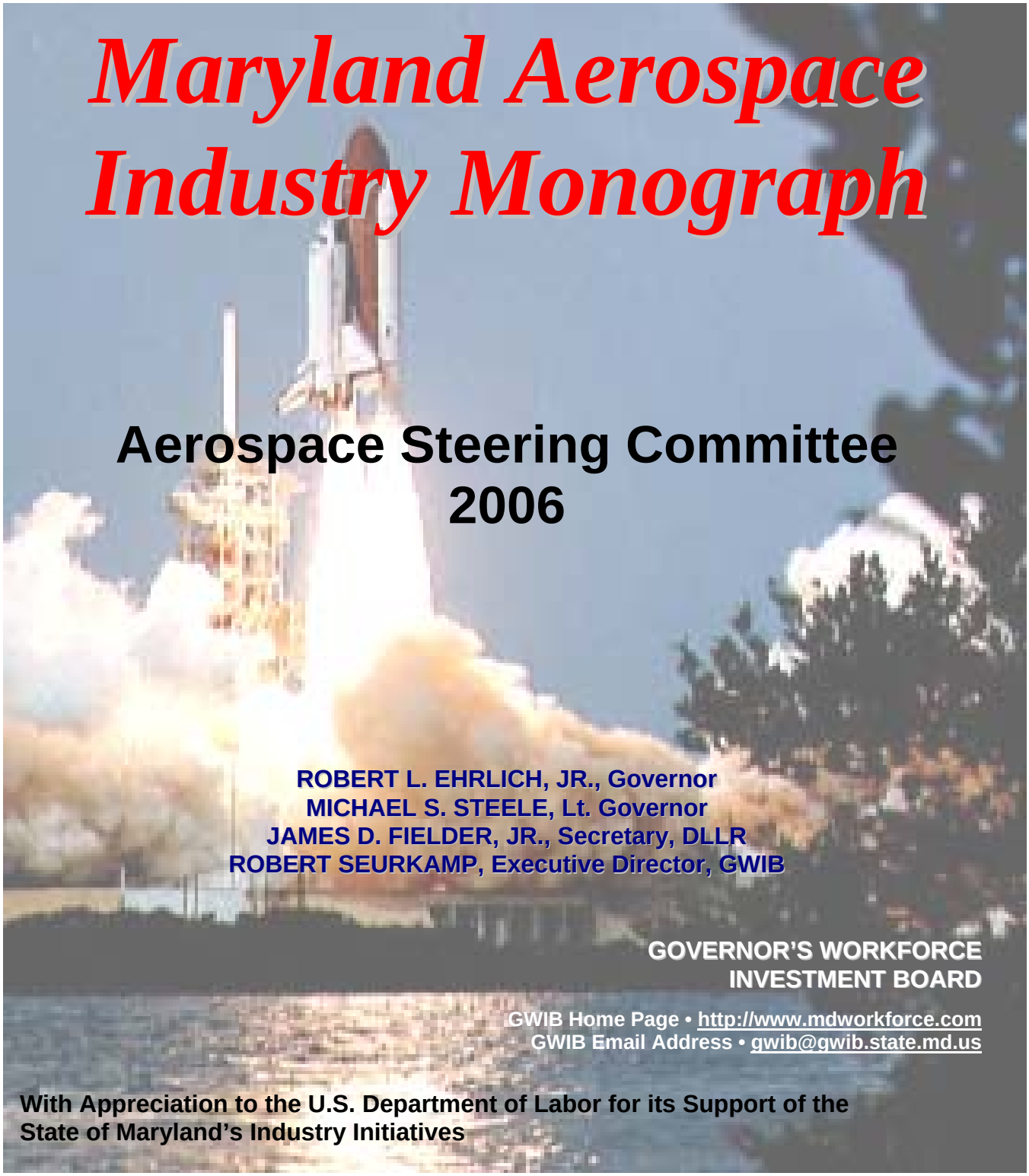
Charting New Directions

Maryland Aerospace Industry Monograph



Aerospace Steering Committee 2006

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With Appreciation to the U.S. Department of Labor for its Support of the State of Maryland's Industry Initiatives

Contents

List of Figures

List of Tables

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Executive Summary

The Governor's Workforce Investment Board's (GWIB) Aerospace Industry Steering Committee has created this "Monograph;" a review of existing literature as well as original research collected by an industry survey and a series of focused discussions between Maryland's high level Aerospace industry leaders, State Government representatives, and senior members of the State's educational institutions about the current and projected employment needs of the Aerospace industry in Maryland. This Monograph is designed to help Maryland's Aerospace industry to articulate their employment needs and to develop a strategic action plan for making their workforce the most competitive in the Nation. This Monograph is both a record of where the industry feels it stands today, and acts as a starting point from which Summit attendees and stakeholders can discuss today's workforce issues and develop tomorrow's potential solutions. The proposed policy and programmatic strategies articulated in this Monograph will be reviewed, edited, discussed, and prioritized in breakout sessions at the GWIB's Aerospace Workforce Summit January 2006. This Summit will launch a long-term action plan to be executed after the Summit in a partnership between Maryland's Aerospace industry, Government and education working together to form viable employment solutions for the Aerospace industry. A proposed action plan for the year will be confirmed by the end of the Summit and will be articulated in the Aerospace Workforce Post-Summit Report.

Data reviewed for the Monograph was compiled from a variety of National and State agencies, including the U.S. Census Department, National Aeronautics and Space Administration (NASA), and the Maryland Department of Labor (DOL), Licensing, and Regulation (DLLR) and the Maryland Department of Business and Economic Development (DBED).

The original research conducted by the GWIB Aerospace Industry Steering Committee in the past 12 months, was designed to better understand the employment needs of this normally discreet and highly competitive industry in Maryland. Research included a survey of 15 Aerospace companies', three Human Resources "Focus Group" discussions in central and southern Maryland, as well as an Education Focus Group late summer of 2005. From the data, a series of critical workforce issues were discussed. There were several recurring themes, and five key workforce areas were identified that the Aerospace Industry Steering Committee felt merited further attention. These specific areas are:

- Pipeline Development Part I: K-12 Education.
- Pipeline Development Part II: Higher Education.
- Workforce Development: Recruitment, Training, Development and Retention.
- Industry Collaboration: Development and Best Practices.
- Security Clearances: Access and Availability.

Each of these topics is given individual attention in this Monograph, and will be the primary challenge of the Strategy Sessions conducted at the Aerospace Workforce Summit in January 2006. It should be stated that although these topics naturally overlap with respect to the issues raised and proposed strategies, they have been separated for purposes of discussion. The issues and strategies have been distributed, as best as possible, to the most logical focus areas. A facilitator will take the participants in the working sessions through an in-depth discussion of the issues in order to develop viable action plans by the end of the Aerospace Workforce Summit.

Following the January 2006 Summit, an Aerospace Post-Summit Report will detail the action plans for the strategies prioritized at the Summit. The GWIB Aerospace Industry Steering Committee will then enter an action phase and begin work at a "sub-committee" level to guide and monitor the development of these individual goals.

The GWIB Aerospace Workforce Post-Summit report will be presented to the Maryland State Secretaries who sit on the GWIB and represent all the State departments including, but not limited to, the Department of Labor, Licensing and Regulation, Transportation, Housing, Higher Education, Business and Economic Development, and K-12 Education among others. The anticipated result of this dialogue will influence the policy and programmatic initiatives designed to help employers attract, develop, and retain their workforce for the next 10 to 20 years.

1. Introduction

Since the beginning of man's conquest of air and space, Maryland's Aerospace industry and its employees have played an integral role in securing the United States' dominance of the heavens. Aerospace is a vibrant and vital business within the State of Maryland, employing tens of thousands of highly-paid and highly-skilled employees. Given its contribution to the economic progression of the State, the future of the Aerospace industry and its workforce in Maryland merits special attention.

The GWIB Aerospace Industry Steering Committee was formed 2 years ago to study the State of Maryland's Aerospace industry. The Aerospace Industry Steering Committee brings together a broad representation of entities invested in Maryland's Aerospace system, including commercial, governmental, and educational perspectives. Jim Pitts, Corporate VP, and President of Northrop Grumman, Electronic Systems, represents the Aerospace Industry Steering Committee on the GWIB. The Committee Co-chairs are Harold Stinger, President and Chief Executive Officer (CEO) of SGT, Inc., and immediate past President of the Maryland Space Business Roundtable, and Anoop Mehta, Vice President and Chief Financial Officer (CFO) of Science Systems and Applications, Inc., (SSAI).

The Aerospace Industry Steering Committee's objective is to analyze the hurdles which impede the growth of the workforce within the Aerospace industry, and to make recommendations to industry participants, related educational institutions, and government leaders that will foster a rich, productive pipeline of talent to further the industry within the State of Maryland. To that end, the Aerospace Summit was created.

1.1 Invitation to Participate

The invitees to the Aerospace Summit are a multifarious group, but all are stakeholders in the sustainability of Maryland's Aerospace workforce. It is imperative that we, as stakeholder organizations, work together to address our industry's challenges. Though the issues facing our Aerospace industry are not all unique to the Aerospace industry, we believe that, with a complete understanding of our industry and the forces that impact our workforce, we will succeed in charting a clear and prosperous course for the future. The real picture of tomorrow's Aerospace workforce is a blank page waiting to be written; working together, we can fill it with solutions for sustainable successes.

Thank you for your involvement in this process and for your active participation in the Aerospace Summit. Your contribution and involvement draws us one step closer to securing a brighter future for our respective organizations, for the State of Maryland, and for everyone involved in this special industry.

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2. Painting the Picture

What is Aerospace? The question is more complicated than a dictionary's definition. The Aerospace industry is broad and has a myriad of faces. If looked at from a National perspective, Aerospace includes the manufacture of civil, military, and business aircraft, helicopters, Unmanned Airborne Vehicles (UAV), space systems, aircraft engines, missiles, materiel, and related components, equipment, services, and information technology. Aerospace includes the governmental and educational entities that focus on research and development of cutting edge technology and are pushing the limits of human and Earth science. Aerospace is both the satellite in space and technicians on the ground who service and maintain its systems. Aerospace is the scientist studying nanotechnology and the engineer testing information systems that will pilot the next unmanned probe. More and more, Aerospace is also the building, servicing, and managing of systems that collect information and, in turn, protect our borders and our citizens.

2.1 How is the Aerospace Industry Defined by the GWIB?

Maryland Aerospace employees play key roles in NASA space programs

Since its creation, the committee has defined the Aerospace industry cluster as including those establishments that contribute to production, research and development, operations, and government administration of Maryland's public and private Aerospace system. These industries are classified under the sectors of Manufacturing; Transportation; Professional, Scientific and Technical services; and Public Administration. The initial intent was to include only those industries that supported the "space" portion of the term "Aerospace." Further discussions across the State, and in particular southern Maryland, indicated that there was much more to this industry than originally considered, and, in fact, there was a significant portion of the State's population employed in both the space and aeronautics fields. Thus, for these purposes, all are included in "Aerospace." The Maryland Aerospace Industry includes the following NAICS codes:

- 334511 Search, detection, navigation, guidance, aeronautical and nautical system and Instrument manufacturing.
- 3364 Aerospace product and parts manufacturing.
- 541512 Computer systems design services.
- 54171 R&D in physical, engineering and life sciences.
- 9271 Space research and technology.

2.2 What is Aerospace in Maryland?

Until recently, the picture of the state of the Aerospace industry workforce in Maryland has gone unstudied. To date, information related directly to the Aerospace industry has not been compiled and analyzed by the industry, National associations, or State agencies.

Because of our proximity to the NASA Goddard Space Flight Center (GSFC), Patuxent Naval Air Station (NAVAIR), and the Department of Defense (DoD) Headquarters, the Aerospace industry in Maryland is unique, and often difficult to compare to the Aerospace industry Nationwide. Unlike other states, Maryland's Aerospace industry is geared toward aircraft and space systems, hardware, manufacturing, and management. This presents a distinct area of opportunities and challenges for the industry and workforce. Due in part to the reliance on Federal budgets that fund many of the missions and related research, manufacturing and management on which the Maryland industry depends, as well as the competitive bidding that secures contracts, employees are subject to fluctuations in employ*ers*, but rarely in employ*ment*. The industry benefits from a steady flow of work, while employees are subjected to a fluctuating employer base due to the nature of the Federal contracting environment in the State.

NASA's Goddard Space Flight Center in Greenbelt, Maryland, is the principle hub of the NASA Communications system for satellites, the Space Shuttle, and International Space Station

For nearly half a century, the industry in Maryland has grown and shrunk and moved in many directions, but has always been an important industry for the State. Today, most Aerospace industry work focuses on Federal government contracts related to Space Exploration, National Security, and Government Mission Management. Maryland Aerospace entities are highly focused on space work in the central area of the State, with low altitude or aeronautical focused efforts primarily supported in southern Maryland.

Regardless of region, the Aerospace industry in Maryland is poised for growth, fueled by plans for Manned and Unmanned Deep Space Exploration as well as growing military and National Security needs. Proximity to Federal contact centers such as NASA, the DoD, the National Oceanic and Atmospheric Administration (NOAA) ensure a steady stream of future work for the State's Aerospace employees.

Statewide focus on space-related manufacturing, project management, and services uniquely positions Maryland to flourish in a future where Federal contracts will focus on space exploration. Maryland also enjoys a current competitive advantage due to its highly-educated population and broad pool of skilled Aerospace employees. The confluence of these two forces has allowed the State and its employers to have high-employment and low-vacancy rates. Maryland's well-educated educated and productive workforce represents a key asset for the Aerospace industry. The State's Aerospace industry ranks 22nd in the Nation by employment, with nearly 40,000 jobs.

Aerospace employees enjoy wages that are higher than the National average for Aerospace employees and significantly higher than the State average wage. The average weekly wage in 2003 was $1426.00 (DLLR) and is much higher today as the shifting worker pool moves from contract to contract. In fact, Maryland Aerospace employees exceed the National average Aerospace wage by nearly 10 percent. Figure 2-1 depicts the average weekly wages in the Aerospace industries within the State.

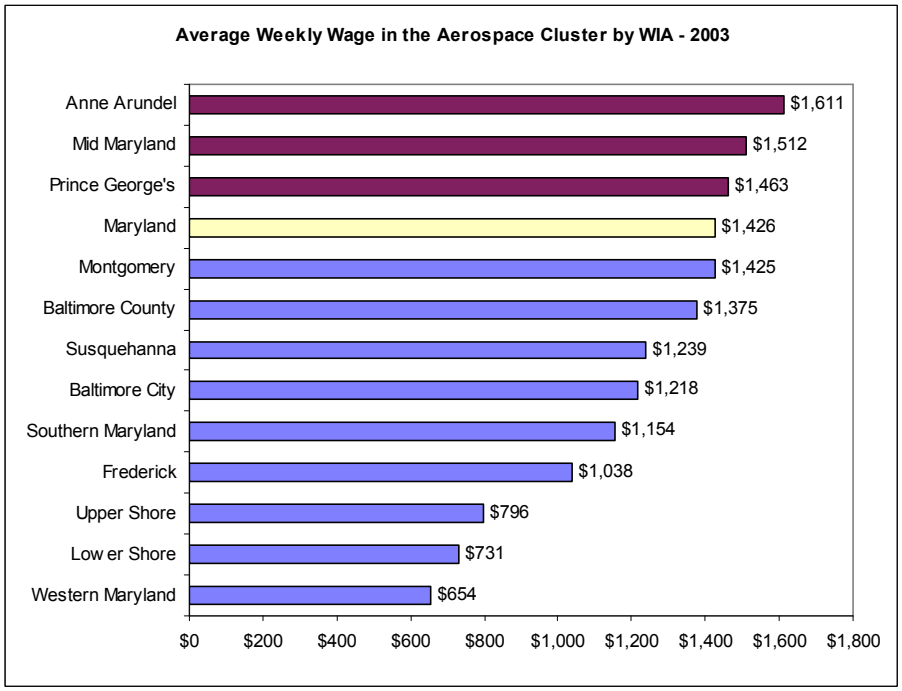

Figure 2-1. Average Weekly Wages in the Aerospace Industries

2.3 Who is Aerospace in Maryland?

Maryland employees are top-ranking in terms of educational attainment, personal income per capita, and the State boasts more scientists and engineers than most others. A survey conducted by the GWIB Aerospace Industry Steering Committee indicates that, on average, 65.4% of Aerospace employees have a Bachelor's degree or above. According to the Maryland Department of Business and Economic Development, the State holds the top rating in the country for a working population with a Bachelor degree or higher. Maryland is also first in professional and technical employees, and employees with mathematical and science related degrees. In today's world, Maryland's strong network of universities and colleges offering science and engineering programs is producing graduates who easily find work in the Aerospace industry.

In fact, official statistics indicate that the Aerospace industry, as defined by the GWIB, employed 63,616 employees in 2003, according to the Maryland DLLR. However, this official

employment number is viewed as significant underestimate of the employment in this industry. There are many reasons for this that can essentially be summarized in the following way. The "official" employment numbers for this industry are collected for the purposes of unemployment insurance by the DLLR. Defense related employment, for example, is significantly underestimated in these numbers and Aerospace also employs a lot of highly secure, defense related employees.

In today's environment, Aerospace is a key contributor for the State, but will it continue to be the economic contributor it has been in the past?

There are a number of issues associated with attracting, developing, and retaining sufficient personnel to support the needs of Maryland's thriving Aerospace industry. While employers' current recruitment difficulties are manageable in many parts of the State, they are not manageable in rural areas and issues such as the aging worker population, the shrinking number of U.S. Citizen science and engineering graduates, and ever increasing taxes and housing costs represent challenges to growth for the industry and its workforce in Maryland.

The recruitment picture in Maryland is as varied as its geography and it shows signs of difficulty now but potentially serious threats in a single generation. According to the focus groups conducted in the central and southern parts of the State, the recruitment difficulties are different, depending on where you are. For example, in central Maryland, the vacancy rates hover around 1-2%, but only 20% of the entry level workforce comes from Maryland. In rural Southern Maryland, most of the entry-level recruits come from Maryland but 10% vacancy rates pose a real threat to the industry, with 500 or so jobs going unfilled at any given point in time. The recruitment picture for experienced and senior staff is different. Over 50% of the workforce is recruited from within Maryland. When employers seek employees from outside the State, they have little trouble finding who they need. However, recruiting from outside the State is expensive and recruits from the Midwest, for example, are likely to return there over time because the cost of living is more attractive back home. International recruits educated here and abroad pose other threats to recruitment and retention within the industry. Most Aerospace jobs require security clearances for which non-U.S. Citizens are not eligible. Furthermore, international recruits are more likely to return to their countries of origin than they were in the past because their home economies are showing signs of significant technological advances and economic growth. While there is currently no shortage of interested applicants, there is a looming threat.

While the number of eligible individuals, adequately trained and cleared for Security purposes, is declining, the average age of Maryland employees is quickly rising. Survey data collected by the GWIB Aerospace Industry Steering Committee indicates that 79.5% of Maryland's Aerospace workforce is age 51 or above (6.9% are above age 60). When asked, "What is the average age that employees in your company retire," employers reported, age 64. Given this, 50% of the Aerospace workforce in Maryland is expected to retire in the next 15 years.

Though the current state of the Aerospace industry is positive, there is no guarantee that Maryland, will *continue* to be inviting to Aerospace employers in the future. And, while Maryland is not alone in this dilemma, because of the advantages the State currently enjoys with regard to Aerospace, it stands to suffer significantly from a potential "brain drain" from the

workforce required to sustain this industry. To protect the future of Aerospace in Maryland, we must maintain a strong pipeline of talent that is qualified to support the needs of the industry.

Traditionally underutilized segments of the population represent a previously untapped resource for new talent. The Aerospace industry is relatively homogonous and employers have difficulty attracting a diverse workforce. Women and minorities make up a small portion of the workforce, and there are challenges to recruiting employees of disparate backgrounds and experiences. The majority of employees come from technical backgrounds, and employers expressed a need/desire to have a more diverse set of education mixed with traditional technical employees.

While opportunities abound, Maryland Aerospace employers face significant challenges attracting women and minorities.

Data collected the by the GWIB Aerospace Industry Steering Committee's industry survey and series of Human Resources (HR) Focus Groups are relatively consistent with National data compiled by the Aerospace Industry Association (AIA) indicating that the population of Aerospace employees is still significantly dominated by males. Survey results from 15 of Maryland's largest Aerospace companies indicate that typically, women in the Aerospace fields comprise only 27 % of the Aerospace workforce in Maryland. In addition to the gender disparity in the industry in Maryland, the workforce is not only dominated by males, but specifically white males.

