trust and respect, teamwork and participation, speed and simplicity, technology and flexibility. Our retention rate is terrific because Delta folks are happy with our company and prove it by their feet—they just don't leave."

Michael Langford, director of human resources for Galaxy Aerospace in Fort Worth, said the essential ingredient for his company's workforce is a customer service mindset paired with technical ability.

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CAREERS 2001: Global Trends

Base Salaries Remain Steady, But New Technologies Drive Pay Increases

Across the aerospace and aviation industries, base-pay salary increases generally are less than 5%. However, more employee compensation packages are including profit-sharing and variable-pay components.

Aerospace companies are becoming increasingly willing to pay more to keep talent they want and need. For example, transportation and aerospace employers are increasingly comparing salaries among all industries, not just their own, ensuring that software developers are on par with their peers at "dot-coms" and information technology and computer networking firms.

However, this year's Aviation Week Careers Special Report compensation survey—which included interviews with more than 70 companies as well as a comprehensive survey of engineers' salaries—determined that aerospace continues to offer compensation primarily in base pay rather than stock options. However, most compensation managers indicate that companies have shifted approximately 10% of base pay into variable compensation, while offering ever-stronger retirement and 401(k) packages that include company stock. Some also are using stock options as incentives for employees continuing their education or increasing sales.

Kit Darby, president of AIR Inc. in Atlanta, reported that airline pay is being driven upward, not only by demand for pilots, but in part by the introduction of new aircraft. The deal inked last year between United Airlines and its pilots raised the standard, and now Delta Air Lines is facing the prospect of raising pay scales again.

Because pilot pay scales among most airlines are comparable in the early years of a career, quality of life is a key consideration for aviators seeking work at commercial carriers.

Northwest Airlines is conscious of the need to address quality-of-life issues, such as attractive base locations, commuting options and career development. The airline offers one of the shortest minimum times to upgrade to captain—less than five years. In addition, use of new aircraft is an important part of the carrier's commitment to its customers and employees.

Jerry Huss of California-based IASCO, a contract aviation training company, said the alternative for an airline pilot is a lease or contract situation. "You don't lose seniority, though the pay is somewhat less," he explained. "You can move, though, without starting completely over."

Many employers are retaining valuable employees by focusing on "re-recruiting" current workers with critical skills.

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Vaughan & Co.'s David Vaughan said, "Supervisors who want to keep talented people need to be talking to them about their careers, about what experience they want to get and when they need a break from a long-term project. A counteroffer is not going to remedy the situation [if the employee wants to leave]," he said. "Money is an emotional response to other things. An employee is not going to leave if she likes her work, respects her boss and believes in the company."

Ralph Kimmich, director of benefits and compensation for Southwest Airlines, says that although his airline pushes for competitive pay, it is not attracting or keeping employees based on salaries. "We want our culture to be the driver of why someone chooses Southwest and stays with Southwest."

Al Haggerty, retiring vice president and general manager of engineering for Boeing in St. Louis, said aerospace companies need to do a much better job of using their cutting-edge products to create excitement about working in the industry. "There aren't many other places where you can put an engineer on board a fighter jet," he said.

As many Internet companies have faltered, talented people are returning to aerospace after having ventured into the dot-com world. The result, recruiters believe, will be the ability of aerospace to attract employees ready to bring new ideas to the table as a result of having visited the "other side."

John Reinert, director of business development at Structural Integrity Engineering (SIE) in Chatsworth, Calif., said the technical challenges of aerospace are a major draw for those returning from the dot-coms. SIE, which specializes in structures and damage tolerance, has just 25 employees but is looking to hire engineers.

Washington, D.C.-based Avitas is another small company that is looking to add people. Doug Kelly, vice president of asset valuation for Avitas, said his company is recruiting new hires for each of its four areas of expertise: aircraft valuation publications, aircraft records and audits, aviation consulting services, and structures and avionics engineering.



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CAREERS 2001: Global Trends

Pilot, Mechanic Shortages Drive Airline Salary Increases

This year's Aviation Week Salary Survey revealed that an airline captain with the maximum number of years on the scale and flying the heaviest of aircraft earns \$178,800 per year, an increase of 5.4% over the 2000 average of \$169,674. The largest increase was at Delta Air Lines, where the senior-most captains now make \$248,040, up from \$209,388 a year ago, an 18.5% increase.