Figure 2-2 depicts the ethnic distribution of individuals employed in Maryland's Aerospace industry.

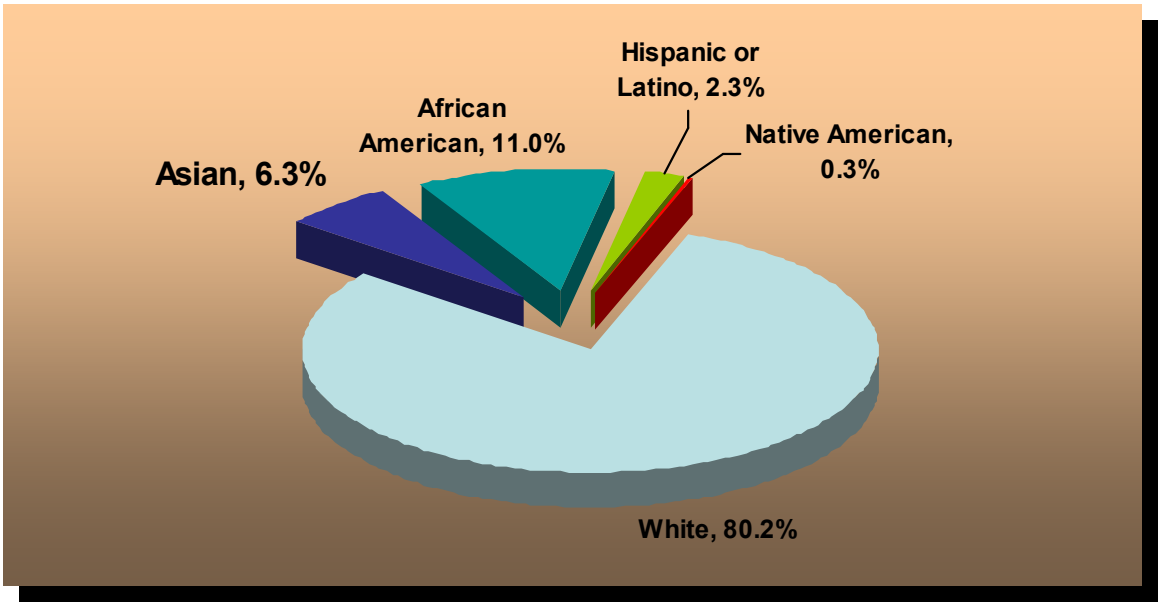

Figure 2-2. Ethnic Distribution of Aerospace Employees in MD

With the exception of southern Maryland, in all other areas of the State, most surveyed employers expressed little or no problem recruiting and retaining new and low-level employees, there is significant concern over a shrinking pool of experienced middle to senior level employees. The experience needed to accomplish many of the required tasks to do take years of on-the-job training and experience. Employers face challenges moving new employees up the chain of experience due to the intricate nature of Aerospace work. Employers are forced to recruit from outside of Maryland in order to fill vacancies, and often recruit from other Aerospace companies within the State, especially when seeking employees with expertise in specialty disciplines.

Maryland Aerospace employers face challenges in employing professionals in many disciplines that support the Aerospace industry, including everything from digital systems designers to lab technicians.

Moreover, there are many specialty disciplines that are particularly difficult to staff. This problem is indicative of the fast changing technology and unique needs of the Aerospace industry. Employees with experience in nanotechnology, data fusion, radio frequency engineering, systems engineering, systems architecture, electrical engineering, and computer engineering are currently in demand. It is anticipated that these specialties will continue to be needed along with robotics and other specialties relating to deep space travel, communication, navigation, and analysis.

Individual employers cited difficulty retaining employees. Interestingly this is a problem for employers, but not significant for employees. The nature of employment in Maryland is such, that employees transition from employer to employer as projects and missions change hands. The competitive bidding for Federal government contracts does not significantly change the employment needs, but does often change the employer. This change is not seasonal or consistently cyclical.

2.4 Variety of Jobs in Maryland

There are extensive career opportunities in the Aerospace industry within the State of Maryland. These range from entry level administrative and clerical support positions, to highly specialized technical disciplines. While the industry requires support from all areas of expertise, the primary focus of the Aerospace Industry Steering Committee has been to identify the status and trends in the more difficult to fill, highly technical positions.

Where are these employees located? Department of Labor data indicates that the majority of these employees are located in Montgomery, Prince Georges, and Anne Arundel Counties Maryland, with the remainder spread throughout the State. This data is based on information through 2003, that is currently available to the Maryland DOL. Figure 2-3 depicts the locations of Aerospace employees within the State.

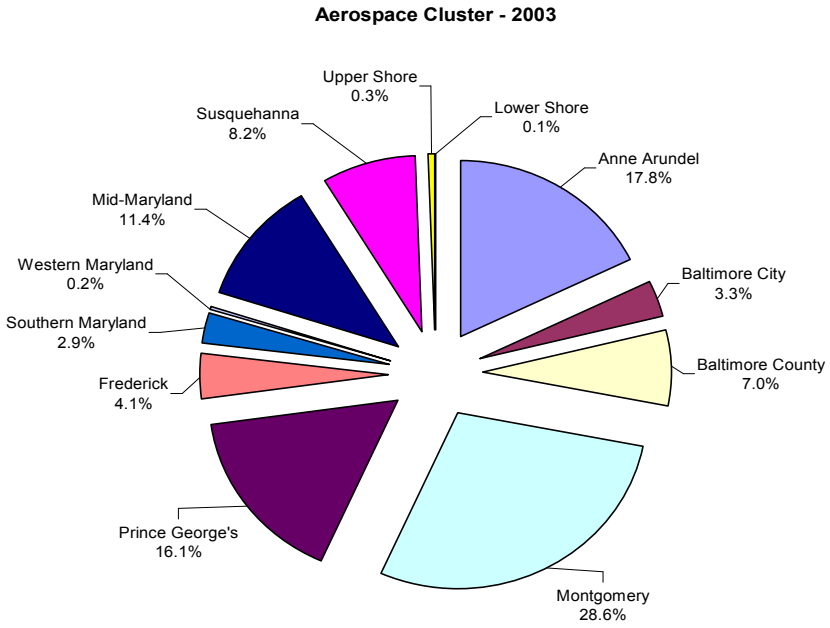

Figure 2-3. Locations of Maryland Aerospace Employees

Figure 2-4 depicts the Maryland DOL Aerospace industry employment population and trends from 2001 through 2003, for each engineering specialty.

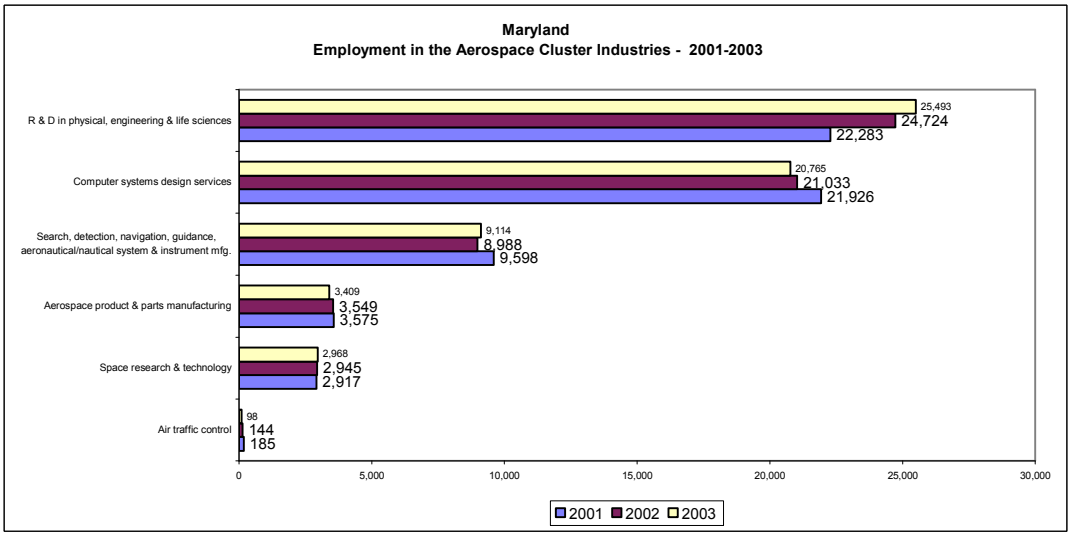

Figure 2-4. Maryland DOL Aerospace Industry Employment Population

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3. What is the Future of the Aerospace Industry?

The future of the Aerospace industry is hard to predict. Reliance on Federal funding makes out year projections somewhat unreliable, but NASA, DoD, NOAA, and other project sources have declared a move towards projects that will probe the deepest reaches of our solar system and space itself. Intelligence operations and increases in security-related technology are likely to increase in the future which will correlate with more work.

NASA's relationship to the private industry, business culture, and management processes are changing and because a great deal of Maryland's Aerospace business is driven by NASA's actions, the industry must change as well. The vision has been stretched out further than ever before and therefore employers must look deeper into the out year than ever required. NASA's long-term space agenda, which now focuses more on Robotic and Human Space Exploration, can significantly benefit Maryland Aerospace employers.

NAVAIR's Patuxent Naval Air Station plays a critical role in aircraft testing and operational qualification, and is likely the most significant economic engine in Southern Maryland

In addition to NASA, NAVAIR's presence in southern Maryland also contributes significantly to the economic vitality of the State. NAVAIR has an operating budget in the realm of $22 billion annually. Not all of this funding is allocated in Maryland, but with a budget in the billions, and a workforce population of over 17,000, NAVAIR certainly wields considerable influence on the aerospace workforce activity.

Those Aerospace firms supporting the defense industry post-9/11 also have expectations of increased demand for new technologies, including higher performance aircraft and increased use of stealth technologies across a wider range of applications.

In early 2004, President George W. Bush announced a new vision for America's civil space program that calls for Human and Robotic missions to the Moon, Mars, and beyond. The vision called for a return of regular Space Shuttle flights, the completion of the International Space Station (ISS), sending a manned orbiter and lander to the Moon as soon as 2015 and no later than 2020. Furthermore, the President's plan called for Mars expeditions and Robotic exploration across the solar system. Such an increase in the space program has not been seen since the Apollo era and represents an opportunity for expansion of Maryland's Aerospace industry in coming years.

The long-term, ambitious space agenda advanced by President Bush has the potential to establish more opportunities for the country's Aerospace industry employers. In order for the industry in Maryland to benefit from this agency redirection, there must be a steady flow of employees available. Challenges abound as the Maryland workforce ages, the number of students graduating with certain science and engineering degrees decreases, and security concerns increase the hurdles new hires must clear in order to be eligible for employment.

Maryland is also expected to be affected by the latest round of Base Realignment and Closing (BRAC) initiatives. While several areas of the country are expected to suffer significantly, Ft. George Meade, NAVAIR and other locations are expected to see increases in activity as a result of closures elsewhere in the country and consolidation of functions at these facilities. While many of the additional jobs transferred to Maryland will be filled by transferring military employees, not all of the civilian workforce will relocate to Maryland. This BRAC activity is expected to create additional workforce demands in the State.

3.1 What Are the Challenges to the Aerospace Industry?

The late 20th century was America's time. The Nation thrived on previously unimagined advances in space transportation and rapidly became the world leader in nearly every industry associated with science and technology. During this time, Maryland's Aerospace industry grew, and is now firmly rooted in the State.

While the U.S. has long been the space leader, European and Asian countries are quickly catching up and, in some cases, exceeding the U.S. in Aerospace development. European companies present the most formidable competition to U.S. companies, but also represent our most important Aerospace trading partner. Future leadership by Maryland and the U.S. can only be attained by investing in the future workforce to ensure that the discoveries of tomorrow are accomplished by our own.

Fortunately, the importance of Aerospace to National security and, more specifically, to Maryland's economy is clear. New technologies open opportunities for the next generation of satellites and launch systems for military operations, homeland defense, global protection and air transportation management. Given the evolving challenges to protecting our country and an increasing reliance on technology, increased and sustained investment in the Aerospace industry is almost certain, and Maryland's workforce is poised to benefit.

What can the State do, given that the primary source of funds for Aerospace programs come from the Federal Government? While the vast majority of funding for Maryland Aerospace activity is from the Federal Government, there are a number of things that should be considered at the State and industry level as it pertains to the growth of Aerospace employment opportunities in Maryland. Portions of Section 4 address some areas for consideration by the Aerospace Industry Steering Committee and Summit participants to ensure Maryland keeps and grows its share of the Aerospace industry funding in the years to come.

3.2 The State's Challenges

Maryland experiences a more profound impact than many other areas of the country due to its proximity to the Federal Government. There is a potential problem of a shortage of skilled employees who can fill middle to senior level positions. This is not a problem unique to Maryland and its Aerospace industry. Not only will we need to attract the best and brightest employees at all levels with the appropriate skills, but these employees will have to pass rigorous background checks in order to obtain security clearances as a prerequisite to being employed in the Federally funded projects within our State. Aerospace employers working on such projects are precluded from recruiting overseas or from hiring foreign students studying in the U.S.

Over the past 6 months, the GWIB has conducted a survey of Aerospace companies and four focus groups with human resource professionals and education program managers to determine the key challenges for the industry in Maryland. Data has been collected, which will guide the discussions of action teams in the coming years to address these challenges.

The central Maryland participants were primarily from those companies that support the Aerospace industry in the Baltimore, MD, and suburban Washington, DC, region, including the largest private employers as well as the National Security Agency (NSA) at Ft. Meade, MD and NASA's GSFC in Greenbelt, MD. The southern Maryland participants were from many of the same companies, but with specific representation from the companies that support the industry at the NAVAIR. The participants in the HR sessions were the industry and State and Federal government hiring managers and HR representatives who are the most adept at understanding the workforce needs and challenges. The education representatives at the focus group session included participants from K-12 and higher education institutions, including participants from the State Department of Education, faculty and deans from State and private colleges and universities, and corporate and government management.

The outcome of these focus groups was paired with the industry and education survey data, a number of issues were raised that the Aerospace Industry Steering Committee felt warranted further research and discussion.

The four areas identified by the Aerospace Industry Steering Committee are:

- Pipeline Development
    - Two sub-groups: K-12 and Higher Education.
    - Ensuring a reliable source of interested and qualified personnel for the government and industry workforce.
- Workforce Development: Recruitment, Training and Retention
    - Maintaining the competency and corporate knowledge of the workforce over time.
- Industry Collaboration: Development and Best Practices

  - Current and new industry activity and collaboration with State organizations to grow opportunities from within the agencies and industry, and attract more work to Maryland.

- Security Clearances: Access and Availability
  - Ensuring the availability of qualified, clearable employment candidates.

Each of these focus areas are addressed in greater detail in Section 4 of this Monograph, and will be the subject of lengthy dialog during the working sessions of the January 2006 Summit.

4. Initiatives

This section examines the major workforce related issues identified by both the Aerospace Industry Steering Committee membership and the focus group participants, and reviews a number of proposed initiatives that might alleviate these issues.

The primary areas of concern identified at this point are employee attraction and recruitment, which is categorized as "Pipeline Development," and includes K-12 and Higher Education; Workforce Training and Development; Industry Collaboration; and Security Clearance Access and Availability. The following sections address each of these key areas in further detail, presenting data collected on a National and State level, and providing recommended initiatives for further discussion and pursuit of solutions.

The material in each of the following sections is broken out in two areas; the problems as they are perceived by those associated with the Aerospace industry and the State agencies, and proposed initiatives suggested by the focus groups. Summit participants will identify those strategies with the most potential, and establish project teams to work toward effecting workable solutions to the problems. Some of these may take only a short time to resolve, and some may take significant effort to resolve. These short and long-term strategies will be documented in the Post-Summit Report, and will be tracked by the Aerospace Industry Steering Committee until they are resolved, eliminated from the list, redefined or replaced by other initiatives.

4.1 Pipeline Development: Attraction and Recruitment

The problem of attraction, recruitment, and retention looms large in the minds of many government and industry representatives in the State. The problems identified include generating interest in technical disciplines at an early age, raising awareness of opportunities within the industry, recruiting the right talent, and then retaining this talent.

The need for increasing the number of employees is currently driven by a number of factors. The most notable of these is the concept of a looming "retirement cliff," or a drastic dropoff in the population of experienced and highly skilled technical personnel. This is due to a combination of circumstances, including the fact that there are fewer qualified students graduating from college with the necessary technical backgrounds, and most significantly, the impending retirement of the aging baby-boom employees who pursued technical careers.

U.S. students are also being outperformed internationally in math and science. The Trends in International Mathematics and Science Study (TIMSS) 2003 is the third comparison of mathematics and science achievement carried out since 1995 by the International Association for the Evaluation of Educational Achievement (IEA), an international organization of national research institutions and governmental research agencies. In 2003, some 46 countries participated in TIMSS, at either the fourth or eighth-grade level, or both. The study found that U.S. students scored above the international average in 4th grade, slightly above average in the 8th grade, and near the bottom in 12th grade.

While there is occasional disagreement within the industry on whether a retirement cliff actually exists, there are, in fact, significant signs that a major workforce crisis is looming in the Aerospace industry somewhere in the near future. The likely retirement 'bulge" in the workforce sets up a scenario that could severely limit Maryland and U.S. Aerospace industry development.

Maryland's population is aging and the number of Aerospace employees eligible for retirement will increase dramatically in just a few years. For instance, NASA currently has three times as many technicians over the age of 60 as under the age of 30. Already tough to fill positions will increase with a dearth of experienced employees to fill the vacancies. This presents a problem for employers not only to fill positions, but for the industry as a whole to remain competitive globally. While employers currently do not have a problem filling vacancies in lower level positions the growing need for employees in middle and senior level positions as well as a expanding technologies draining the pool of potential employees paints a dismal picture for the future.

To reiterate statistics cited earlier, survey data collected by the GWIB Aerospace Industry Steering Committee indicates that 79.5% of Maryland's Aerospace workforce is age 51 or above (6.9% are above age 60). The average age employees retire is 64. As a result, 50% of the current Aerospace workforce in Maryland is expected to retire in the next 15 years.

The institutional memory held by these employees is important to the growth of the industry. These employees hold mid and senior level positions that are not easily filled. Due to fewer college students studying math, engineering, and science the pipeline of qualified new employees is shrinking.

The threat of a workforce shortage hangs over the industry. Employees from non-technical fields cannot easily transfer skills to Aerospace. There are also concerns that competition for qualified candidates could increase in the future as employers fight for the few college graduates whom possess the necessary degrees and experience that translates to this highly technical and specialized industry.

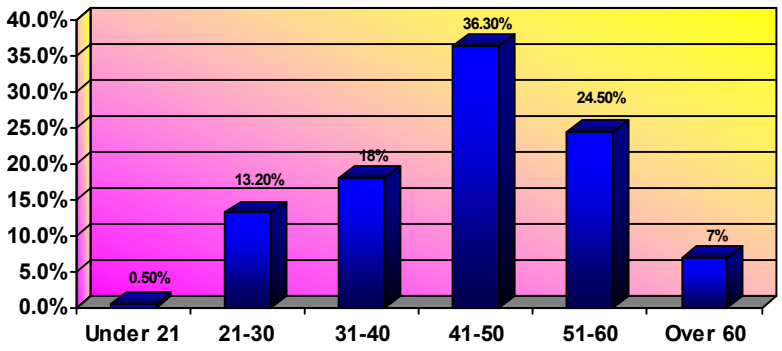


Figure 4-1. Ages of MD Aerospace Employees

There has also been significant attention paid to the increasing difficulty of attracting younger workers to the industry, developing talent of entry and middle level technical and managerial personnel, taking advantage of and effectively transferring knowledge from the senior level experts in their fields, and ensuring continuity of knowledge and innovation as older workers move into retirement.

4.1.1 The Role of Maryland Educational Institutions

A pipeline of highly qualified workers must be developed to meet the rapidly changing demands of Maryland's Aerospace industry. In order to keep pace with the growth of the space program, Maryland business leaders and educators must work collaboratively and take bold actions.

This section of the Monograph describes the role of Maryland secondary and postsecondary education in addressing the workforce needs of Maryland's Aerospace industry and the escalating demand for students proficient in science, technology, engineering, and math. Issues and challenges facing Maryland education are presented as well as recommended initiatives to develop the K-16 pipeline. Section 4.1.2 specifically addresses those discussions related to the State's K-12 educational institutions, and Section 4.1.3 addresses discussion s regarding the State's higher education institutions.

The State of Maryland boasts one of the most highly educated workforces in the nation

Maryland must invest in the creation of individuals with advanced degrees in order to backfill retirees that will take institutional memory and specialization with them.

A study performed for the Defense industry and presented in June 2005, at the U.S. Military Academy, West Point, NY illustrates the reasons for the concern within the Aerospace industry as a whole. This study also underscores the need for involvement of the educational community in preparing future members of the Aerospace workforce.

Data obtained from the National Science Foundation indicates that between 1994 and 2001, there was a dramatic increase in the enrollment of non-U.S. Citizens in highly specialized engineering and science disciplines. There was a dramatic corresponding enrollment decrease in these engineering and science studies by U.S. students. The overall impact of this is not fully understood, because while many of these specialized disciplines are in high demand, the employability of these graduates in Maryland, particularly on Federal contracts, is not known. We do not have current or detailed data on the nationality of the students graduating from these programs, but it is generally understood that the majority of these students are not from Maryland, and most of those not from Maryland are also not U.S. Citizens. Thus, while State colleges and universities are doing an admirable job in graduating highly skilled individuals, many of these return to their home states or countries.

Figure 4-2 depicts National trends in graduation, by field of expertise, in the science fields between 1994 and 2001. In three of the four disciplines shown here, physics, chemistry and math, U.S. Citizen enrollments in graduate school appear to have dropped between 10 and 27 percent. In the fourth discipline, computer science, U.S. Citizen enrollment appeared to rise by 14 percent. However, during the same time period temporary visa alien enrollments rose more than 100 percent.

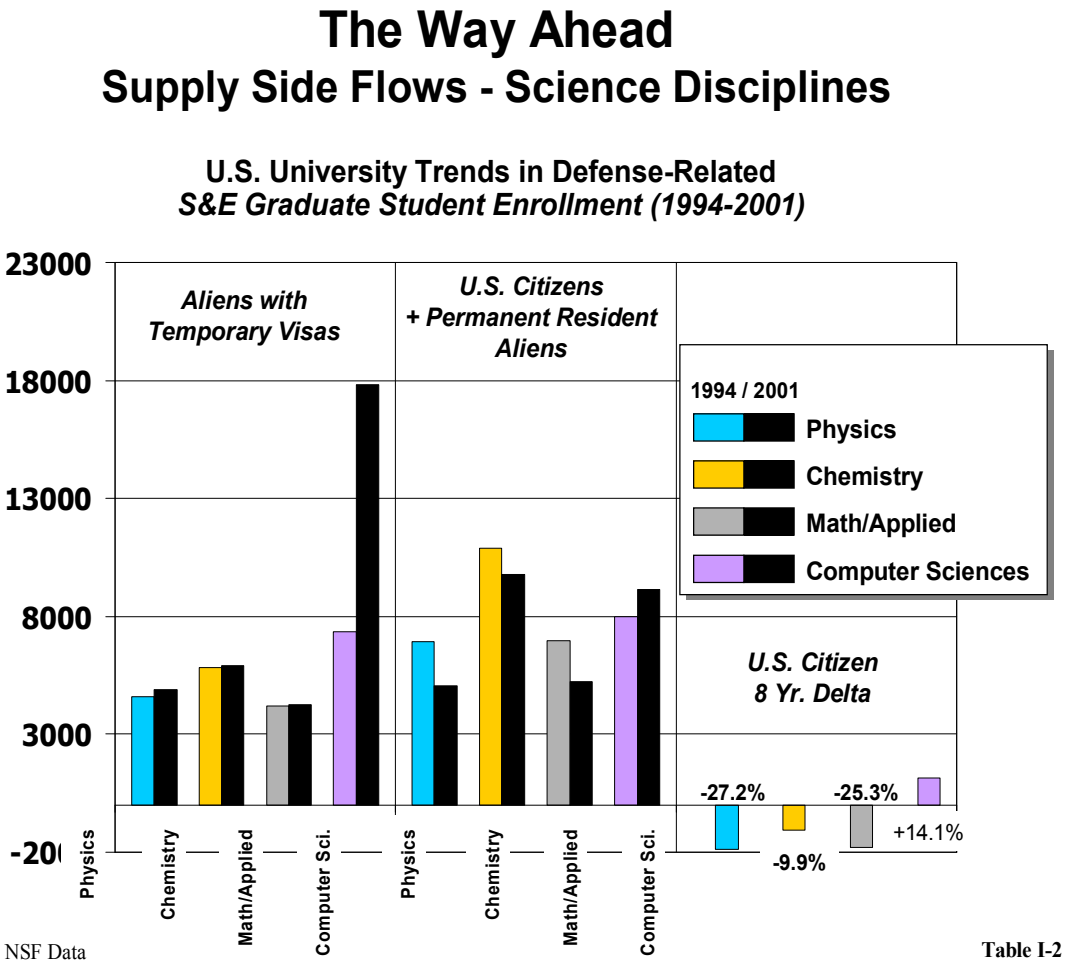


Figure 4-2. Supply Side Flows - Science Disciplines

Figure 4-3 also depicts National trends in graduation, by field of expertise, in the engineering fields between 1994 and 2001. Here, all of the engineering discipline data imply a decrease in the number of U.S. Citizen engineering graduate students, with these decreases ranging from 19 to 49 percent. During this same period, graduate enrollment of aliens with temporary visas increased in all disciplines except nuclear engineering.

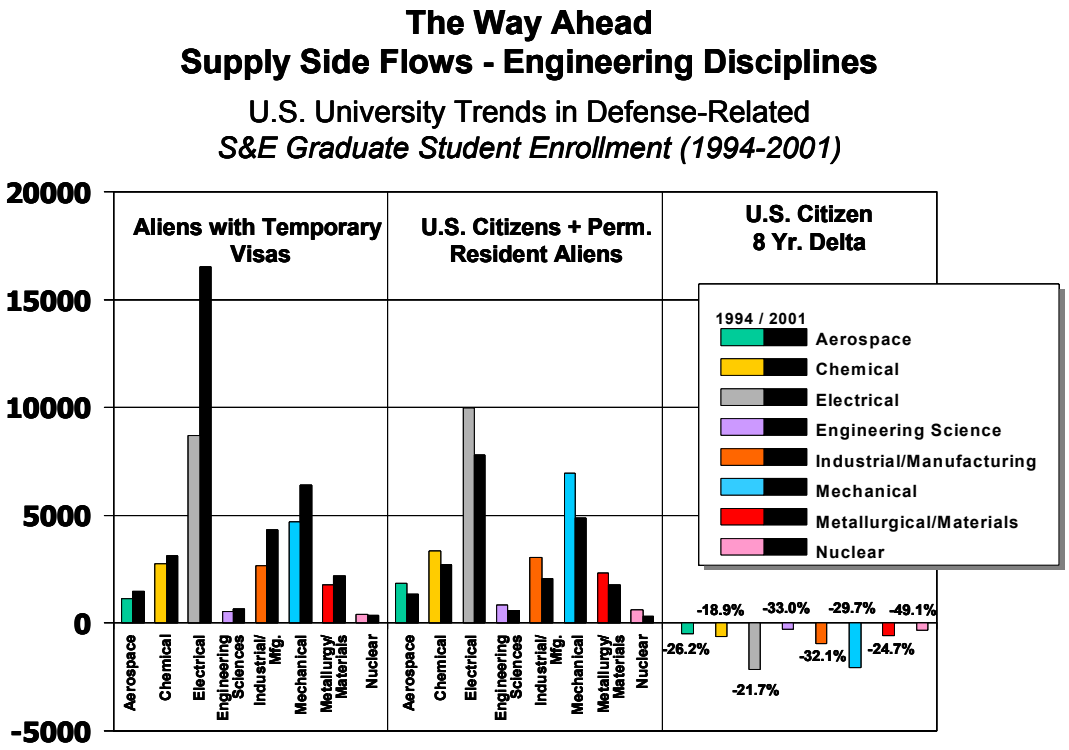


Figure 4-3. Supply Side Flows - Engineering Disciplines

While the data in these figures is considered somewhat dated relative to this report, and we understand that the number of alien student temporary visa has been restricted since the terrorist attacks of September 11, 2001, this enrollment trend has generally continued. The appearance of this data in this section of the Monograph is intended to underscore the need for better preparation of our young U.S. citizens for careers in technology industries in general, and the Aerospace industry in particular, and to set the stage for the subsequent discussions on the necessary role of the K-12 and higher education institutions in the State. The challenge to our educational systems will be significant in the coming years. Without adequate college preparation of our own U.S. citizen K-12 students, and the preparation of our own college students for the challenges of the new workplace, Maryland will be faced with a workforce dilemma that will be hard to overcome.

On September 30, 2005, the Aerospace Industry Steering Committee held a meeting on "Industry Education Partnerships in the Aerospace Industry in Maryland." Thirty-seven participants attended this working session, including industry education program managers, the deans of university engineering departments, and K-12 education program managers.

The purpose of this dialogue was to discuss the current investments that industry is making to improve the Aerospace workforce in Maryland and to discuss whether there was a need to improve the coordination of isolated efforts.

Participants were shown data on Maryland's Aerospace industry demand for specific Aerospace occupations that had emerged from the three Aerospace HR focus groups and a HR survey. In addition, they were given information about Maryland's ability to generate its own "supply" for the Aerospace industry in the State. They were shown statistics on the graduation rates in Aerospace-related areas of study in Maryland's higher education system based on high growth occupations identified by the industry. They were also given statistics about Maryland's youth and their success in science and math based on a couple of different measures used by the Maryland State Department of Education.

Participants were then asked for their impressions about the quality of current students and programs. Although the questions were varied, in essence, they asked whether the situation should or could be refined in any way by better coordinating the communication between industry, education, and government. The issues raised and strategies proposed are incorporated into the following discussions.

4.1.2 Pipeline Development Part I: K-12 Education

In order to determine the role that industry can play in developing a pipeline of individuals with the requisite knowledge and technical skills for the Aerospace industry, it is important to understand what is currently happening in Maryland's education systems at both the secondary and postsecondary levels.

Earning a Diploma: Students can earn a Maryland diploma in one of three ways. They can be:

a. A University System of Maryland completer, which means they satisfy the minimum requirements for entry at any of Maryland's 4-year public institutions of higher education.

b. A Career and Technology Education completer, which means they successfully earned four or more credits in a State-approved career program that was comprised of a sequence of courses.

c. A dual completer, which means they satisfied both a and b.

In earning a diploma, students who do a combination of four or more of the following also meet the rigorous high school program indicators:

a. Two or more credits in the same foreign language with a "B" or better.

b. One or more credits in a mathematics course higher than Algebra II and Geometry with a "B" or better.

c. Four credits of science with a "B" or better.

d. Two or more credits of an approved advanced technology education with a "B" or better.

e. Score 1,000 or higher on the SAT or score 20 or higher on the ACT.

f. A cumulative GPA of 3.0 or higher on a 4.0 scale.

Table 4-1 shows the number and percent of students meeting graduation and the rigorous high school program indicator requirements.

Table 4-1. Percent of Students Meeting Requirements

High School Program Completion: All Students		
Maryland High School Diploma	54,170	98.9%
a. University System of Maryland Course Requirements	31,216	57.0%
b. Career and Technology Education Program Requirements	7,369	13.5%
c. Both University and Career/Technology Requirements	6,579	12.0%
d. Rigorous High School Program Indicators	13,363	24.4%
e. One or more of Categories a, b, c, or d	45,377	82.9%
Total 12th Grade Number	54,737	

Source: 2005 Maryland School Report Card

Refer to Table 4-2 for rigorous course indicators for mathematics and science:

Table 4-2. Rigorous Course Indicators

Subject	Number of Students	Percent of Students
Mathematics	17,369	29.7%
Science	12,042	20.6%
Source: 2004 CTE Performance Report		

Advanced Placement (AP): In 2004, 13,073 Maryland Students Passed the AP Exam with a score of "3" or Higher in the following areas (refer to Table 4-3).

Table 4-3. Advanced Placement

Subject	# Passed	# of Test Takers	Percent
Biology	1,993	3182	62.6%
Calculus AB	2,666	4027	66.2%
Calculus BC	2,008	2552	78.7%
Chemistry	1,243	2150	57.8%
Computer Science A	452	673	67.2%
Computer Science AB	280	374	74.9%
Environment Science	845	1529	55.3%
Physics B	543	856	63.4%
Physics C (Electronics & Magnetism)	396	539	73.5%
Physics C (Mechanics)	713	992	71.9%
Statistics	1934	2989	64.7%

4.1.2.1 How is Maryland Secondary Education Responding?

Project Lead The Way (PLTW): PLTW is pre-engineering program. Its mission is to create dynamic partnerships with the nation's schools to prepare an increasing and more diverse group of students to be successful in engineering and/or engineering technology programs.

All students in the PLTW program take the three foundational courses and the capstone course. The school and school system chooses which pathway course it will implement (refer to Table 4-4).

Table 4-4. Pathway Courses

Foundation Courses	Capstone Course	Pathway Courses
▪ Principles of Engineering ▪ Introduction to Engineering Design ▪ Digital Electronics	▪ Engineering Design and Development	▪ Computer Integrated Manufacturing ▪ Civil, Engineering and Architecture ▪ Aerospace Engineering ▪ Biotechnical Engineering

Schools in Maryland started implementing PLTW in the 2003-2004 school-year. Currently, PLTW is in 15 Maryland school systems with over 950 students. Additionally, two schools are implementing the Aerospace Engineering pathway course which is being piloted throughout the United States this school-year.

Technology Education: All students in Maryland must complete one credit of Technology Education in order to graduate. Technology Education is an integrated instructional program. It results in the application of mathematics and science concepts in technology systems. Students discover, create, solve problems and construct by using a variety of tools, machines, materials, processes and computer systems. The Maryland State Board of Education recently accepted a Technology Education Voluntary State Curriculum which aligns to national standards for technological literacy. The national standards were developed through a collaborative effort of International Technology Education Association, NASA, National Science Foundation and the National Academy of Engineers.

4.1.2.2 Challenges

One of the greatest challenges to filling the pipeline is teacher staffing. Table 4-5 identifies some of the current and most persistent areas of teacher shortage. The national press has reported nationwide shortages in most of the same areas as Maryland. Because of this, Maryland's local school systems are in competition with neighboring states and the nation.

Table 4-5. Teacher Shortages

Career and Technology ▪ Technology Education (7-12)
Computer Science
Mathematics (7-12)
Science ▪ Chemistry (7-12) ▪ Earth/Space (7-12) ▪ Physical Science (7-12) ▪ Physics (7-12)

Source: Maryland Teacher Staffing Report 2005-2007

The following issues have been identified by the Aerospace Industry Steering Committee members and the focus group participants as actual or perceived problems associated with the K-12 Educational System that likely have direct correlation to the Aerospace industry in Maryland.

Problems identified by the Aerospace Industry Steering Committee in the areas of Pipeline Development: K-12 Education include:

a. Overall, U.S. born high school students seem less enthusiastic than they used to be about math, science and technology education and are less likely to take advanced coursework in these areas.

b. There are not enough U.S. citizen high school graduates applying for higher education programs that would prepare them for high demand occupations in Aerospace.

c. There is a perceived lack of awareness by students and educators about career opportunities within the Aerospace industry.

d. There is a disconnection between the skill-set lexicon used by industry and that used by the educational system. Because educational institutions do not use the same language as industry, industry cannot always determine the usefulness and relevancy of skill sets developed by students entering the workplace.

e. Science, math and technology education teachers need more industry relevant skills.

f. The transition from high school math and science to college engineering programs is not smooth. Graduating high school students do not have the necessary applied math and science skills. They often do not have enough practical knowledge to complete college courses although they may be able to pass entrance test requirements.

g. High schools have insufficient information about existing innovative pre-engineering programs such as PLTW. This is particularly true in smaller schools in rural areas. These schools could also use assistance in the program application process. In particular, Washington County and Southern Maryland were cited as areas that could use more information and assistance. Additional high schools may be interested in developing programs.

h. High school students need additional information about the availability of higher education programs specifically designed for high demand Aerospace careers. Additional information may help students to prepare early for acceptance into appropriate higher education programs.

i. The development of an AP engineering program should be explored.

j. There is not enough participation by U.S. Citizen students in existing AP and international baccalaureate programs.

   1. Students may not understand and appreciate the value of these programs for entry into higher education programs.

   2. An insufficient number of high schools offer these programs.

k. High school students with internship and practical skills associated with high demand occupations in aerospace are not adequately tracked in Maryland as a resource for industry jobs.

l. There is insufficient geographic distribution of K-12 institutions in Southern Maryland. Employees recruited to come to the area are disappointed in the educational resources available to their children.

m. There is a shortage of math, science and technology education teachers.

n. There are not enough women graduating from high school entering higher education programs associated with high demand occupations in Aerospace.

o. There are not enough minorities with U.S. Citizenship graduating from high school entering higher education programs associated with high demand occupations in Aerospace.

The following initiatives have been identified by the Aerospace Industry Steering Committee members and the focus group participants as possible solutions or recommendations associated with the K-12 Educational System that might mitigate those problems being experienced by the Aerospace industry employers in Maryland.

Recommended Initiatives by the Aerospace Industry Steering Committee in the areas of Pipeline Development: K-12 Education include:

a. Reinvigorate the math, science and technology education curriculum to make it more relevant and interesting for all students in K-12.

   1. Promote applied activities and field trips.

   2. Invite aerospace professionals to teach classes or organize after school activities.

b. Improve math and science literacy for all Maryland K-12 students.

   1. Promote early identification of problems.

   2. Promote early identification of talented underrepresented groups for mentoring and encouragement in math and science, including U.S. Citizen females and minorities.

   3. Update math and science curriculum and promote relevance to Aerospace careers.

   4. Increase the total numbers of math, science and technology education teachers.

c. Expand industry advisory boards to all K-12 institutions.

d. Create a STEM Center of Excellence in STEM Education for Maryland.
    1. Create a central place where information can be shared.
    2. Conduct Return on Investment analysis of programs.
    3. Facilitate post-secondary partnerships
e. Grow more math, science and technology teachers with industry relevant skills.
    1. Align teacher programs with industry needs.
    2. Encourage the hiring of retired professionals from the Aerospace industry as teachers and teacher mentors.
f. Investigate the viability of developing AP engineering programs in the schools.
g. Work with higher education to develop articulation agreements between high school pre-engineering programs such as PLTW and college programs.
h. Develop and expand high school credit for Aerospace industry internships and industry sponsored education programs.
i. Create collaborative mechanism between industry and education to identify and track students with practical, technical skills for recruitment into industry.
j. Initiate a concerted outreach effort to high school programs throughout Maryland to increase awareness of pre-engineering programs such as Project Lead the Way. Provide application assistance wherever necessary.
k. Create a mechanism to identify current Aerospace internship opportunities and shortfalls and then develop an approach to expand as necessary.
l. Expand criteria for creating K-12 schools in Southern Maryland where there are not enough schools to support recruitment efforts of employees to the area.

4.1.3 Pipeline Development Part II: Higher Education

The following sections address the current role of the higher education institutions in the State of Maryland. Much of the statistical data has been compiled by the Maryland Department of Education, and is further supported by data provided by the Aerospace Industry Steering Committee industry representatives, focus group participants as part of their focus group discussions, as well as the industry survey data.

4.1.3.1 Commitment to Workforce Development

Maryland looks to its colleges, universities, community colleges, and private career schools for leadership in meeting Maryland's rapidly changing workforce needs. Maryland postsecondary

institutions provide rich and diverse educational opportunities for research, learning, and preparation for initial employment, career advancement, and career changes.

What institutions comprise postsecondary education in Maryland and contribute to the development of the State's overall workforce? Table 4-6 provides a breakdown of all segments of postsecondary education in Maryland and their reported enrollments in FY 2004.

Table 4-6. MD Higher Education Institutions and Enrollment

Segments of Postsecondary Education	Institutions	Enrollments
Community Colleges	16	118,947
University System of Maryland	11	128,806
Morgan State University	1	6,892
St. Mary's College of Maryland	1	1,935
Independent College & Universities	29	53,902
Private Career Schools	164	32,506
Total	222	342,988

Maryland's postsecondary institutions are committed to addressing the workforce needs of the State. Goal 5 of the 2004 State Plan for Postsecondary Education is to: "*Promote economic growth and vitality through the advancement of research and the development of a highly qualified workforce.*" Included under this goal is an action recommendation to: "*Increase the supply of qualified graduates in identified high demand fields and workforce shortage areas by adopting strategies tailored to specific occupational fields.*"

4.1.3.2 Supply Data – Maryland Postsecondary Education

What programs and courses must Maryland's colleges, universities, and community colleges provide to meet the projected workforce needs of Maryland's Aerospace industry? In this section, data compiled by the Maryland Higher Education Commission is provided for select engineering, physical science, mathematics, and aviation programs offered by Maryland colleges, universities, and community colleges. Data is presented that measures the supply of potential Aerospace workers produced by Maryland postsecondary institutions over a 10-year period.