According to Kit Darby, president of AIR Inc., the Atlanta-based company that provided the data for airline salaries, the increases are due to several factors—base pay increases, plus the introduction of new aircraft and technologies to manage and monitor the performance of the aircraft.



Southwest Airlines may have an edge in attracting new pilots because of its designation as one of the "Top Companies to Work for in America" by Fortune magazine.

During the past year, entry-level pay for first and second officers at the major airlines rose 1.4% from an average of \$32,269 a year ago to \$32,724 this year. FedEx continues to offer the highest entry-level pay, while Delta pays the highest maximum level pay for pilots.

So what is the key differentiator for airlines as employers?

Recruiters say it is the type of aircraft flown, the rates at which pay increases throughout a career, retirement packages, number of vacation days and policies that allow pilots to sell flight days for training purposes.

Because of a shortage of experienced pilots, Darby said airlines are changing their recruiting requirements to meet, not exceed, FAA minimums, including eyesight correctable to 20/20. Some airlines also are providing assistance in gaining ratings prior to hire, as well as facilitating career transfers from affiliated regional airlines to the majors.

At Southwest Airlines, pilot applicants no longer need a 737 rating in order to get an interview. Instead, they can be selected and then given

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six months to earn the rating. The change, according to Southwest's Lorraine Grubbs-West, director of field employment, reflects the increased competition for the best pilots.

For military pilots, the pay scale is moving closer to that of commercial carriers, according to John Bird, program advertising officer for the U.S. Navy's Recruiting Command. Base pay for a naval pilot with five years' experience is \$57,264 versus approximately \$87,732 for a commercial pilot with the same amount of experience. The difference is that the naval aviators also receive housing/subsistence, incentive and continuation pay. The gap between military and commercial pilot pay escalates over time, but the Navy continues to boost incentive and continuation pay to offset the difference.

A shortage of airline maintenance technicians has most companies scrambling to attract and keep talented mechanics. United Airlines led the hiring surge last year by filling 60-80 mechanic positions per month. UPS Air Services plans to hire more than 125 maintenance technicians in 2001. Most airlines will continue to hire maintenance technicians this year to support an increase in the number of aircraft they have in service.

Brian Finnegan, executive director of the Washington, D.C.-based Professional Aviation Maintenance Assn., said there are 140,000 licensed airframe and powerplant (A&P) mechanics in the U.S., although the number of people who actually work in the industry is lower.

Finnegan said the shortage of mechanics shows up most in the inability of companies to grow their maintenance businesses. "There is more work than there are people to get it done," he said. "I have people tell me that they are busy, and if they had 20 more mechanics with real experience, they could build another hangar."

In addition, fewer students are enrolling in A&P programs, and only 30% of those who begin actually finish. Part of the problem is the focus of U.S. educators on preparing every high school student for college rather than directing some toward trade school.

"That's a real shame," said Finnegan. "There is a good return on the investment in an A&P education, and it can be a stepping-stone to increased responsibility in the maintenance and flight operations field."

Finnegan and others are working to attract young people to the aviation maintenance field.

Predictably, maintenance technician compensation has increased steadily during the past decade to reflect the shortage of qualified personnel in the industry as well as the growth of responsibility and advancements in aircraft technology.

Some airlines are paying sign-on bonuses, and base pay for maintenance technicians ranges from \$11-18 per hour. The actual compensation level depends on whether a maintenance technician works for an air carrier; a maintenance, repair and overhaul shop; a corporate flight department; or a fixed-base operator.

A&P training may even be an entree to entrepreneurship. The Assn. of Women in Aviation Maintenance reported last year that one of the fastest-growing business ownership opportunities for women in aviation is owning a small maintenance, repair and overhaul operation.