Employer focus groups identified the projected demand occupations within Maryland's Aerospace industry and the academic programs required to prepare graduates for entry and advancement in these fields. Occupations and occupational specialties that are "difficult to fill" and projected to "continue to grow" were identified by two Aerospace employer focus groups convened by the GWIB and facilitated by Bruce Mahone of the AIA. A compiled list of these occupations and specialties is presented in Table 4-7.

Table 4-7. Occupations and Specialties in Maryland's Aerospace Industry

Occupations and Specialties Reported by Aerospace Companies as Growing and/or Difficult to Fill			
	Continue to Grow	**Difficult to Fill**	**Discipline or Field**
Scientific Occupations:			
Engineering - Computer Network Engineer	x		Engineering - Computer
Engineering - Contamination Engineer	x		Engineering
Engineering - Electrical Engineer	x		Engineering - Electrical
Engineering - Engineering Manager	x		Engineering - Management
Engineering - Propulsion	x		Engineering - Mechanical
Engineering - Quality Engineer	x		Engineering - Reliability (Quality)
Engineering - Robotics	x		Engineering - Mechanical
Engineering - Systems Engineer	x	x	Engineering - Systems
Flight Engineer		x	Engineering - Flight
IT Security/Security Personnel	x	x	IT
Physicists	x	x	Physics
Scientific Occupational Specialties:			
Access Control	x		
Artificial Intelligence	x		
Avionics - flight guidance	x		Avionics
Avionics - navigation	x		Avionics
Communications - Optical	x		Communications
Communications - Radio	x		Communications
Communications - Satellite	x		Communications
Control Systems	x		
Cryogenics	x		
Detector Systems	x		
Laser	x		
Nanotechnology	x		
Remote Sensing	x		
Flight Operations		x	Avionics
Program Management		x	Science/Mgmt
Non-Scientific Occupations:			
Contract Specialist/Procurement Specialist/Program Control		x	Finance/Mgmt

Additionally, an informal Academic Program Survey was administered to eight Maryland Aerospace companies participating in an April 13, 2005, focus group. The companies were requested to review a list of 72 academic programs and indicate the demand within their company for graduates of each program. Employers were asked to identify whether each program is either "in little or no demand," "in demand," or "in most demand."

Table 4-8 reports the results of the survey. From the list of 72 programs, 45 programs were reported "in demand." Seventy-five percent of the companies surveyed identified a demand for the first five programs identified in Table 4-9, with many of them reported in "most demand."

Summarized in Table 4-9 are the occupations identified in high demand by the employer focus groups and the Academic Program Survey. Because of the high demand and special concerns expressed by Maryland companies for these occupations, postsecondary programs that prepare graduates for these occupations are the primary focus of this section. In addition, available graduate data is provided for 28 of the 45 types of programs also identified in demand by Maryland's Aerospace employers in the Academic Program Survey.

For this monograph, graduate data was compiled for over 300 individual engineering, physical science, mathematics, and aviation programs offered by 35 Maryland institutions of higher education from FY 1996 to FY 2005. Included are the programs of 20 colleges and universities, 14 community colleges, and 1 independent 2-year college. Reported are graduates of postsecondary programs at all degree levels – Certificate, Associate, Baccalaureate, Masters, and Doctorate.

Before examining the supply of potential Aerospace workers produced by Maryland postsecondary institutions, there are several points to take into consideration. First, most of the programs described in this section prepare graduates to work in a variety of industries in Maryland, in the rest of the country, and the world. Therefore, Maryland Aerospace companies must compete with other industries for graduates of these engineering, science, technology, and math programs. Similarly, Maryland Aerospace companies are not limited to the graduates of Maryland schools, but aggressively recruit both nationally and internationally for the most qualified professionals.

Second, although Maryland's Aerospace companies identified specific demand occupations and the academic programs that prepare graduates for these occupations, as yet, there is no indication of the quantity required. For higher education to effectively address the workforce needs of Maryland's Aerospace industries, sufficient data must be available to conduct a supply and demand analysis to identify and quantify any gaps in the supply.

Third, this section measures the supply of potential workers from selected Maryland postsecondary programs. For the most part, these program graduates are prepared for entry into the Aerospace industry. Only the advanced degree programs offered by Maryland's college and universities address the critical need for qualified professionals to fill mid-level positions within Maryland's Aerospace companies.

Table 4-8. Demand of Aerospace Industry for Higher Education Programs

(Eight Aerospace Companies' Responses to April 13, 2005 Survey)

Most Demand	Some Demand	Total	Programs	Fields
# Companies				
7	1	8	**Electrical, Electronics, & Communications Engineering**	Engineering
7	1	8	**Systems Engineering**	Engineering
5	2	7	**Computer Engineering**	Engineering
4	3	7	**Aerospace, Aeronautical, and Astronautical Engineering**	Engineering
4	2	6	**Mechanical Engineering**	Engineering
3	2	5	Computer & Information Sciences, General	IT
4		4	Computer Programming	IT
2	2	4	Engineering	Engineering
1	3	4	Materials Engineering	Engineering
1	3	4	Engineering Physics	Engineering
1	3	4	Physics, General	Science
0	4	4	Applied Mathematics	Mathematics
	4	4	**Engineering Mechanics**	Engineering
1	2	3	Reliability Engineering	Engineering
1	2	3	Statistics, Mathematical & Theoretical	Mathematics
1	2	3	Information Science & Systems	IT
	3	3	Mathematics, General	Mathematics
1	2	3	Systems Analysis	IT
	3	3	Astronomy	Science
2		2	Telecommunications	Engineering
2		2	Physical Sciences, General	Science
1	1	2	Atmospheric Sciences and Meterology	Science
1	1	2	Geophysics & Seismology	Science
	2	2	Chemical Engineering	Engineering
	2	2	**Industrials & Management Engineering**	Engineering
	2	2	**Engineering Management**	Engineering
	1	2	Data Processing	IT
	2	2	Chemistry, General	Science
	2	2	Geology	Science
	2	2	Electromechanical Technologies	Technology

Table 4-8. Demand of Aerospace Industry for Higher Education Programs (cont)

Most Demand	Some Demand	Total	Programs	Fields
# Companies				
1		1	Computer Programmer Technologies	IT
	1	1	Geological Engineering	Engineering
	1	1	Ceramic Engineering	Engineering
	1	1	Computer Operator & Peripheral Equipment Operation Technologies	IT
	1	1	Data Processing Equipment Maintenance Technologies	IT
	1	1	Molecular Physics	Science
	1	1	Nuclear Physics	Science
	1	1	Inorganic Chemistry	Science
	1	1	Organic Chemistry	Science
	1	1	Physical Chemistry	Science
	1	1	Geochemistry	Science
	1	1	Oceanography	Science
	1	1	Architectural Drafting Technology	Technology
	1	1	Instrumentation Technologies	Technology
	1	1	Mechanical Technologies	Technology

Table 4-9. Occupations and Projected Demand

High Demand Occupations/Academic Programs	Academic Programs In Demand	Occupations Projected to Continue to Grow	Occupations Difficult to Fill
Electrical Engineer	X	X	
Systems Engineer	X	X	X
Computer Engineer	X	X	
Aerospace (Flight) Engineer	X		X
Mechanical Engineer	X	X	X
Physicist	X	X	X
Reliability (Quality) Engineer	X	X	
Engineering Manager	X	X	

Finally, this section does not include any information on the extent to which continuing education and training is provided to Aerospace professionals by Maryland's higher education institutions. Statewide data is not available at this time. As indicated in Table 4-7, there is a need for Aerospace professionals with expertise in a variety of new and emerging specialties including, but not limited to, nanotechnology, artificial intelligence, lasers, cryogenics, and remote sensing. Higher education must work collaboratively with Maryland's Aerospace industry to keep abreast of the shifting training needs and provide the appropriate type, level, and volume of continuing education required by the industry.

4.1.3.3 10-Year Graduate Trends for Eight High Demand Programs

As noted in the following paragraphs and Figure 4-4, five of the eight most high demand programs experienced increased numbers of graduates from FY 1996 to FY 2005. Increases were reported for:

a. Electrical Engineering.

b. Systems Engineering.

c. Computer Engineering.

d. Aerospace Engineering.

e. Mechanical Engineering.

Electrical Engineering

- Electrical engineering programs are offered at the graduate and undergraduate levels at the following Maryland colleges and universities (refer to Table 4-10).
- 547 total electrical engineering graduates were produced in FY 2005, after a 3-year recovery from a record low of 419 graduates in FY 2002.
- 48% of the total electrical engineering graduates completed advanced degrees at the Masters and Doctorate level in FY 2005.

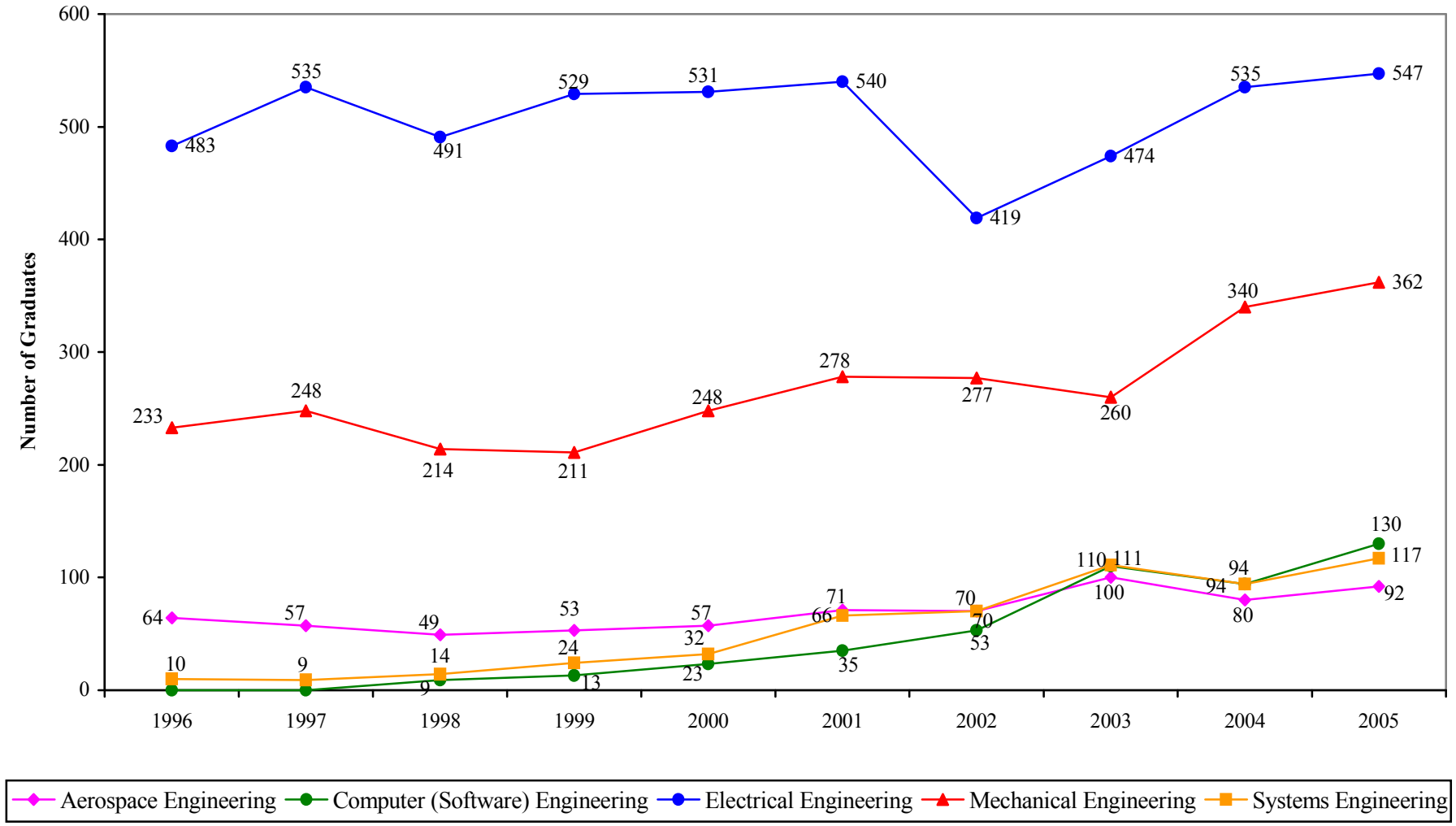


Figure 4-4. 10-Year Graduate Trends: Maryland Engineering Programs with Increased Graduates from FY 1996 to FY 2005

Table 4-10. Electrical Engineering Programs

Higher Education Institutions	Program Levels		
	Bachelors	Masters	Doctorate
Capitol College	X		
Johns Hopkins University	X	X	X
Loyola College	X		
Morgan State University	X		
University of Maryland, Baltimore County		X	X
University of Maryland, College Park	X	X	X

Systems Engineering

- Systems engineering programs are offered only at the graduate level by the following Maryland universities (refer to Table 4-11).
- Systems engineering programs are relatively new and experienced a dramatic 1070% increase in graduates from FY 1996 to FY 2005. Ten graduates were produced in FY 1996 compared to 117 in FY 2005.
- 84% of the FY 2005 graduates completed Masters degree programs.

Table 4-11. Systems Engineering

Maryland Higher Education Institutions	Program Levels	
	Graduate Certificate	Masters
Johns Hopkins University	X	X
University of Maryland, College Park	X	X

Computer Engineering

- Computer engineering is another relatively new field. The following Maryland colleges and universities offer programs at the undergraduate and graduate levels (refer to Table 4-12).
- The first computer engineering graduates were produced at the undergraduate level in FY 1999 and at the graduate level in FY 2000.
- In FY 2005, 95% of the graduates completed an undergraduate program.

Table 4-12. Computer Engineering

Higher Education Institutions	Program Levels	
	Bachelors	Masters
Capitol College	X	
Johns Hopkins University	X	
University of Maryland, Baltimore County	X	X
University of Maryland, College Park	X	

Aerospace Engineering

- Aerospace engineering programs are offered at the undergraduate and graduate levels at the following Maryland universities (refer to Table 4-13).
- The 92 Aerospace engineering graduates produced in FY 2005 represent a 67% increase in graduates from FY 1996. However, the FY 2005 level is down from a high of 100 graduates in FY 2003.
- 54% of the total Aerospace engineering graduates completed advanced degrees at the masters and doctorate level in FY 2005. This is significant because foreign students comprise a majority of those graduating with advanced degrees.

Table 4-13. Aerospace Engineering Programs

Higher Education Institutions	Program Levels		
	Bachelors	Masters	Doctorate
Johns Hopkins University		X	
University of Maryland, College Park	X	X	X

Mechanical Engineering

- Programs in mechanical engineering are offered at the undergraduate and graduate levels at the following Maryland universities (refer to Table 4-14).
- University of Maryland, Baltimore County, offers graduate certificate programs in Computational Thermal/Fluid Dynamics and in Mechatronics.
- 362 mechanical engineering graduates were produced in FY 2005, representing a 10-year high and a 55% increase over the 233 graduates in FY 1996.
- 72% of the mechanical graduates produced in FY 2005, completed a bachelors degree.

Table 4-14. Programs in Mechanical Engineering

Higher Education Institutions	Program Levels		
	Bachelors	Masters	Doctorate
Johns Hopkins University	X	X	X
University of Maryland, Baltimore County	X	X	X
University of Maryland, College Park	X	X	X

As shown in Figure 4-5, the following three programs reported decreased numbers of graduates in FY 2005, compared to FY 1996:

a. Engineering Management.

b. Reliability (Quality) Engineering.

c. Physics, General.

Engineering Management

- Engineering management programs are offered at the graduate level by the following Maryland institutions (refer to Table 4-15).
- The already small supply of engineering management graduates is declining. In FY 2005, only 4 program graduates were reported, representing an 85% decrease from the 26 graduates produced in FY 1996.

Table 4-15. Engineering Management

Higher Education Institutions	Graduate Certificate	Masters
Capitol College	X	
University of Maryland, Baltimore County		X
University of Maryland University College (with UMBC)		X

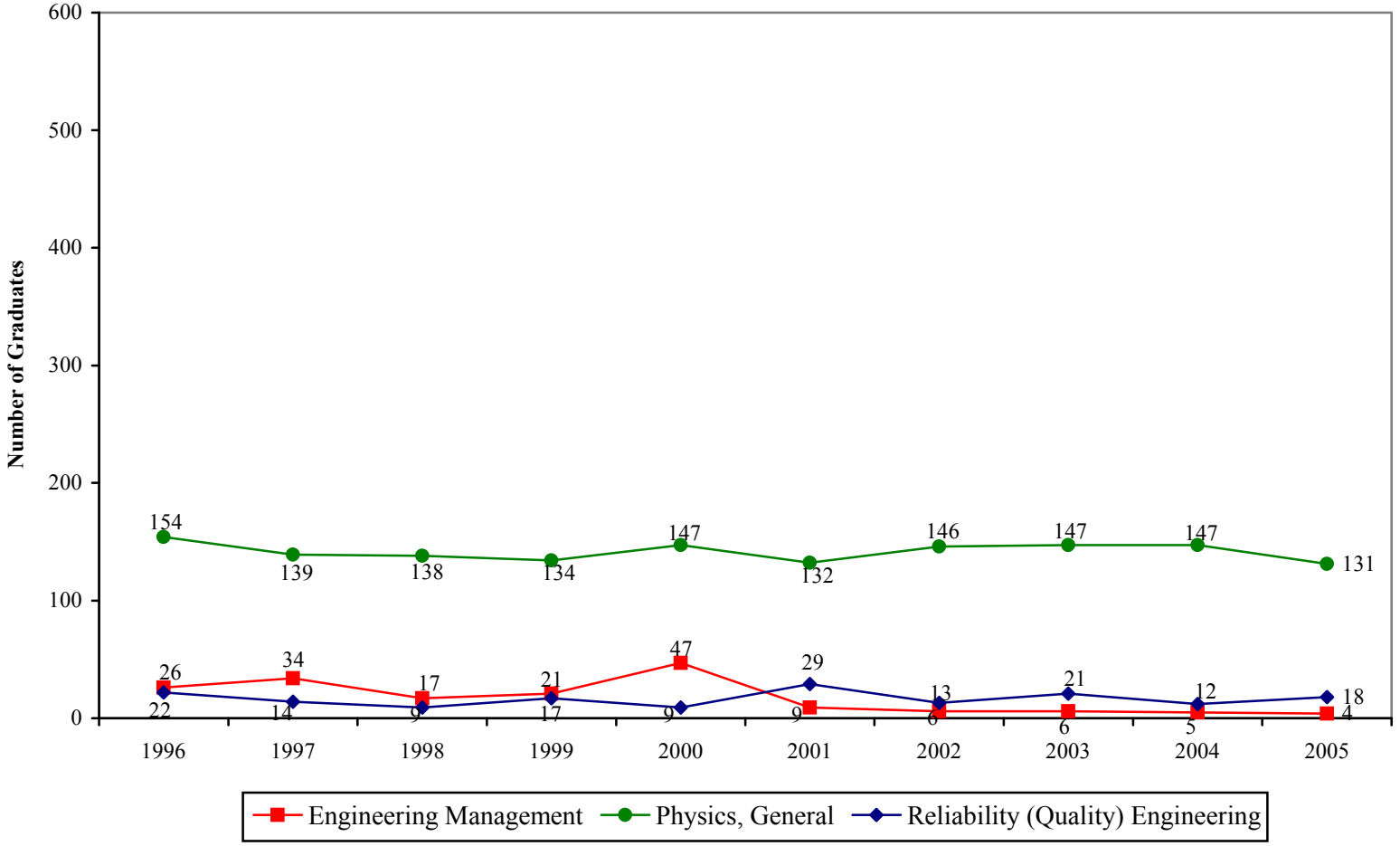


Figure 4-5. 10-Year Trends: Maryland Engineering and Science Programs with Decreased Graduates from FY 1996 to FY 2005

Reliability (Quality) Engineering

- Reliability engineering programs are offered by one institution at the graduate level.
- There were 18 Program Graduates in FY 2005, representing an 18% decrease over the 22 graduates reported in FY 1996. (Refer to Table 4-16).

Table 4-16. Reliability (Quality) Engineering

Higher Education Institutions	Program Levels	
	Masters	Doctorate
University of Maryland, College Park	X	X

Physics, General

- The following Maryland institutions offer programs in general physics at the undergraduate and graduate levels (refer to Table 4-17).
- A 10-year low of 131 graduates was produced in FY 2005.
- 39% of the graduates completed advanced degrees at the Masters and Doctorate level.

Table 4-17. Physics, General

Higher Education Institutions	Program Levels		
	Bachelors	Masters	Doctorate
College of Notre Dame	X		
Columbia Union	X		
Frostburg State University	X		
Goucher College	X		
Johns Hopkins University	X	X	X
Loyola College	X		
McDaniel College	X		
Morgan State University	X		
Salisbury University	X		
St. Mary's College	X		
Towson University	X		
University of Maryland, Baltimore County	X		
University of Maryland, College Park	X	X	X
Washington College	X		

Figure 4-6 provides a breakdown, by degree level, of the FY 2005, graduates completing the eight high demand engineering and science programs. Note that three of these programs are offered only at the graduate degree level. They are:

a. Systems Engineering.

b. Engineering Management.

c. Reliability (Quality) Engineering.

In addition, over 40% of the graduates from the following programs completed advance degrees: (1) electrical engineering and (2) Aerospace engineering. This is significant, because, according to the engineering deans participating in the Aerospace focus groups, foreign students comprise a majority of program graduates obtaining advanced degrees. This means that a significant number of graduates from Maryland's postsecondary programs may not be eligible for the increasing number of Aerospace-related positions requiring security clearances.

4.1.3.4 10-Year Trends for 28 Demand Programs:

Table 4-18 presents available data for 28 programs reported in demand by Maryland Aerospace companies on the Academic Program Survey.[1] Identified are: (1) the number of graduates in FY 1996 and FY 2005 and (2) the percent change between FY 1996 and FY 2005. More than half of these 28 programs increased the number of graduates from FY 1996 to FY 2005. Four programs had over 100 additional graduates and two others had an additional 50 graduates.

Among the 13 programs with decreased numbers of graduates in FY 2005, the reductions were small. No program reported a loss of more than 25 graduates.

Figure 4-7 reports the change from FY 1996 to FY 2005 in total graduates in selected engineering, science, and technology programs offered by Maryland higher education institutions. Programs are listed by the change in the number of graduates from FY 1996 to 2005.

[1] The following 10 types of programs are not reported because graduate data is not broken out for these specialties: (1) Geophysics & Seismology, (2) Geological Engineering, (3) Ceramic Engineering, (4) Molecular Physics, (5) Nuclear Physics, (6) Inorganic Chemistry (7) Organic Chemistry, (8) Physical Chemistry, (9) Geochemistry, (10) Oceanography.

In addition, data is not currently compiled for the following eight types of Information Technology (IT) programs: (1) Computer & Information Sciences, General (2) Computer Operator & Peripheral Equipment Operation Technologies, (3) Computer Programmer Technologies, (4) Computer Programming, (5) Data Processing, (6) Data Processing Equipment Technologies, and (7) Information Science & Systems.

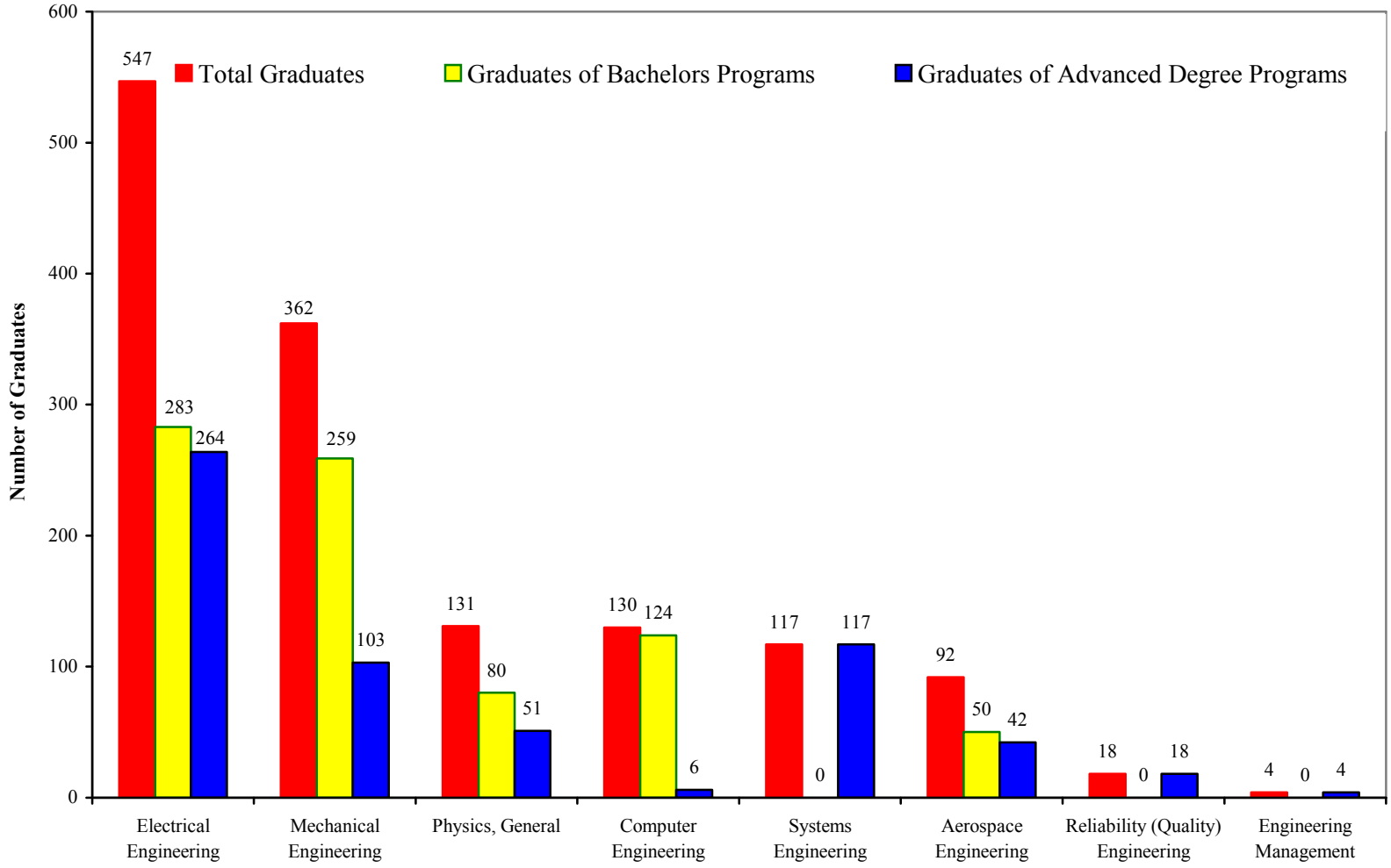


Figure 4-6. FY 2005 Graduates of Eight High Demand Engineering and Science Programs – By Degree Level

Table 4-18. Graduate Trends for Selected Programs Offered by Maryland Higher Education

Programs reported in demand by 8 Aerospace companies – Programs listed by % change in graduates from 1996 to 2005

Industry Demand *	Program Name	FY 1996 Graduates	FY 2005 Graduates	Change from 1996 - 2005	
				#	%
	Telecommunications	239	395	156	65%
6	Mechanical Engineering	234	365	131	56%
7	**Computer Engineering ****	0	130	130	
8	**Systems Engineering *****	10	117	107	1070%
1	Instrumentation Technologies	0	88	88	
8	**Electrical, Electronics, & Communications Engineering ****	483	547	64	13%
7	**Aerospace, Aeronautical, and Astronautical Engineering *****	64	92	28	44%
3	Statistics, Mathematical & Theoretical	34	55	21	62%
4	Applied Mathematics	82	95	13	16%
3	Systems Analysis	0	5	5	
3	Astronomy	15	19	4	27%
1	Architectural Drafting Technology	77	80	3	4%
4	Engineering Physics	3	5	2	67%
2	Atmospheric Sciences and Meterology	10	12	2	20%
1	Mechanical Technologies	10	11	1	10%
2	Geology	18	16	-2	-11%
3	Mathematics, General	236	234	-2	-1%
2	Industrial & Management Engineering	14	11	-3	-21%
3	**Reliability Engineering ****	22	18	-4	-18%
2	Chemical Engineering	108	103	-5	-5%
4	Engineering Mechanics	8	2	-6	-75%
4	Materials Engineering	45	34	-11	-24%
4	Engineering	171	157	-14	-8%
2	Electromechanical Technologies	16	1	-15	-94%
2	Physical Sciencies, General	19	4	-15	-79%
2	Chemistry, General	204	186	-18	-9%
2	**Engineering Management ****	26	4	-22	-85%
4	**Physics, General *****	154	131	-23	-15%

* *Programs identified in demand by 8 Maryland Aerospace companies surveyed. Identified is the number of companies that identified the program as in demand.*

** *Occupations with projected growth reported by Maryland Aerospace companies.*

*** *Occupations with reported projected growth and difficulty filling vacancies.*

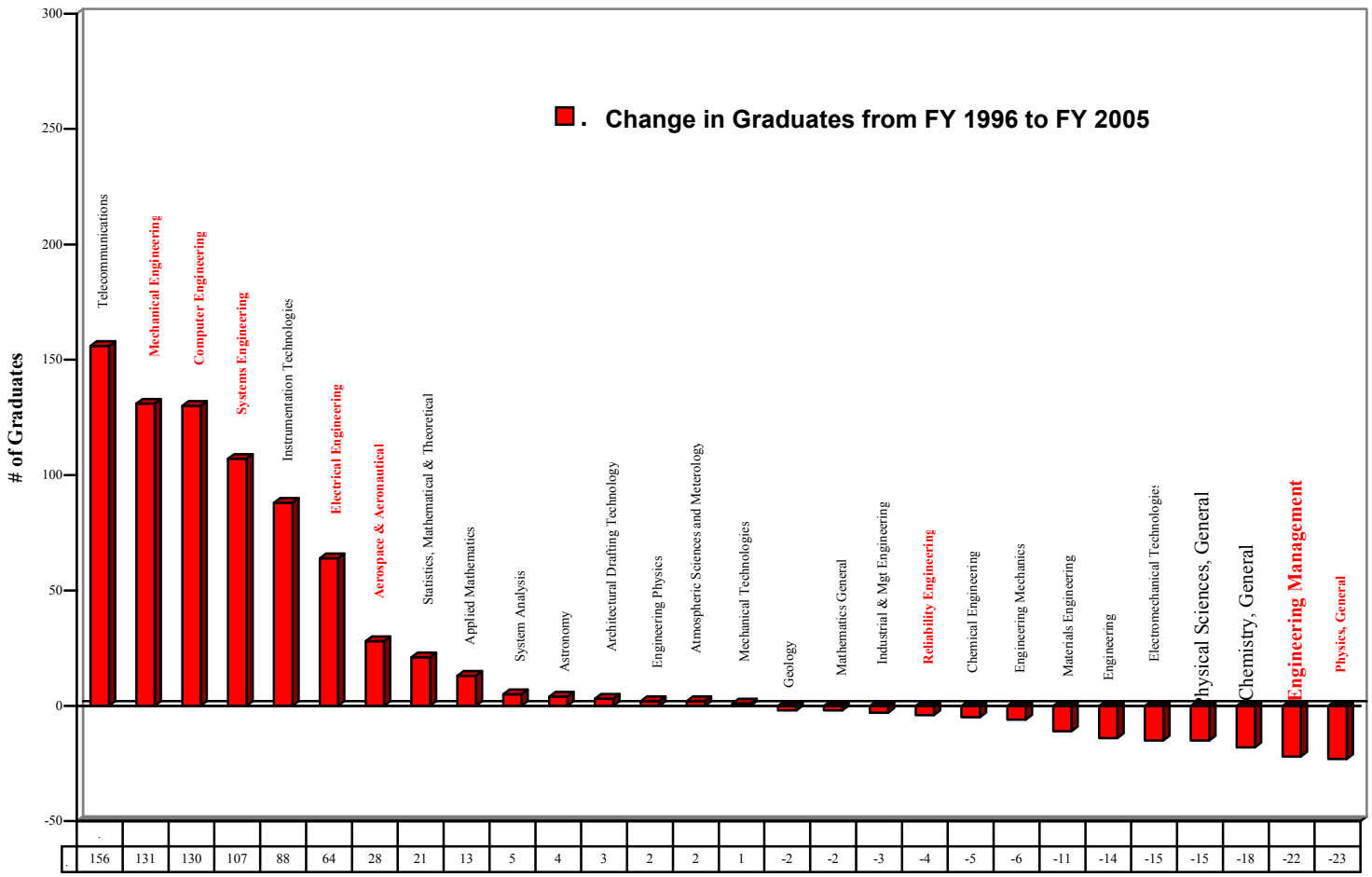


Figure 4-7. 10-Year Trends – Change in Graduates of Selected Programs Offered by Maryland Higher Education Institutions (Change from FY 1996 to FY 2005)

Provided in Appendix A are separate reports containing 10-year graduate trend data for each of the five types of programs identified below:

a. Selected engineering programs.

b. Selected physical science programs.

c. Aviation programs.

d. Mathematics program.

e. Telecommunications programs and systems analysis programs.

Within these reports, annual graduate data is presented for over 300 programs offered by Maryland higher education institutions from FY 1996 to FY 2005. The graduate data is compiled and reported by program and degree level. For example, the physical science report includes 10-year graduate trend data for every astronomy program and Earth science program offered at the Bachelors, Masters, and Doctorate degree levels. Also provided is a complete list of colleges, universities, and community colleges whose program data is contained in these reports.

The following issues have been identified by the Aerospace Industry Steering Committee members and the focus group participants as actual or perceived problems associated with the State's Higher Education institutions that have a direct correlation to the Aerospace industry in Maryland.

Problems identified by the Aerospace Industry Steering Committee in the areas of Pipeline Development Part II: Higher Education include:

a. There is a disconnection between the skill-set lexicon used by industry and that used by the educational system. Because educational institutions do not use the same language as industry, industry cannot always determine the usefulness and relevancy of skill sets developed by students entering the workplace.

b. Educational institutions are not keeping pace with specific industry requirements. Industry technology is changing at an increasingly rapid pace and there is not a consistent method of communicating these changes to education.

c. College curriculum does not provide sufficient practical experience in high demand Aerospace occupational disciplines. They have difficulty applying their knowledge in the workplace without significant training.

d. Students studying technical curriculum do not develop sufficient basic project management theory and skills.

e. Most Aerospace employers in Maryland recruit 20% or less of their entry-level employees in Maryland. With the exception of Southern Maryland, many companies do not have difficulty recruiting students from outside the State however, this process is time consuming and costly. Reasons given why Maryland students are not filling the majority of Maryland Aerospace jobs:

   1. Many Maryland graduates with engineering degrees are foreign born and are increasingly returning to their country of origin due to increased job opportunities at home and homeland security obstacles to working in the United States after 911.

   2. Foreign born graduates in Maryland are not security clearable.

   3. Infrastructure and cost of living issues may hinder the retention of graduates in Maryland.

f. There are no Bachelor of Science programs in Southern Maryland although there is a great need for these graduates in the area. Most companies report steady 10% vacancy rates in Southern Maryland which amounts to approximates 500 empty jobs at any given time. It is assumed that recruiting local graduates who are accustomed to the rural environment would be easier to recruit than graduates from elsewhere.

g. U.S. Citizen high school graduates are often insufficiently prepared for the reality of college coursework, despite their ability to "test into" the college curriculum.

The following initiatives have been identified by the Aerospace Industry Steering Committee members and the focus group participants as possible solutions or recommendations associated with the State's Higher Education institutions that might mitigate those problems being experienced by the Aerospace industry employers in Maryland.

Recommended Initiatives by the Aerospace Industry Steering Committee in the areas of Pipeline Development Part II: Higher Education include:

a. Evaluate frequency of higher education curriculum assessments and consider more appropriate "refresh" cycle to ensure greater consistency with industry requirements.

b. Use Aerospace industry advisory boards to improve the educational skill set lexicon so that it is easily communicated with and relevant to industry.

c. Create mechanisms for students to gain greater practical experience industry settings while in school so that they will have relevant, hands-on experience upon graduation.

d. Create joint technical and business management programs so those students are better prepared to become program managers.

e. Create incentives and provide assistance to graduating students in high demand occupations for Aerospace to remain in Maryland and work in the Aerospace industry. Maryland based students are cheaper and can be recruited in less time than students outside the State. Furthermore, they are more likely to be retained in Maryland's Aerospace industry than recruits from out of state. Incentives should help to defray cost of living, home ownership, transportation and loan repayment costs.

f. Create incentives for U.S. citizens versus other students to enter Maryland higher education programs associated with high demand occupations in Aerospace.

g. Expand Bachelor of Science programs in Southern Maryland either by:

   1. Supplementing to the B.A. curriculum so those students can receive a B.S.

   2. Partnering with other B.S. programs throughout the State.

   3. Adding new B.S. programs to the local colleges.

h. Create a mechanism for Maryland higher education programs to advise K-12 on the entry-level requirements for entry into Aerospace related graduate programs.

i. Create articulation agreements between K-12 pre-engineering programs, such as "Project Lead the Way," and higher education in Maryland.

j. Create mechanism for higher education in Maryland to acknowledge and provide incentives to students who obtain practical, hands-on experience in industry obtained though industry internships or training in high demand Aerospace occupations prior to entering college.

k. Expand industry/education partnerships to facilitate students' practical, hands-on experience with the Aerospace industry's high demand occupations.

l. Explore ways of beginning the security clearance process for students before they graduate from higher education programs.

m. Create a mechanism for industry to use experienced, retiring employees to mentor and grow entry-level candidates from the beginning of higher education programs.

n. Create alternative teacher credentials for high level Aerospace retirees so they can work in K-12 and universities.

What additional directions can educational institutions take at this juncture?

NASA and the DoD have a history of partnering with higher education institutions in Maryland for the purpose of providing student internships, teaming with the agencies on technology and space science programs, leveraging graduate and post-graduate student knowledge into NASA's research, science and engineering endeavors.

4.2 Workforce Development: Recruitment, Training, Development and Retention

Employee retention has been an increasing problem for the Aerospace industries in recent years, though there had been some stability following the "Dot Com" failures of the early part of this century. Recent dramatic increases in the focus on Homeland Security programs have begun to draw workers from the Aerospace industry; primarily "cleared" computer engineers, software engineers and IT professionals. While these disciplines are not specifically "Aerospace" or "aeronautical" engineers, these same skills are critical for the development and maintenance of data systems that control spacecraft, aircraft, and the systems that process data acquired by Aerospace sensors and instrumentation.

There have been a number of initiatives in the Federal industry to create more opportunity for workers at the entry and mid levels. The most visible of these is the early retirement "buyout' options periodically offered by the Federal Government. Intended primarily to entice the most senior personnel to retire, thus creating advancement opportunity for other workers, this has often had unintended results. In many instances, older workers who are experts in their field, prefer to continue working. Thus, younger mid-level technical and management personnel, seeing little opportunity for themselves, often take the buyouts instead and retire early; transitioning into industry, earning comparable or higher salaries and also drawing their government pension. A new approach needs to be formulated to provide ample career opportunity within the government ranks, and to attract and develop the correct level and type of complementary support to the government from industry.

With the dramatic advancements in technology, it is also critical to provide ongoing training and development opportunities to the existing (and in some cases displaced) workforce. Old, outdated technologies are more and more quickly being supplanted by the new. These new technologies and manufacturing techniques require continuous skills improvement. Programs need to be developed and deployed within government and industry to allow Maryland workers to continue to advance their skills consistent with these changes, enabling the State to provide and retain the highest caliber workforce for one of the most technologically advanced and rapidly changing industries in the world.

Problems identified by the Aerospace Industry Steering Committee in the areas of Workforce Development: Recruitment, Training, Development and Retention include:

a. In Maryland, most companies have to recruit over 50% of their entry-level candidates from outside the State of Maryland.

b. There is no central source of information on Aerospace training programs in the State of Maryland.

c. Job seekers in Maryland do not know about the diverse range of skilled and semi-skilled career opportunities in Aerospace in Maryland.

d. Southern Maryland, (primarily in the Patuxent River area), is having difficulty filling vacancies (10% vacancy rates/over 500 open positions at any given time) for experienced and entry-level positions from the pool of candidates from within and outside the State. This is a growing problem since the total number of jobs in the area is growing.