Annual Average Airline Pilot Base Pay				
Position	2nd/1st Officer	1st Officer	Captain	Captain
Yr.	Entry	5	10	Max
Alaska	\$39,228	\$77,208	\$146,556	\$148,320
America West	36,552	77,220	125,832	132,504
American	27,792	92,400	143,976	201,384
Continental	30,000	95,184	147,420	193,656
Delta	33,720	97,896	157,152	248,040
Northwest	30,180	94,416	142,992	207,372
Southwest	37,212	84,528	144,624	147,804
TWA	30,000	58,452	98,940	109,776
United	32,076	102,324	148,464	216,048
US Airways	36,000	87,792	140,532	180,744
Airborne Express	26,268	79,356	134,508	164,388
DHL	26,796	72,180	122,352	143,388
FedEx	46,284	96,972	156,228	191,436
UPS	26,004	101,892	192,732	196,560
Average Annual Pay	32,724	87,732	143,652	178,800

Source: AIR Inc.

Airline Pilot Pay				
Position	2nd/1st Officer	1st Officer	Captain	Captain
Yr.	Entry	5	10	Max
Major Airlines Annual Average Pay	\$32,724	\$87,732	\$143,652	\$178,800
National & Jet Operators Annual Average Pay	\$26,256	\$43,392	\$79,912	\$89,016

Source: AIR Inc.

Aviation Maintenance Technician Wages	
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CAREERS 2001: Global Trends

The Industry Learns How To Educate Employees Better

Just-in-time learning is but one of many strategies being used by aerospace and aviation companies to keep employees moving forward. It is part of the new "employee contract"—an agreement in which employees are responsible for their own careers, and companies are responsible for providing challenging work and the chance to grow. Consequently, many companies are forming partnerships with colleges to establish high-tech online learning courses that employees can tailor to individual and immediate needs.

Leadership continues to be one of the employee skills companies are striving to develop. The Boeing Co. has established a leadership center in St. Louis and had several thousand managers take courses there in 2000. Boeing, like many other aerospace employers, has found that the primary reason an employee stays with a company is because he or she has a strong, talented boss.

"Salary may be important, but 86% of the time a person leaves because of bad leadership and management," said Jim Dagnon, Boeing's vice president of people. "We want to bring together the melting pot of different company cultures and people that exist across this company. And we needed to develop a common framework [for Boeing people]. The results are telling—people who have taken this course respond higher to our employee satisfaction index than do those who have not."

In addition to the leadership center and skills training, Boeing is pouring \$85 million per year into continuing education at colleges and universities. Money is available to an employee to take any college course. "If you earn a degree, you get 50-100 shares of stock," added Dagnon.

Raytheon reorganized its learning model in 2000 into five learning institutes—learning, leadership, six sigma, engineering and enterprise excellence. The learning institute links learning to the company's strategic business plan. The engineering institute allows people to build their skills with software languages, tools, systems, test and emerging technologies. The institutes are coupled with more than 300 Web-based classes offered to employees.

At Bell Helicopter Textron, employees have been offered personal computers to use at home. Bell also is enrolling managers in a leadership development course that was developed in conjunction with nearby Texas Christian University.

"We wanted to provide the means for employees to continuously acquire new skills and knowledge," explained P.D. Shabay, Bell's executive vice president of administration and human resources. "We will be offering more courses over the Internet and Bell's intranet," he

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added.

The Nordam Group formed Nordam University in 2000. "We identified a set of leadership skills needed for this company," explained Laura Lundquist, director of human resources. "We then pulled together programs that link with those skills." Nordam also offers on-the-job training for technical skills and online learning.

Northrop Grumman's Electronic Sensors and Systems Sector is offering an internal mini-MBA program to employees. In addition, it offers "experiential learning," which includes visits to Civil War battlefields and use of Shakespearean works in its leadership development program.

Rockwell Collins revamped its education and learning strategy in 2000.

"Before last year, we offered every kind of learning in a classroom setting," explained Cliff Purington, manager of learning/development. "The downside to that approach is that it was only offered here in Cedar Rapids, yet about 40% of our employee population is outside of Cedar Rapids. People had to register for a class and then travel to Cedar Rapids. If a business priority came up, then they had to start the whole process over again. It just wasn't a system that supported the geographical distribution of our workforce."

Today, the company offers alternative learning that is available 24/7 worldwide. "We have 350 courses online and are in the process of adding another 100," said Purington.

He added that the emphasis is on providing people with knowledge when they need it to meet business requirements. That objective led Rockwell Collins to define the metrics of successful education as that which offers global reach as close to the work environment as possible, within the workplace if possible and tied to business goals and high-quality programming.