   1. Positive living conditions in the area are not well promoted.
   2. Housing is too expensive for entry-level workers.
   3. There are not enough entertainment and cultural options.
   4. There are not enough roads.

e. Smaller companies are having difficulty paying rising salary costs because contract turnover drives wages up.

f. Federal employers are having difficulty competing against private employers for talent because wages in government are lower than in private industry.

g. Government has difficulty retaining mid-level technical talent because:

   1. Competition with private industry for wages and type of work (private industry work can sometimes be more hands-on versus government work which is more administrative).
   2. Senior employees are retiring later thus limiting the total number of available senior positions in government.

h. Private industry has trouble retaining and building the skills of mid-level employees due to the nature of Federal contract periods of performance. For example, a company can lose a body of knowledge with the loss of a single contract.

i. When older workers retire their experience and knowledge may not be retained in the company. A related problem is that younger workers are not benefiting sufficiently from the knowledge of older workers.

   1. In many instances, there are no formal mechanisms in place for a transfer of knowledge.
   2. Job security concerns are discouraging older workers from mentoring younger workers.
   3. Contractors have an ever-changing workforce.

The following initiatives have been identified by the Aerospace Industry Steering Committee members and the focus group participants as possible solutions or recommendations associated with Workforce Training, Development and Retention that might mitigate those problems being experienced by the Aerospace industry employers in Maryland.

Recommended Initiatives for consideration by the Aerospace Industry Steering Committee in the areas of Workforce Development: Recruitment, Training, Development and Retention include:

a. Work to incorporate retraining/skills enhancement into Federal contracts as part of normal support activity (part of the job).

b. Assess buyout opportunities for early retirement programs and consider pro-rating these to seniority so that the right people retire and the right people remain in their jobs during downsizing.

c. Create college tuition scholarship/grant programs for technical and managerial skills enhancement- tied to a commitment to remain in the Maryland Aerospace industry for a specified period.

d. Create incentives for industry to become more aggressive in providing professional/career development programs to employees.

e. Promote knowledge transfer by developing mentoring programs for entry-level and mid-level technical and managerial workers.

f. Create incentives for older workers to participate in mentoring programs.

4.3 Industry Collaboration: Development and Best Practices

Industry collaboration has become a sensitive topic of discussion over the past few years; within industry participants in general, and is even evidenced within the membership of this Aerospace Industry Steering Committee. For a variety of reasons, company to company collaboration is rare unless one or more companies are teamed in a contract relationship for a specific piece of work. Even in these cases, information between these companies is closely controlled and limited through a series of non-disclosure agreements. While working together on one program, these same companies are often competing against each other in other contracting arenas.

On a national level, there are a number of organizations that foster collaboration between industry members, and industry and government agencies. One example of these is the Aerospace Industries Association, which works on a national level to represent the nation's leading manufacturers and suppliers of civil, military, and business aircraft, helicopters, UAVs, space systems, aircraft engines, missiles, materiel and related components, equipment, services, and information technology.

At the present time, there is no corresponding organization or effort on a State level to work on behalf of the industry participants in Maryland. The industry would benefit greatly from a collective effort, teaming with each other and State government agencies to promote Aerospace industry issues within the State, and between the State and Federal governments. Working together at the appropriate level, these industries could effect both the growth of the Aerospace

work in the State of Maryland, as well as the quality of the work and the workforce associated with the industry.

The following issues have been identified by the Aerospace Industry Steering Committee members and the focus group participants as actual or perceived problems associated with the need for improved industry collaboration that might have a direct correlation to the Aerospace industry in Maryland.

Problems identified by the Aerospace Industry Steering Committee in the areas of Industry Collaboration: Development and Best Practices include:

a. Currently, there is no Aerospace Industry Association in Maryland where information about the industry, its employees and concerns can be readily obtained.

   1. Tracking of student talent built upon practical experience in industry sponsored training programs is done on an ad hoc basis if at all. Information cannot be readily used for recruitment purposes.

   2. Vacancy rates by occupation in Aerospace are not monitored for strategic planning purposes.

b. There is no collective voice for the Aerospace industry in Maryland to speak on its behalf in State and Federal government.

c. The employment numbers for the Aerospace industry are not easily captured by traditional labor market statistics. Therefore, the size and scope of this industry is often underestimated.

   1. Many Aerospace firms are conducting classified work.

   2. Companies that conduct Aerospace elated work are often not classified as Aerospace in the NAICS coding system.

   3. Much of the Aerospace work is contracted out by small companies whose employment numbers are not easily captured as part of the Aerospace industry.

   4. Traditional labor market statistics are collected for unemployment insurance purposes. People employed by organizations that do not file for unemployment insurance are not captured.

   5. Military related Aerospace work is often not counted as part of the Aerospace industry.

   6. Civilian employment on military bases is often not counted as part of the Aerospace industry.

d. General public and policy making bodies in and outside the State are likely to underestimate the large presence of the Aerospace industry in Maryland.

e. The availability of Aerospace careers and job opportunities in Maryland are not widely advertised in a central place.
    1. This is likely to have an impact on the attraction of new talent.
    2. This makes it difficult for transitioning employees in a fluctuating, contract based employment market.

f. Many private and public Aerospace entities invest money in training young talent.
    1. Investigate whether the system could be improved through public/private partnerships applied in a systematic and strategic manner. It is not currently known what the strengths and weaknesses of this informal set of scholarship and training programs are.
    2. It is unclear which students have knowledge of or access to these programs.
    3. It is not known whether investments for philanthropic purposes are focused on high demand careers in the industry.

The following initiatives have been identified by the Aerospace Industry Steering Committee members and the focus group participants as possible solutions or recommendations associated with improved industry collaboration that might mitigate those problems being experienced by the Aerospace industry employers in Maryland.

Recommended Initiatives for consideration by the Aerospace Industry Steering Committee in the areas of Industry Collaboration: Development and Best Practices include:

a. Develop a Maryland based Aerospace organization to serve as a collective voice for the industry in State and Federal government.

b. Create a mechanism for the Aerospace industry to generate more accurate industry employment statistics to monitor current a future employment talent gaps. Include, as part of this strategy, an effort to work collaboratively with State to improve data collection methodologies so that Aerospace employment can be better understood for policy-making, training, and economic development purposes.

c. Advertise and promote the presence of the Aerospace industry and its careers in Maryland. Promote Aerospace tourism as part of this strategy.

d. Create a mechanism for systematically branding and advertising Aerospace related job openings in Maryland.

e. Create a mechanism to increase collaboration and participation of Aerospace entities that invest in growing the Aerospace talent pool through internships and scholarships.

   1. Through this process, they may communicate about and fill the gaps for opportunities in high demand occupations.

   2. This process may also systematically tap previously underutilized segments of the U.S. Citizen labor pool to create a greater number of qualified, security clearable job candidates.

f. Create a central place where Aerospace entities can separately share their labor market needs in a secure environment so that the collective needs of the industry can be communicated with the educational system and others who can help to fill that need.

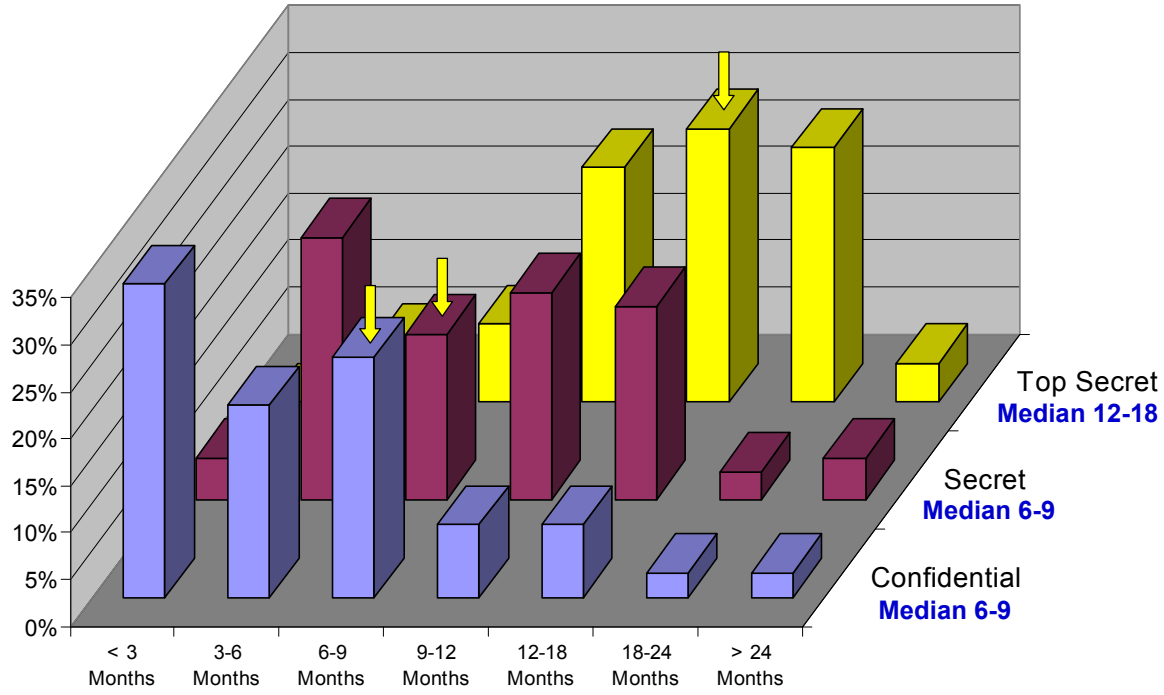
4.4 Security Clearances: Access and Availability

The sensitive nature of many Aerospace missions and projects requires clearances. This precludes hiring individuals who are not U.S. citizens or those with backgrounds that prevent granting a Federal security clearance. This alone reduces the pool of qualified applicants significantly, and due to the increase in National security work in recent years, there is an increase in the number of positions requiring clearances. Jobs that once would have been filled by an individual without a security clearance now go unfilled until someone who has or can obtain a clearance is found. This is a significant burden on many Aerospace employers and has significantly reduced the eligible applicant pool for some of the hardest to fill positions. It also has a significant impact on Maryland citizens' ability to qualify or learn about attractive employment opportunities.

Figure 4-8 depicts data compiled from a national level sample encompassing all science and engineering fields. Figure 4-8 shows delays in obtaining so-called "collateral" security clearances-those which do not require access to sensitive intelligence or weapons information.

Figure 4-9 shows delays in obtaining clearances requiring access to Sensitive Compartmented Information (SCI), with "SCI/Poly" referring to clearances requiring a polygraph test.

There are more types of security clearances than shown here, but Figures 4-8 and 4-9 provide a reasonable depiction of delays for the majority of U.S. Citizen clearances in the Fall of 2004. Those data represent experiences similar to that of Maryland employers, who were part of the sample.



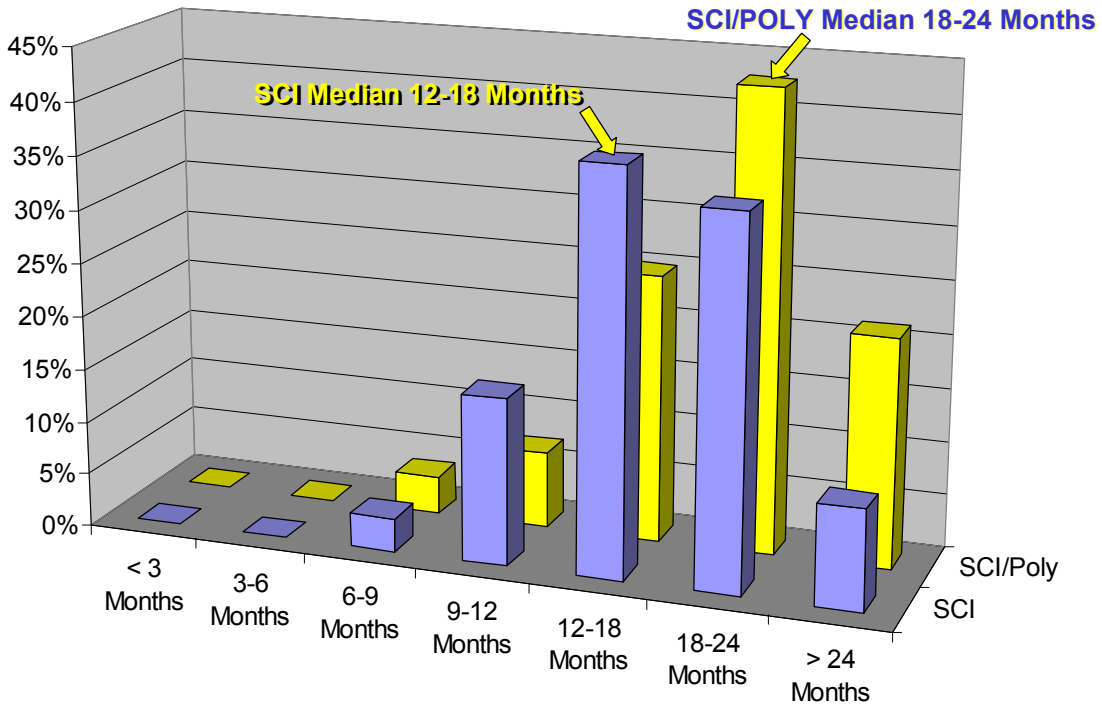
(Data from snapshot survey sponsored by Aerospace Industries Association and the National Defense Industrial Association)

Figure 4-8. National Data: Time to Obtain Collateral Security Clearance

It is interesting to note that some of the most stringent clearances are completed within 6 months, while most require a year or more. This may be due to a difference among government agencies. There are approximately nine distinct adjudication processes supporting different agencies, not necessarily a negative fact, but that could account for some of the variation. Some could have better resources or more easily managed constant flow of new applicants.

There are other potential sources of variation in security clearance delays. Applicants come from a variety of circumstances, some of which are easier to investigate than others. For example, first generation U.S. Citizens may have close family ties in foreign countries, which may need to be reviewed.

Some citizens may report youthful misdemeanors, which could lead to further exploration by investigators, not necessarily leading to denial of clearance, but causing additional delay.



(Data from snapshot survey sponsored by Aerospace Industries Association and the National Defense Industrial Association)

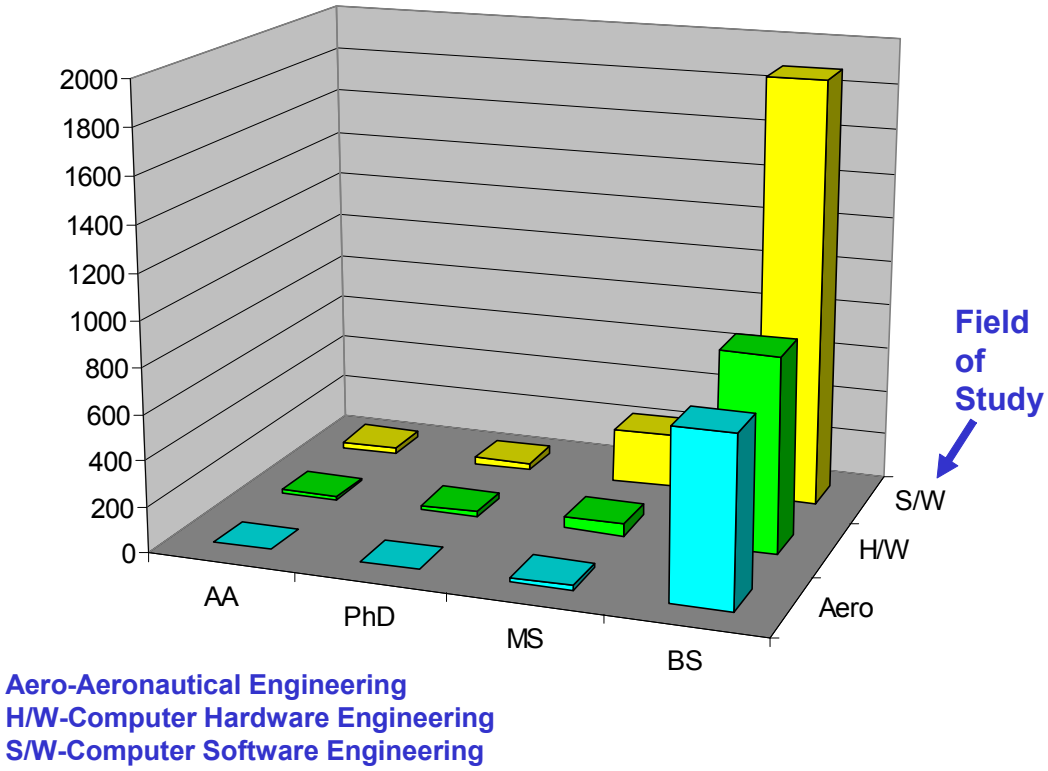
Figure 4-9. National Data: Time to Obtain Collateral Security Clearance-SCI

Agencies use the same criteria for adjudication, but may weigh them differently. For example, the FBI may weigh youthful use of illegal substances more heavily than other agencies because of the need to testify in court.

Delays in approval for clearances have severe impacts on both Maryland employers and candidate employees.

If a government contract requires an engineer with a Top Secret Clearance, either the corporation has to have something for that expensive engineer to do for a year or more while waiting for a clearance, or they have to hire someone with a clearance. That increases competition for cleared employees, which tends to increase turnover among all corporations, inside and outside Maryland.

Figure 4-10, from the same November 2004 survey, shows several hundred unfilled Aerospace engineer requisitions from a sample of only 70 corporations on a national level.



(Data from snapshot survey sponsored by Aerospace Industries Association and the National Defense Industrial Association)

Figure 4-10. National Data: Unfilled Requisitions by Field of Study

This is consistent with Maryland experience. A significant portion of that large number of unfilled requisitions is due to security clearance delays. Additional study is required to refine our understanding of the total impact of clearance delays.

In addition, these long delays may have significant effect on the lifetime labor supply decisions of scientists and engineers, when they decide whether to seek a DoD or intelligence industry job requiring a clearance. Clearances impact Maryland citizen employment decisions in multiple ways. When considering whether to pursue Aerospace or some other field of study, students are heavily influenced by their perception of the qualities of a career's work in Aerospace as well as the potential stream of salary and benefits. Jobs requiring clearances tend to hide details behind a veil of secrecy that is hard for students to penetrate. Some interesting, vital subject matter is almost totally obscured. Industry and government must make additional efforts to provide information from behind that veil.

The fact of delays may well be enough to cause an otherwise qualified candidate to veer toward other employment, rather than defer salary for a year or more while waiting for a clearance which is not guaranteed.

The value of a previous clearance to employers is reflected by what they are willing to pay for new staff. There are "headhunter" firms who receive thousands of dollars for proving a candidate resume who is hired. Those headhunter firms charge potential employees nothing. Also, corporations frequently reward existing employees with a standard bonus for every new employee they bring to the corporation-usually a few thousand dollars each. Those rewards exist only because cleared citizens are relatively rare.

Of course, for corporations there is a classic Catch-22. For sensitive work requiring SCI clearances, companies cannot compete without cleared employees. However, unless they have an active contract requiring SCI access, the government will not grant "billets" to maintain employee clearances. This is a way to keep a lid on the number of clearances. On the other hand, there are tens of thousands, perhaps in the neighborhood of a hundred thousand U.S. Citizens with sensitive clearances. One wonders whether there would be much of an impact from maintaining clearances for more Aerospace engineers not on a current contract. From a backlog perspective, a pool of cleared Aerospace engineers would be negative in the near term, but good for reducing future clearance backlogs.

Most of the information on this subject is anecdotal, in the form of the perceptions of deeply experienced employers. The average government backlog in clearance processing appears to be huge with no improvement in sight. Some government agencies appear to have no backlogs. Educators, students, and counselors do not seem to completely understand security clearance criteria or processes. The actual impact on employers and candidate employees is unknown, largely because this must be industry-wide to be useful, the data are ephemeral, and no one has an incentive to retain it or the authority to collect and maintain it for use by all.

To summarize, there are several issues related to security clearances that could well yield workforce improvements in Aerospace engineering. Why do some agencies have backlogs and others none? What is happening now or planned in Maryland to make that situation better, or worse? How can we get better information to educators, students, and counselors? Who will take the lead for collecting, maintaining, analyzing, and sharing industry-wide information? How can new and small companies get assistance to understand and manage clearance processes?

This is a rich subject that can lead to significant Aerospace workforce improvements.

The following issues have been identified by the Aerospace Industry Steering Committee members and the focus group participants as actual or perceived problems associated with the "employability and suitability" of candidates for or current members of the workforce that require some level of background check or security clearance that likely have direct correlation to the Aerospace industry in Maryland.

Problems identified by the Aerospace Industry Steering Committee in the areas of Security Clearances: Access and Availability include:

a. Many Maryland higher education graduates in Aerospace related fields are not security clearable for employment in Maryland's Aerospace industry. Insufficient numbers of U.S. Citizens are being recruited/accepted into Aerospace related engineering educational programs.

b. Insufficient numbers of U.S. Citizens are being recruited/accepted into Aerospace related engineering educational programs.

c. The process for obtaining security clearances for new personnel has become time intensive, costly and difficult to manage for many companies in the Aerospace industry.

   1. Companies cannot perform classified work without cleared staff. Lack of cleared staff affects the government through delays and cost increases. It affects the ability of companies to perform well, increases cost, and makes it more difficult to obtain reasonable profit on classified work.
   2. Current contracts are required to have billets for cleared employees. Ups and downs of contract-based work severely impacts the number clearance billets, which impacts the ability to compete for new work.
   3. New and smaller companies need greater assistance managing this process.
   4. Clearance delays constitute a barrier to entry for potential new employees, creating an adverse impact on attracting new talent.

d. Companies who understand and manage the clearance process have a competitive advantage. This makes it more difficult for new and small businesses in Maryland to win new contracts.

e. Empirical information is lacking. However, the following perceptions exist.

   1. The backlog of clearances being processed appears to be huge, long-standing, with no improvement in sight.
   2. The number of applications seems to far exceed the capacity of the government to process them.
   3. Some government agencies have small or no backlog, while others have massive backlogs.
   4. Educators, students and otherwise qualified candidates do not understand clearance criteria or processes.
   5. These problems impact all fields of study, not just Aerospace.

The following initiatives have been identified by the Aerospace Industry Steering Committee members and the focus group participants as possible solutions or recommendations associated with "employability and suitability" of candidates for or current members of the workforce that require some level of background check or security clearance that likely have direct correlation to the Aerospace industry in Maryland.

Recommended Initiatives by the Aerospace Industry Steering Committee in the areas of Security Clearances: Access and Availability include:

a. Develop strategies to keep security-cleared talent in Maryland.
   1. Create tax incentives for security clearable talent to buy homes in Maryland.
   2. Investigate the need for a career network for security cleared personnel so that when they transition into new jobs, they are made aware of local opportunities and opportunities elsewhere in Maryland.
   3. Attract and retain exiting military technical talent.

b. Develop strategies to attract a flow of talented segments of the U.S. Citizen population into Aerospace related educational programs and careers.

c. Facilitate citizen, counselor, and educator access to information on government and industry Aerospace internships.

d. Educate U.S. Citizen students, counselors and educators about security clearance criteria and processes.

e. Establish a current flow of empirical data from the government and provide to Maryland employers and citizens information on current backlogs and delays in government security clearance processing.

f. Advocate on behalf of Maryland employers to prevent the massive backlog in clearances from getting worse, and to eliminate the backlog in the near term.

g. Assist smaller companies, as well as companies new to classified contracts, to better understand, plan for, and manage their security clearance processes.

h. Develop a research methodology and mechanism to better understand and address the nature and scope of the security clearance problem for Maryland industry, starting with Aerospace.
   1. Monthly unfilled requisitions by field of study.
   2. Clearance delays.
   3. Points of contact.
   4. Emerging technology skill requirements.

i. Finds ways for companies to maintain a pool of cleared employees without contract billets.

j. Find ways to begin security clearance process while students are in school.

5. The Next Steps: Implementing the Plan of Action

The next steps of this effort involve the development of a Post Summit Report that will be distributed to all Aerospace Summit participants, and the execution of a Plan of Action developed out of the dialogue, exchange, and strategic activity of the Aerospace Summit.

In order to move forward, initiative "Champions" and supporting Aerospace industry teams will be selected and assigned to work toward implementation of the initiatives identified. The Plan of Action will engage leaders from the Aerospace Industry, government and education to pursue the strategies and recommendations for workforce issues and solutions established at the Summit. The Aerospace Industry Steering Committee will continue to meet monthly to review progress of the strategy implementation, and provide oversight during this phase.

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Appendix A. Graduate Trends

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Higher Education Institutions with Graduate Data Reported for Programs Related to the Maryland Aerospace Industry

Engineering and Engineering Technology Programs	Physical Science Programs	Mathematics Programs	Aviation Programs
Capitol College	College of Notre Dame	Bowie State University	Chesapeake College
Johns Hopkins University	Coppin State College	College of Notre Dame	Community College of Baltimore County
Loyola College	Frostburg University	Columbia Union College	Frederick Community College
Morgan State University	Goucher College	Coppin State College	
University of Maryland, Baltimore County	Johns Hopkins University	Frostburg University	
University of Maryland, College Park	Loyola College	Goucher College	
	McDaniel College	Hood College	
	Morgan State University	Johns Hopkins University	
Anne Arundel Community College	Mount St. Mary's College	Loyola College	
Baltimore City Community College	Salisbury University	McDaniels College	
Carroll Community College	St. Mary's College	Morgan State University	
Cecil Community College	Towson University	Mount St. Mary's College	
Chesapeake College	University of Maryland, Baltimore County	Salisbury University	
College of Southern Maryland	University of Maryland, College Park	St. Mary's College	
Community College of Baltimore County	Villa Julie College	Towson University	
Hagerstown Community College	Washington College	University of Maryland, Baltimore County	
Harford Community College		University of Maryland, College Park	
Howard Community College		Villa Julie College	
Montgomery College	Anne Arundel Community College	Washington College	
Prince George's Community College	Cecil Community College		
Wor-Wic Community College	Montgomery College		
		Anne Arundel Community College	
Columbia Union College			
TESST College of Technology			

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Bachelors	AEROSPACE ENGINEERING	36	29	30	28	27	44	44	65	52	50	
	Subtotal	36	29	30	28	27	44	44	65	52	50	39%
Masters	AEROSPACE ENGINEERING	22	17	15	20	18	22	17	25	20	32	
Masters	SPACE TECHNOLOGY	0	0	0	0	0	0	0	0	0	0	
	Subtotal	22	17	15	20	18	22	17	25	20	32	45%
Doctorate	AEROSPACE ENGINEERING	6	11	4	5	12	5	9	10	8	10	
	Subtotal	6	11	4	5	12	5	9	10	8	10	67%
	TOTAL GRADUATES	64	57	49	53	57	71	70	100	80	92	44%
Bachelors	ELECTRICAL ENGINEERING	11	29	16	15	20	14	17	9	9	14	
Bachelors	ELECTRICAL ENGINEERING	34	35	34	20	29	25	16	36	36	37	
Bachelors	ELECTRICAL ENGINEERING	4	5	7	8	3	7	2	4	1	5	
Bachelors	ELECTRICAL ENGINEERING	42	44	59	62	32	66	55	55	63	57	
Bachelors	ELECTRICAL ENGINEERING	159	182	163	170	155	153	116	128	140	170	
	Subtotal	250	295	279	275	239	265	206	232	249	283	13%
Post Bac. Cert.	ELECTRICL ENGINEERING	0	0	0	4	0	0	0	1	1	0	
	Subtotal	0	0	0	4	0	0	0	1	1	0	*
Masters	ELECTRICAL ENGINEERING (W/ UMCP)	19	8	9	5	8	5	6	1	6	13	
Masters	ELECTRICAL ENGINEERING	51	53	53	68	90	61	67	73	92	58	
Masters	ELECTRICAL AND COMPUTER ENGINEERING	131	131	99	142	147	163	114	120	136	140	
	Subtotal	201	192	161	215	245	229	187	194	234	211	5%
Doctorate	ELECTRICALENGINEERING	5	8	7	6	9	8	4	5	10	14	
Doctorate	ELECTRICAL ENGINEERING	1	3	8	3	8	6	4	8	4	5	
Doctorate	ELECTRICAL ENGINEERING	26	37	36	26	30	32	18	34	37	34	
	Subtotal	32	48	51	35	47	46	26	47	51	53	66%
	TOTAL GRADUATES	483	535	491	529	531	540	419	474	535	547	13%
Post Bac. Cert.	SYSEMS ENGINEERING	0	0	0	0	0	32	19	34	17	19	
	Subtotal	0	0	0	0	0	32	19	34	17	19	*

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Masters	SYSTEMS ENGINEERING	0	4	8	17	24	26	41	65	66	94	
Masters	SYSTEMS ENGINEERING	10	5	6	7	8	8	10	11	11	4	
	Subtotal	10	9	14	24	32	34	51	76	77	98	880%
	TOTAL GRADUATES	10	9	14	24	32	66	70	110	94	117	1070%
Bachelors	COMPUTER ENGINEERING	0	0	0	0	2	2	1	7	5	6	
Bachelors	COMPUTER ENGINEERING	0	0	5	3	6	12	17	16	14	14	
Bachelors	COMPUTER ENGINEERING	0	0	4	10	9	9	11	29	31	43	
Bachelors	COMPUTER ENGINEERING	0	0	0	0	6	12	24	58	101	61	
	Subtotal	0	0	9	13	23	35	53	110	151	124	
Masters	COMPUTER ENGINEERING	0	0	0	0	0	0	0	1	4	6	
	Subtotal	0	0	0	0	0	0	0	1	4	6	
	TOTAL GRADUATES	0	0	9	13	23	35	53	111	155	130	
Post Bac. Cert.	ACQUISITION & PROJECT MGT.	0	0	0	0	0	0	0	2	0	0	
	Subtotal	0	0	0	0	0	0	0	2	0	0	
Masters	ENGINEERING MANAGEMENT (W/UB)	11	8	6	3	33	2	4	3	4	4	
Masters	ENGINEERING MANAGEMENT (W/ UMBC)	15	26	11	18	14	7	2	1	1	0	
	Subtotal	26	34	17	21	47	9	6	4	5	4	-85%
	TOTAL GRADUATES	26	34	17	21	47	9	6	6	5	4	-85%
Bachelors	ENGINEERING	65	59	50	70	15	0	0	0	0	0	
Bachelors	ENGINEERING	14	13	16	11	11	8	8	6	8	9	
Bachelors	ENGINEERING (BA)	5	1	0	2	1	1	1	1	2	0	
Bachelors	ENGINEERING SCIENCES	0	0	0	0	0	0	0	0	1	3	
Bachelors	ENGINEERING SCIENCE	8	2	3	3	3	3	3	4	2	4	
	Subtotal	92	75	69	86	30	12	12	11	13	16	-83%
Upper Certificate	ENGINEERING	16	14	13	16	10	21	13	7	6	15	
Post Bac. Cert.	ENGINEERING	0	0	0	0	0	2	0	8	8	10	
	Subtotal	16	14	13	16	10	23	13	15	14	25	56%
Masters	ENGINEERING	0	0	0	7	8	14	5	19	14	15	
Masters	ENGINEERING	19	40	51	60	67	64	56	54	75	84	
Masters	ENGINEERING SCIENCE	44	54	50	61	47	46	37	33	25	12	
	Subtotal	63	94	101	128	122	124	98	106	114	111	76%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Doctorate	ENGINEERING	0	0	0	0	0	0	2	5	5	5	
	Subtotal	0	0	0	0	0	0	2	5	5	5	
	TOTAL GRADUATES	171	183	183	230	162	159	125	137	146	157	-8%
Bachelors	MATERIALS SCIENCE & ENGINEERING	7	7	8	6	8	3	3	0	7	4	
Bachelors	MATERIALS SCIENCE AND ENGINEERING	0	0	0	0	3	8	4	8	6	8	
	Subtotal	7	7	8	6	11	11	7	8	13	12	71%
Masters	MATERIALS SCIENCE & ENGINEERING	6	8	4	8	5	2	4	4	1	3	
Masters	MATERIALS SCIENCE & ENGINEERING	10	8	9	11	9	7	7	8	11	6	
	Subtotal	16	16	13	19	14	9	11	12	12	9	-44%
Doctorate	MATERIALS SCIENCE & ENGINEERING	14	4	5	7	7	6	8	11	0	4	
Doctorate	MATERIALS SCIENCE & ENGINEERING	8	6	8	8	3	11	4	4	4	9	
	Subtotal	22	10	13	15	10	17	12	15	4	13	-41%
	TOTAL GRADUATES	45	33	34	40	35	37	30	35	29	34	-24%
Bachelors	ENGINEERING TECHNOLOGY	7	3	7	6	6	6	10	12	10	0	
Bachelors	ELECTRONICS ENGINEERING TECHNOLOGY	36	20	30	23	7	16	17	15	7	8	
Bachelors	COMPUTER ENGINEERING TECHNOLOGY	9	13	12	5	14	10	15	8	9	3	
	Subtotal	52	36	49	34	27	32	42	35	26	11	-79%
Masters	ENGINEERING TECHNOLOGIES	0	0	0	0	0	0	0	0	0	0	
	Subtotal	0	0	0	0	0	0	0	0	0	0	
	TOTAL GRADUATES	52	36	49	34	27	32	42	35	26	11	-79%
Masters	RELIABILITY ENGINEERING	17	11	7	13	4	26	10	20	9	13	
	Subtotal	17	11	7	13	4	26	10	20	9	13	-24%
Doctorate	RELIABILITY ENGINEERING	5	3	2	4	5	3	3	1	3	5	
	Subtotal	5	3	2	4	5	3	3	1	3	5	0%
	TOTAL GRADUATES	22	14	9	17	9	29	13	21	12	18	-18%
Bachelors	MECHANICAL ENGINEERING	25	21	19	26	27	30	25	37	35	36	
Bachelors	MECHANICAL ENGINEERING	0	0	0	0	24	31	38	33	40	52	
Bachelors	MECHANICAL ENGINEERING	112	132	100	88	105	115	96	91	157	171	
	Subtotal	137	153	119	114	156	176	159	161	232	259	89%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Post Bac. Cert.	COMPUTATIONAL THERMAL/FLUID DYNAMIC	0	0	0	0	0	0	1	1	0	0	
Post Bac. Cert.	MECHATRONICS	0	0	0	0	0	0	3	0	0	0	
	Subtotal	0	0	0	0	0	0	4	1	0	0	
Masters	MECHANICAL ENGINEERING	24	25	24	29	28	16	27	24	28	39	
Masters	MECHANICAL ENGINEERING	6	6	7	6	8	7	10	6	7	10	
Masters	MECHANICAL ENGINEERING	38	38	30	32	44	49	50	41	36	20	
	Subtotal	68	69	61	67	80	72	87	71	71	69	1%
Doctorate	MECHANICAL ENGINEERING	5	10	9	12	3	5	8	11	5	6	
Doctorate	MECHANICAL ENGINEERING	6	3	8	5	1	4	1	3	6	0	
Doctorate	MECHANICAL ENGINEERING	17	13	17	13	8	21	18	13	26	28	
	Subtotal	28	26	34	30	12	30	27	27	37	34	21%
	TOTAL GRADUATES	233	248	214	211	248	278	277	260	340	362	55%
Bachelors	ENGINEERING MECHANICS	1	0	1	2	1	0	2	4	2	3	
Masters	ENGINEERING MECHANICS	0	0	0	0	0	0	0	0	0	0	
Doctorate	ENGINEERING MECHANICS	0	0	0	0	0	0	0	0	0	0	
	TOTAL GRADUATES	1	0	1	2	1	0	2	4	2	3	200%
Bachelors	INDUSTRIAL ENGINEERING	0	0	0	0	0	0	0	0	0	0	
Bachelors	INDUSTRIAL ENGINEERING	14	8	19	18	11	12	10	10	9	11	
	Subtotal	14	8	19	18	11	12	10	10	9	11	-21%
	TOTAL GRADUATES	14	8	19	18	11	12	10	10	9	11	-21%
Bachelors	CHEMICAL ENGINEERING	0	0	0	0	0	20	15	19	9	14	
Bachelors	CHEMICAL ENGINEERING	43	55	40	35	32	37	39	39	20	27	
Bachelors	CHEMICAL & BIOMOLECULAR ENGINEERING	22	33	27	18	21	15	12	16	14	22	
	Subtotal	65	88	67	53	53	72	66	74	43	63	-3%
Masters	CHEMICAL ENGINEERING	7	8	10	5	8	15	7	5	3	10	
Masters	CHEMICAL & BIOMOLECULAR ENGINEERING	10	5	4	7	7	8	8	7	7	6	
Masters	CHEMICAL & BIOCHEMICAL ENGINEERING	8	7	1	5	1	5	1	6	6	6	
	Subtotal	25	20	15	17	16	28	16	18	16	22	-12%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Doctorate	CHEMICAL ENGINEERING	10	5	6	6	9	11	8	5	7	9	
Doctorate	CHEMICAL & BIOMOLECULAR ENGINEERING	5	2	6	7	4	11	6	1	6	7	
Doctorate	CHEMICAL & BIOCHEMICAL ENGINEERING	3	0	2	1	3	5	2	3	2	2	
	Subtotal	18	7	14	14	16	27	16	9	15	18	0%
	TOTAL GRADUATES	**108**	**115**	**96**	**84**	**85**	**127**	**98**	**101**	**74**	**103**	-5%
Associate	SPACE ENGINEER TECHNOLOGY	0	1	0	2	1	0	0	0	0	0	
	Subtotal	0	1	0	2	1	0	0	0	0	0	
	TOTAL GRADUATES	**0**	**1**	**0**	**2**	**1**	**0**	**0**	**0**	**0**		
Associate	ELECTRICAL ENGINEERING TECH	8	4	10	7	6	8	4	4	2	2	
	Subtotal	8	4	10	7	6	8	4	4	2	2	-75%
	TOTAL GRADUATES	**8**	**4**	**10**	**7**	**6**	**8**	**4**	**4**	**2**	**2**	-75%
Certificate	ENGINEERING TECH	0	0	1	0	0	1	0	0	1	1	
Certificate	ENGINEERING TCHNLGY:MNFCTR TTCHNLGY	1	0	0	1	1	1	0	1	0	0	
Certificate	MANUFACTURING ENGINEERING TECHNOLOG	0	0	0	0	0	0	0	0	2	0	
	Subtotal	1	0	1	1	1	2	0	1	3	1	0%
Associate	ENGINEERING TECH	3	3	3	3	2	5	4	4	1	2	
Associate	ENGINEERING TECHNOLOGY	2	1	7	3	0	0	1	8	3	1	
Associate	GENERAL ENGINEERING	0	0	0	0	0	0	0	0	1	0	
Associate	MECHANICAL ENGINEERING TECH	0	0	0	0	0	0	0	0	0	0	
	Subtotal	5	4	10	6	2	5	5	12	5	3	-40%
	TOTAL GRADUATES	**6**	**4**	**11**	**7**	**3**	**7**	**5**	**13**	**8**	**4**	-33%
Certificate	ELECTRONICS MICROPROCESSORS	0	0	0	0	0	0	0	1	0	0	
Certificate	ELECTRONICS AND COMPUTER TECHNOLOGY	0	0	0	0	0	0	75	89	99	88	
Certificate	ELECT., COMPUTER & ROBTIC TECH (ECR	0	0	0	0	0	0	53	0	0	0	
Certificate	COMPUTER & ELECTRONIC CONTROL TECHN	0	0	0	0	0	0	35	58	0	0	
	Subtotal	0	0	0	0	0	0	163	148	99	88	
Associate	OPTOELECTRONICS ENGINEERING TECH	0	1	0	0	0	0	2	0	1	0	
	Subtotal	0	1	0	0	0	0	2	0	1	0	
	TOTAL GRADUATES	**0**	**1**	**0**	**0**	**0**	**0**	**165**	**148**	**100**	**88**	