Rockwell Collins is operating its new programs at 34% lower cost, not including the technology investment.

University for People is Southwest Airlines' answer to its training and education needs. "We focus on first- to mid-level manager positions," said Rita Bailey, who leads the university. "One of our new programs is an intensive leadership development program for ground-level leaders that is designed to meet the specific needs of a department, including managerial and technical skills they need every day."

Southwest also offers workshops on self-assessment so employees can determine what their talents and directions are. "We are finding that most employees decide they are with the right company; they just want to expand their current role and enjoy it more."



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CAREERS 2001: Global Trends

Companies, Colleges Team Up To Develop Talent

Many aerospace companies and universities have forged alliances that include research and development projects for graduate students and employees serving as course instructors. Erik Pillet, Airbus Industrie's senior vice president for human resources, said these alliances are critical to ensuring that graduates are ready to contribute fully once on the job.

Graduates from the U.K.'s Cranfield University help current students at the college.

"The alumni association is very strong," said Patrick Peal of Cranfield's College of Aeronautics, who noted that such support has helped place graduates with companies in the U.S. as well as Europe. Peal said the most pressing need of aerospace companies is for graduates who have hands-on experience and have participated in aircraft design and structural projects.

Despite warnings about declining nationwide aerospace student enrollment, Purdue University's aerospace student population is up 20% from a year ago. While the number of female students there has grown to 20%, the number of minority students is down slightly.

"I think the general increase in enrollment is because there has been a lot of excitement generated about aerospace," said Tom Farris, a professor at the Purdue School of Aeronautics and Astronautics. "The competition for minority students is intense, making it harder every year for us to make progress."

Farris said the one pressing need most university programs have is for cooperative education or internships.

As part of its alumni and corporate partnership efforts, Purdue has established the Raisbeck Engineering Distinguished Professorship for Engineering and Technology Integration. The \$2-million program allows Purdue to bring in a visiting professor to share specific



Besides its aeronautics programs, Embry-Riddle Aeronautical University is offering new courses in applied meteorology, safety science and air traffic management.

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What result will Boeing's decision to move its headquarters from Seattle have?

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expertise.

James Raisbeck, founder of Raisbeck Engineering in Seattle, said the professorship provides a way to ensure continued links to the university and the quality of its programs.

Vascar Harris, head of the aeronautical program at Tuskegee (Ala.) University and a former Tuskegee Airman, said the institution continues to be the No. 1 producer of African-American aerospace engineers. The school began offering an accredited engineering program in 1982.

"Clearly, tradition and heritage are part of our program," said Harris. "It sets the motivation. We have a small, accredited program that provides a good education, and that pretty much guarantees jobs to graduates. We just wish we had more students to take advantage of the positions."

Harris and Tuskegee are working with a consortium of historically black colleges with accredited engineering programs—Prairie View University, Southern University, North Carolina A&T, Hampton University, Howard University, Morgan State, Florida A&M and Tennessee State—to extend the reach of these engineering schools to African-Americans. Among their efforts is a virtual university in which all of the aforementioned schools will collaborate on research, share faculty and collaborate on research contracts that will offer still more opportunities to students and faculty.

Thomas McKnight, chairman of the Airway Science Dept. at Delaware State University, said enrollment has been increasing about 10% every year, due primarily to an increase in pilot hiring. Just as many airlines are using personal computers for pilot training to save money and because flight simulator time is difficult to obtain, the college is using PCs in its training programs.

The U.S. Air Force Academy offers some unique educational opportunities. Cadets in the highly regarded aerospace and aeronautics courses work on research programs ranging from NASA's X-38 crew recovery vehicle to hypersonic missile development and jet engine fatigue studies. The laboratory is equipped with wind tunnels and engine test cells.

The academy also offers a flight test course for cadets entering their senior year. Faculty members are offered flights to increase competency in aeronautical knowledge. In addition, the academy has upgraded its program to offer hands-on rocket/spacecraft research projects.

The academy has graduated 264 engineers and 2,124 flight-training candidates since 1997.

The College of Aeronautics at New York's LaGuardia Airport has been preparing airframe and powerplant (A&P) technicians since 1936. Although 30% of the college's students are enrolled in the A&P curriculum, Herb Armstrong, vice president of academic affairs, said an increasing number of students are interested in computer-aided design (CAD), airport management and flight operations.

Armstrong said the college is considering expansion in another area—engineering technology. "Internships are a growing piece of the program, particularly as we expand courses in the management area and CAD."

The College of Aeronautics also is extending its flight program and

expects to establish a second home at Newburg, N.Y. "This will allow us to expand demographically and evaluate the possibility of a residential campus," Armstrong explained.

Embry-Riddle Aeronautical University (ERAU), one of the top aviation schools, has revamped its programs, offering more baccalaureate degrees and switching its A&P program from an associate's degree to a non-academic program that is designed to lead to FAA certification.

ERAU's new degrees include a B.S. in applied meteorology. Paul Bankit, chief academic officer, said this degree reflects changes in the field of meteorology and the changing demand for weather services.

"We are shifting from a strictly scientific academic preparation to an applications orientation," said Bankit.

Students can choose a concentration in flight weather, media weather, commercial weather or research.

ERAU also has added a bachelor's degree in safety science. The program is designed to produce safety professionals for aviation, aerospace and other advanced technology settings. The university also offers a master's degree in safety science.

To meet the projected increase in demand for air traffic controllers, ERAU now offers a bachelor's degree in air traffic management.

Toni Sauer, director of the air science programs at Dowling College, in Shirley, N.Y., said his institution continues to evolve its programs in order to draw more people to aviation careers. Last year, Dowling launched a program to attract young, at-risk females to an aviation summer camp.

The University of Maryland, Eastern Shore (UMES) has made several changes to offer an increasingly high-level aviation program. A "wingman" program pairs each UMES freshman with an upper-class mentor. The school plans to establish its own aircraft fleet during the next 5-10 years and increase the use of its Frasca 142 simulator for instrument flight training.

Ronald B. Levy, aviation sciences program coordinator, said that while UMES, a historically black university, draws its aviation students primarily from Maryland, the international student population, particularly from African and Caribbean countries, continues to grow.

"As such, we have a strong commitment to minority and other traditionally underserved and underrepresented students," said Levy. "More than 15% of our students are women, which is three times the national figure of 5% of the pilot population."

Pan Am International Flight Academy is working closely with approximately 200 airlines to develop new talent through its air traffic control, flight attendant and career pilot training programs.

Pan Am has invested about \$6 million in two state-of-the-art campuses— one at Deer Valley Airport in Phoenix and the other at St. Lucie Airport in Fort Pierce, Fla. Todd Huvad, the company's vice president of marketing and communications, said, "We can have new students ready for the airlines in about 13 months."

A Pan Am program called ACE serves as a bridge that allows newly minted pilots to gain the operational experience they need to fly for an airline. Five regional carriers have conditional agreements with Pan Am to hire graduates of the program.

A relatively new school, the Robert C. Byrd National Aerospace Education Center, is already attempting to double its existing space to meet the growing need for maintenance technicians. The component of Fairmont State College, which is located in the Mid-Atlantic Aerospace Complex at Benedum Airport in Clarksburg, W. Va., graduated its first class in 1994. Of the 140 students currently enrolled at NAEC, some 110 are working toward associate degrees in aviation maintenance technology, while the rest are taking four-year courses in technology management or aviation administration.



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CAREERS 2001: Global Trends

Diversity Still Valued in Tight Aerospace Labor Market

A tight labor market has facilitated advancements in the diversity of the general workforce. Aerospace and aviation are no different, and industry leaders have learned that talent is the first priority, and replacing a known talent is an expense most aerospace companies can ill afford.

Although aerospace workers still are primarily white males, an increasing number of people from different racial, educational and cultural backgrounds are working in the field. Most top industry officials also are white, but a number of minority leaders have emerged in recent years, including Hansel Tookes, the African-American who leads Raytheon Aircraft.



Tuskegee University is the leading producer of African-American aerospace engineers. The Alabama school began offering an accredited engineering program in 1982.

Another change is that the measures of success in valuing diversity have shifted from counting who is being interviewed and hired to determining whether women and minority employees are being retained and promoted at the same pace as white males.

Companies have found that the prospects for retention and promotion can be improved when employees feel respected, believe they can contribute and are being prepared for their next career move by acquiring new skills and competencies. The bar is not being lowered, but talent is being identified early, training and education are being provided, career options are being explored, and everyone is allowed to succeed and, just as important, to fail.

Peggy Chabrian, executive director of Women in Aviation International (WIAI), reported that the number of females in the aviation industry continues to increase.

"I know I am dealing with more female business owners and vice presidents," she said. "Sometimes we forget that one of the key factors is that for women to reach the executive levels, they have to have

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experience. Now, that is [finally] occurring. We also are seeing more efforts by colleges and universities to attract women into their programs."

At Boeing, valuing diversity continues to be a focus but has extended well beyond race and gender.

"We have merged with a number of companies, and each of them has deep roots. We have to know that culture and make it work for us," said Jim Dagnon, Boeing's vice president of people. The company also is recruiting engineers and other professionals from Europe, which requires that employees focus on understanding how people from different countries might approach the same situation.

Bell Helicopter has shifted from evaluating leaders on the basis of interviewing diverse job candidates to increasing the retention of diverse employees. P.D. Shabay, executive vice president for administration and human resources, said the shift may appear subtle, but it is tied directly to the company's future.

"We hold people accountable for the efforts they make to create a stronger work team," said Shabay. "By definition, that means valuing what makes each person unique."

The Tulsa, Okla.-based Nordam Group is increasingly reliant on skilled craftspeople to remain competitive, and that is the part of the company workforce that is most diverse. Laura Lundquist, director of human resources, said the company also is maintaining its efforts to increase the diversity of its management team.

"One of our biggest challenges is that we have to help people who are new fit in with the majority of Nordam employees who have been here for over a decade," said Lundquist.

Nordam also is offering incentives to attract employees over the age of 50. "There are many 50-year-olds who want full-time work, and that is a market we focus on.

"We also are going out to the community and are identifying people who have no skills and no career. Then we enroll them in a training program where they learn to read blueprints, follow a process and learn a craft," Lundquist said. "We want to bring in 14 new people per month, creating opportunities for those who do not currently have employable skills."

Raytheon Missile Systems boasts a workforce that is 20% female and 23% minority. "We continue to look at retention and promotion rates," said Noreen Nelson, the company's director of staffing and diversity programs. "We continue to build the infrastructure to help employees grow and develop professionally and personally."

Southwest Airlines has long focused on generating mutual respect among employees. Lorraine Grubbs-West, manager of field employment, said, "In this workplace, we must respect one another. We also pay attention to the diversity of people we hire. We want to reflect our customer base. We promote so much from within that it is important we bring in a diverse group to begin with."

United Airlines has established a mentor program in tandem with the Organization of Black Airline Pilots, Women Mentoring Women and sons and daughters of current employees. Anyone who meets the basic qualifications for becoming a pilot will receive voluntary mentoring from a United flight crew member on how to succeed in the interview process. United also offers an intern program.

Richard Wright, dean of the College of Aviation at Western Michigan State University, worked with the Kellogg Foundation to develop a program to attract more women and minorities to the pilot program at the school. Today, 16% of the more than 700 students enrolled in the program are women and 8% are minorities.

"We're educating future airline captains while working very hard to enhance diversity in the industry," said Wright. "The airline industry, as a whole, has atrocious numbers in this regard—generally, 5% of pilots are women and 3% are minorities. We must do something here, at our level, for the industry to change."

Europe faces additional challenges in its quest for diversity. With each nation struggling to maintain its deep traditions in the broader European Union, this can be a real challenge, according to Airbus' Erik Pilllet. To simplify and separate cultural differences from the corporate environment, Airbus is conducting business in English—all meeting notes, memorandums and business documents are written in English.

Northrop Grumman, as with most of the larger companies that have grown through mergers and acquisitions, lists diversity as one of its top business initiatives. Sandra Evers-Manly, corporate director of diversity, EEO programs and contributions, said the company's changing structure has directly affected the number of women and minority executives.

"The sale of our commercial aerostructures business area last year, for example, and merger activities continue to play a role in the composition of our workforce," explained Evers-Manly. "As a result of these mergers, we have lost both women and minority executives. [However] diversity continues to be a major focus throughout the company in the selection and development of executives and future talent," she added. About 9.5% of Northrop Grumman managers are minority and almost 13% are women.

One concern is that companies are recruiting talented minorities and women from each other. Among the companies known for producing high-talent women in technology is Texas Instruments (TI), which played a role in the development of Christine Davis, a former executive with Raytheon Sensors and Electronic Systems; Julie England, the vice president and general manager of TI's Sun business; and Dixie Garr, vice president for customer success engineering at Cisco Systems.

WIAI's Chabrian said other prominent examples of female leaders in the aviation and aerospace industries include Jane Garvey, FAA Administrator; Deborah McElroy, president of the Regional Airline Assn.; and Elizabeth Haskins, president and CEO of Signature Flight Support.

However, the number of women and minorities in the top tier remains low. This underscores the need to identify top talent, build skills and values, and then retain talented individuals.



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CAREERS 2001: Global Trends

Attracting Talent With Technology

According to a report by Fortune Personnel Consultants of New York City, the top reasons people remain loyal to their work are allegiance to their bosses, the vision and integrity of the company, and the intrigue of the work. Money is merely an emotional response to these factors, according to most recruiting experts.

Gregory Ford, senior staffing manager of Annapolis, Md.-based ARINC, said, "We are seeing software engineers returning from dot-coms to the 'stability' of companies such as ARINC."



Northrop Grumman uses integrated product teams to facilitate teamwork among individuals working on its high-tech projects.

There are those who point to aerospace and aviation as mature industries, where major advances are a thing of the past. But the technological challenges in aerospace and aviation continue to expand. In fact, aerospace and aviation companies around the world continue to attract those who dream about conquering new frontiers.

In the area of space exploration, for example, Hamilton Sundstrand Space Systems employees are working on water processing and oxygen generation systems for the International Space Station. Hamilton Sundstrand people also are working with NASA to develop sixth-generation space suit gloves that will improve dexterity, allowing astronauts to work more comfortably and with less fatigue.

Northrop Grumman offers a range of cutting-edge projects, including development of software-intensive sensors, C4I suites and cyberwar simulations.

This work involves testing to determine the potential impact of a series of coordinated and organized attacks on computer systems and deciding how best to restore any data that might be corrupted or compromised.

Rockwell Collins, which produces avionics suites for business and regional jets, is focusing on increasingly complex inflight electronics, including avionics, entertainment systems and office-in-the-sky

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products.

Bell Helicopter Textron is moving toward production of an all-new type of civil aircraft—the Model 609 tilt rotor. P.D. Shabay, executive vice president for administration and human resources, said, "The manufacturing and logistics efficiency is part of the new technology, too."

Brazil's Embraer has established a virtual reality center to assess aircraft designs, manufacturing processes and final assembly practices.

TRW continues to make breakthroughs in its high-energy laser weapons programs. In 2000, TRW demonstrated its tactical high-energy laser weapon system.

"We are also leveraging our expertise in advanced indium phosphide semiconductors to become a high-volume supplier of chips for a wide range of commercial fiberoptic applications and consumer wireless communications devices," said Dwight Streit, vice president and executive director for advanced semiconductors.

Incubators of aerospace innovation are the so-called "ideation" programs, in which new concepts are tested for market feasibility. Employees who come up with a novel idea that is deemed worthy of further consideration can take a leave of absence from their regular jobs in order to explore their concepts further.

To promote the development of innovations, Honeywell's aerospace business has established the Grow Fund. Boeing has the Chairman's Innovation Initiative, which is supported by a stand-alone business called Boeing Ventures. Funded with \$200 million in seed money, the program allows employees to submit ideas and then develop a business case for the idea with the help of internal mentors and experts. The result may be a new product, but the process also helps individuals develop business skills.

The first product to come out of Boeing's Innovation Initiative is a suite of underwater exploration services for oil and gas exploration and telecommunications companies. Employees at the company's Space Communications business in Anaheim, Calif., developed the ideas, and the company is now selling a new product designed to cut the cycle times and improve the accuracy of deep-water surveys.



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