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Associate	ENGINEERING TRANSFER	2	1	2	1	0	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	5	4	3	2	3	1	6	9	11	14	
Associate	ENGINEERING TRANSFER	2	0	0	1	4	2	1	1	5	2	
Associate	ENGINEERING TRANSFER	3	2	6	3	1	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	4	10	4	6	4	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	11	13	11	16	16	16	6	7	14	6	
Associate	ENGINEERING	3	1	1	1	1	2	1	0	0	0	
Associate	ENGINEERING TRANSFER	0	0	0	0	0	9	5	3	1	4	
Associate	ENGINEERING TRANSFER	2	1	1	1	2	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	2	1	3	4	2	10	5	8	5	8	
Associate	ENGINEERING TRANSFER	3	3	9	11	3	6	2	7	5	10	
Associate	ENGINEERING	1	0	0	0	0	0	0	0	0	0	
Associate	ENGINEERING SCIENCE	0	0	0	0	0	16	25	29	50	63	
Associate	ENGINEERING TRANSFER	4	1	3	1	0	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	23	14	13	16	8	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	0	0	0	1	0	0	0	0	0	0	
Associate	ENGINEERING TRANSFER	10	10	6	9	12	6	6	5	6	11	
	Subtotal	75	61	62	73	56	68	57	69	97	118	57%
	TOTAL GRADUATES	**75**	**61**	**62**	**73**	**56**	**68**	**57**	**69**	**97**	**118**	57%
Certificate	ELECTRONIC ENGINEERING TECH	17	6	13	25	19	23	21	16	19	13	
Certificate	ELECTRONIC ENGINEERING TECHNOLOGY	0	0	0	0	0	0	0	0	1	1	
Certificate	ELECTRONIC TECH	1	3	3	0	0	0	0	0	0	0	
Certificate	ELECTRONIC TECHNICIAN	29	24	24	22	0	0	0	0	0	0	
Certificate	ELECTRONICS	3	4	5	9	3	2	1	5	3	1	
Certificate	ELECTRONICS	1	1	2	1	0	2	3	1	0	0	
Certificate	ELECTRONICS TECH	2	3	3	0	5	0	0	0	0	0	
Certificate	ELECTRONICS TECH	1	1	1	2	5	2	2	2	1	0	
Certificate	ELECTRONICS TECH	0	1	3	3	0	1	0	0	1	1	
Certificate	ELECTRONICS TECH	0	1	0	0	2	0	0	0	1	0	
Certificate	ELECTRONICS TECHNOLOGY	5	2	10	0	5	5	7	5	3	0	
Certificate	ELECTRONICS TECHNOLOGY	2	0	0	0	0	0	0	0	0	0	
Certificate	ELECTRONICS, COMPUTER & TELECOMMUN.	0	0	0	0	0	0	96	50	28	24	
Certificate	INDUSTRIAL ELECTRICITY/ELECTRONIC T	0	0	0	0	0	0	0	0	22	1	
Certificate	AUTOMATION CONTROL	0	0	0	0	0	1	0	0	0	0	
Certificate	COMMUNICATIONS/MICROPROCESSOR	2	0	4	1	2	4	0	0	0	0	
Certificate	ENGINEERING TECH	1	2	6	8	3	2	1	2	2	0	
Certificate	ELECTRICITY/ELECTRONICS TECHNOLOGY	6	14	16	10	4	0	0	0	0	0	
	Subtotal	70	62	90	81	48	42	131	81	81	41	-41%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Associate	ELECTRONIC ENGINEERING TECH	16	14	18	15	13	15	12	13	11	10	
Associate	ELECTRONIC ENGINEERING TECH	9	13	15	7	8	7	6	6	3	10	
Associate	ELECTRONIC ENGINEERING TECHNOLOGY	0	0	1	4	3	3	4	2	4	5	
Associate	ELECTRONICS	11	5	6	6	15	16	5	7	9	4	
Associate	ELECTRONICS	5	3	5	4	0	0	0	0	1	0	
Associate	ELECTRONICS	0	1	0	3	0	0	0	0	0	0	
Associate	ELECTRONICS	0	0	0	0	0	0	0	0	0	0	
Associate	ELECTRONICS	3	4	0	2	1	0	0	0	0	0	
Associate	ELECTRONICS ENGINEERING TECHNOLOGY	8	6	3	3	5	5	4	3	2	1	
Associate	ELECTRONICS TECH	7	14	7	6	9	0	0	0	0	0	
Associate	ELECTRONICS TECH	0	0	0	0	0	0	0	0	0	0	
Associate	ELECTRONICS TECH	0	1	0	2	8	1	3	4	12	6	
Associate	ELECTRONICS TECH	1	6	3	5	3	8	3	4	1	2	
Associate	ELECTRONICS TECH	9	4	4	0	4	0	2	2	2	0	
Associate	ELECTRONICS TECHNOLOGY	2	11	5	7	5	2	2	0	0	2	
Associate	ELECTRONICS TECHNOLOGY	3	0	0	0	0	0	0	0	0	0	
Associate	ELECTRONICS,COMPUTER & TELECOMMUN.	0	0	0	0	0	0	0	49	101	91	
Associate	ENGINEERING TECHNOLOGIES	0	0	0	0	0	3	1	1	3	0	
Associate	INDUSTRIAL ELECTRICITY/ELECTRONICS	0	0	0	0	0	1	1	0	14	5	
Associate	ELECTRICITY/ELECTRONICS TECHNOLOGY	11	11	11	6	4	0	0	0	0	0	
	Subtotal	85	93	78	70	78	61	43	91	163	136	60%
	TOTAL GRADUATES	**155**	**155**	**168**	**151**	**126**	**103**	**174**	**172**	**244**	**177**	14%
Certificate	ELECTROMECHANICAL SYSTEMS ENG TECH	0	0	0	1	6	0	0	0	0	0	
Certificate	ELECTROMECHANICAL SYSTEMS ENG TECH	0	0	0	0	0	0	0	0	0	0	
Certificate	ELECTROMECHANICAL SYSTEMS ENG TECH	3	8	6	1	3	0	0	0	0	0	
Certificate	ELECTROMECHANICAL SYSTEMS ENG TECH	0	0	0	0	0	0	2	1	0	0	
	Subtotal	3	8	6	2	9	0	2	1	0	0	-100%
Associate	ELECTROMECHANICAL TECH	10	10	4	5	0	0	0	0	0	0	
Associate	ELECTROMECHANICAL SYSTEMS ENG TECH	0	2	2	0	0	0	0	0	0	0	
Associate	ELECTROMECHANICAL SYSTEMS ENG TECH	0	2	0	0	0	0	0	0	0	0	
Associate	ELECTROMECHANICAL SYSTEMS ENG TECH	3	2	2	3	0	0	0	0	0	0	
Associate	ELECTROMECHANICAL SYSTEMS ENG TECH	0	0	0	0	0	2	1	2	0	1	
	Subtotal	13	16	8	8	0	2	1	2	0	1	-92%
	TOTAL GRADUATES	**16**	**24**	**14**	**10**	**9**	**2**	**3**	**3**	**0**	**1**	-94%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Certificate	QUALITY MANAGEMENT TECH	8	1	3	0	1	0	0	0	0	0	
Certificate	QUALITY MANAGEMENT TECH	0	0	0	0	0	6	0	6	0	0	
	Subtotal	8	1	3	0	1	6	0	6	0	0	-100%
Associate	QUALITY MANAGEMENT TECHNOLOGY	0	0	0	0	0	6	5	2	0	0	
	Subtotal	0	0	0	0	0	6	5	2	0	0	
	TOTAL GRADUATES	**8**	**1**	**3**	**0**	**1**	**12**	**5**	**8**	**0**	**0**	-100%
Certificate	INDUSTRIAL MAINT TECH	0	1	0	0	0	0	0	0	0	0	
Certificate	INDUSTRIAL MAINTENANCE TECHNOLOGY	0	0	0	0	0	15	11	4	25	3	
Certificate	INDUSTRIAL MAINTENANCE TECHNOLOGY	3	7	16	13	28	0	0	0	0	0	
	Subtotal	3	8	16	13	28	15	11	4	25	3	0%
Associate	INDUSTRIAL MAINTENANCE TECHNOLOGY	0	0	0	0	0	10	7	3	2	1	
Associate	INDUSTRIAL MAINTENANCE TECHNOLOGY	3	3	9	14	7	0	0	0	0	0	
	Subtotal	3	3	9	14	7	10	7	3	2	1	-67%
	TOTAL GRADUATES	**6**	**11**	**25**	**27**	**35**	**25**	**18**	**7**	**27**	**4**	-33%
Certificate	COMPUTER-AIDED MANUFACTURING	2	3	3	6	5	0	0	0	0	0	
Certificate	COMPUTER-AIDED MANUFACTURING	0	0	0	0	0	4	2	0	0	0	
	Subtotal	2	3	3	6	5	4	2	0	0	0	-100%
Associate	MECHANICAL ENGINEERING TECH	4	6	6	7	6	9	5	10	7	7	
Associate	MANUFACTURING TECH	0	0	0	0	0	0	0	0	0	0	
Associate	COMPUTER-AIDED MANUFACTURING	4	4	0	4	5	0	0	0	0	0	
Associate	COMPUTER AUTOMATED MANUFACTURING	0	0	0	0	0	0	2	0	1	2	
Associate	HIGH PERFORMANCE MANUFACTURING	0	0	0	0	0	0	0	0	1	2	
	Subtotal	8	10	6	11	11	9	7	10	9	11	38%
	TOTAL GRADUATES	**10**	**13**	**9**	**17**	**16**	**13**	**9**	**10**	**9**	**11**	10%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Certificate	AUTOCAD OPERATOR	0	0	0	0	0	0	0	0	9	6	
Certificate	CAD MANAGEMENT	0	0	0	0	0	0	0	0	2	1	
Certificate	CAD MECHANICAL MODELING	0	0	0	0	0	0	0	0	2	3	
Certificate	COMPUTER AIDED DESIGN TECH	3	3	2	1	0	1	1	0	1	2	
Certificate	COMPUTER AIDED DRAFTING	0	0	0	0	0	0	1	2	2	0	
Certificate	COMPUTER-AIDED DESIGN	3	0	3	3	2	2	2	1	0	0	
Certificate	COMPUTER-AIDED DESIGN (CAD)	0	0	0	0	0	0	0	0	2	4	
Certificate	COMPUTER-AIDED DESIGN FOR ARCH. & E	12	10	11	15	13	0	0	0	0	0	
Certificate	COMPUTER-AIDED DESIGN FOR ARCH. & E	0	0	0	0	0	5	7	21	6	1	
Certificate	COMPUTER-AIDED DRAFT. & DESIGN	0	0	0	0	0	1	2	7	7	6	
Certificate	COMPUTER-AIDED DRAFTING CERTIFICATE	0	0	0	0	0	0	2	0	0	1	
Certificate	BASIC COMPUTER-AIDED DRAFTING	0	0	0	0	1	0	12	11	9	6	
Certificate	DESIGNING AND DRAFTING TECH	0	9	16	9	5	5	6	1	6	9	
Certificate	DRAFTING	0	0	2	0	0	0	3	1	0	0	
Certificate	DRAFTING	8	3	2	0	3	12	0	1	0	0	
Certificate	DRAFTING TECH	14	9	10	6	9	0	0	0	0	0	
Certificate	DRAFTING TECH	0	0	0	0	0	3	3	7	1	6	
Certificate	DRAFTING TECHNOLOGY	1	1	2	0	1	2	0	2	0	0	
Certificate	DRAFTING-SURVEYING	0	0	0	0	0	0	0	0	0	0	
Certificate	ENGINEERING DRAFTING	1	2	3	5	0	2	4	1	2	0	
	Subtotal	42	37	51	39	34	33	43	55	49	45	7%
Associate	COMPUTER AIDED DESIGN (JOINT W/HARF	0	1	0	3	0	0	0	0	0	0	
Associate	COMPUTER AIDED DESIGN TECH	6	2	3	5	1	4	4	3	6	5	
Associate	COMPUTER AIDED DRAFTING AND DESIGN	0	0	2	0	0	0	4	4	2	6	
Associate	COMPUTER-AIDED DESIGN	2	0	2	1	3	1	2	0	0	0	
Associate	COMPUTER-AIDED DESIGN FOR ARCH. & E	7	8	6	12	6	0	0	0	0	0	
Associate	COMPUTER-AIDED DESIGN FOR ARCH. & E	0	0	0	0	0	4	5	6	8	4	
Associate	COMPUTER-AIDED DRAFT. & DESIGN	0	0	0	1	1	1	2	1	3	9	
Associate	DRAFTING TECH	15	11	8	8	6	0	0	0	0	0	
Associate	DRAFTING TECH	0	0	0	0	0	9	2	5	3	6	
Associate	DRAFTING TECH	2	7	1	4	2	3	3	0	3	4	
Associate	DRAFTING TECHNOLOGY	3	8	5	12	2	6	1	3	2	1	
	Subtotal	35	37	27	46	21	28	23	22	27	35	0%
	TOTAL GRADUATES	**77**	**74**	**78**	**85**	**55**	**61**	**66**	**77**	**76**	**80**	4%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Bachelors	AVIATION SCIENCE	6	3	3	4	5	11	5	8	9	9	
	Subtotal	6	3	3	4	5	11	5	8	9	9	50%
	TOTAL GRADUATES	6	3	3	4	5	11	5	8	9	9	50%
Bachelors	ASTRONOMY	4	5	3	4	5	6	12	5	11	6	
	Subtotal	4	5	3	4	5	6	12	5	11	6	50%
Masters	ASTRONOMY	6	3	8	3	3	2	5	3	4	8	
	Subtotal	6	3	8	3	3	2	5	3	4	8	33%
Doctorate	ASTRONOMY	5	5	2	1	4	5	3	3	2	5	
	Subtotal	5	5	2	1	4	5	3	3	2	5	0%
	TOTAL GRADUATES	15	13	13	8	12	13	20	11	17	19	27%
Masters	METEOROLOGY	6	7	16	8	8	9	6	9	14	7	
	Subtotal	6	7	16	8	8	9	6	9	14	7	17%
Doctorate	METEOROLOGY	4	9	1	6	2	4	2	5	4	5	
	Subtotal	4	9	1	6	2	4	2	5	4	5	25%
	TOTAL GRADUATES	10	16	17	14	10	13	8	14	18	12	20%
Bachelors	EARTH-SPACE SCIENCE	0	0	0	0	0	0	0	1	2	2	
Bachelors	EARTH AND PLANETARY SCIENCES	5	10	7	6	2	6	0	4	3	4	
Bachelors	EARTH SCIENCE	0	0	1	0	6	12	9	7	8	8	
	Subtotal	5	10	8	6	8	18	9	12	13	14	180%
Masters	EARTH AND PLANETARY SCIENCES	9	3	5	5	3	7	11	5	3	4	
	Subtotal	9	3	5	5	3	7	11	5	3	4	-56%
Doctorate	EARTH AND PLANETARY SCIENCES	0	6	9	2	3	3	4	3	2	5	
	Subtotal	0	6	9	2	3	3	4	3	2	5	
	TOTAL GRADUATES	14	19	22	13	14	28	24	20	18	23	64%
Masters	ATMOSPHERIC PHYSICS	0	0	0	0	0	0	1	3	5	0	
	Subtotal	0	0	0	0	0	0	1	3	5	0	

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Doctorate	ATMOSPHERIC PHYSICS	0	0	0	0	0	0	0	0	1	0	
	Subtotal	0	0	0	0	0	0	0	0	1	0	
	TOTAL GRADUATES	0	0	0	0	0	0	1	3	6	0	
Bachelors	PHYSICS,GENERAL	8	4	3	2	2	3	0	2	3	0	
Bachelors	PHYSICS	0	0	0	0	0	0	0	0	0	0	
Bachelors	PHYSICS	7	9	7	4	10	10	6	3	6	6	
Bachelors	PHYSICS	0	0	0	0	0	0	1	0	0	2	
Bachelors	PHYSICS,GENERAL	10	8	6	6	3	2	17	10	13	0	
Bachelors	PHYSICS	6	2	2	1	3	2	0	3	2	2	
Bachelors	PHYSICS	1	1	4	1	4	3	7	4	5	5	
Bachelors	PHYSICS	0	1	0	0	2	2	2	1	0	1	
Bachelors	PHYSICS	5	8	6	4	9	5	8	13	8	4	
Bachelors	PHYSICS	0	6	2	4	9	1	2	4	3	5	
Bachelors	PHYSICS	6	2	2	6	8	4	5	2	6	8	
Bachelors	PHYSICS	10	5	7	9	5	6	6	7	3	10	
Bachelors	PHYSICS	13	17	9	16	19	24	25	28	30	33	
Bachelors	PHYSICS,GENERAL	2	1	4	1	3	2	1	3	1	4	
	Subtotal	68	64	52	54	77	64	80	80	80	80	18%
Masters	PHYSICS,GENERAL	7	14	30	28	30	26	30	20	19	14	
Masters	PHYSICS	25	21	10	14	13	17	16	12	7	2	
	Subtotal	32	35	40	42	43	43	46	32	26	16	-50%
Doctorate	PHYSICS,GENERAL	17	13	17	11	7	7	6	16	12	6	
Doctorate	PHYSICS	37	27	29	27	20	18	14	19	29	29	
	Subtotal	54	40	46	38	27	25	20	35	41	35	-35%
	TOTAL GRADUATES	154	139	138	134	147	132	146	147	147	131	-15%
Masters	APPLIED PHYSICS	0	0	0	0	0	0	0	17	23	15	
Masters	APPLIED PHYSICS	1	2	1	0	4	4	6	5	2	4	
	Subtotal	1	2	1	0	4	4	6	22	25	19	1800%
Doctorate	APPLIED PHYSICS	4	3	0	1	2	2	0	2	0	5	
	Subtotal	4	3	0	1	2	2	0	2	0	5	25%
	TOTAL GRADUATES	5	5	1	1	6	6	6	24	25	24	380%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Bachelors	ENGINEERING PHYSICS	3	2	2	4	1	2	5	4	4	5	
	Subtotal	3	2	2	4	1	2	5	4	4	5	67%
	TOTAL GRADUATES	3	2	2	4	1	2	5	4	4	5	67%
Masters	CHEMICAL PHYSICS	1	0	0	3	2	1	0	0	1	0	
	Subtotal	1	0	0	3	2	1	0	0	1	0	-100%
Doctorate	CHEMICAL PHYSICS	6	5	4	3	4	9	2	2	4	2	
	Subtotal	6	5	4	3	4	9	2	2	4	2	-67%
	TOTAL GRADUATES	7	5	4	6	6	10	2	2	5	2	-71%
Bachelors	CHEMISTRY	4	3	3	5	1	4	2	4	0	4	
Bachelors	CHEMISTRY	0	0	0	0	2	1	0	0	0	1	
Bachelors	CHEMISTRY	2	0	1	1	1	2	2	2	3	1	
Bachelors	CHEMISTRY	7	6	2	2	7	6	5	5	8	4	
Bachelors	CHEMISTRY	5	4	5	4	7	12	2	3	9	8	
Bachelors	CHEMISTRY	6	5	3	2	2	3	4	2	2	0	
Bachelors	CHEMISTRY,GENERAL	15	24	20	16	21	13	20	9	9	13	
Bachelors	CHEMISTRY	2	6	9	5	5	6	2	4	7	7	
Bachelors	CHEMISTRY	3	1	3	0	1	4	1	1	5	3	
Bachelors	CHEMISTRY	17	11	17	24	12	15	15	9	12	10	
Bachelors	CHEMISTRY,GENERAL	3	3	2	1	2	1	1	3	1	1	
Bachelors	CHEMISTRY	4	9	10	11	6	13	12	10	7	12	
Bachelors	CHEMISTRY	9	8	5	5	7	7	9	6	6	6	
Bachelors	CHEMISTRY	8	9	7	12	2	8	5	0	13	13	
Bachelors	CHEMISTRY,GENERAL & BIOLOGICAL	7	9	17	11	13	9	7	13	3	11	
Bachelors	CHEMISTRY	0	6	1	6	5	9	8	4	4	3	
Bachelors	CHEMISTRY	41	23	26	18	23	21	25	15	19	17	
Bachelors	CHEMISTRY	0	0	0	5	1	4	5	7	1	6	
Bachelors	CHEMISTRY	5	9	6	7	5	4	0	1	2	7	
	Subtotal	138	136	137	135	123	142	125	98	111	127	-8%
Masters	CHEMISTRY	7	4	7	9	4	2	6	1	7	9	
Masters	CHEMISTRY	12	12	12	9	9	6	15	0	5	6	
Masters	CHEMISTRY,GENERAL	17	15	16	15	16	14	21	12	23	18	
	Subtotal	36	31	35	33	29	22	42	13	35	33	-8%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Doctorate	CHEMISTRY	7	6	4	3	5	3	2	1	8	4	
Doctorate	CHEMISTRY	13	18	19	10	13	9	6	16	10	12	
Doctorate	CHEMISTRY,GENERAL	10	12	13	10	15	8	9	14	13	10	
	Subtotal	30	36	36	23	33	20	17	31	31	26	-13%
	TOTAL GRADUATES	204	203	208	191	185	184	184	142	177	186	-9%
Bachelors	GENERAL SCIENCE	12	11	21	9	16	15	10	13	6	3	
Bachelors	GENERAL SCIENCE	16	8	7	4	1	0	0	0	0	0	
Bachelors	GEOSCIENCES	20	23	6	5	10	3	2	0	0	0	
	Subtotal	48	42	34	18	27	18	12	13	6	3	-94%
Masters	SCIENCE	0	0	0	0	3	5	4	1	6	5	
	Subtotal	0	0	0	0	3	5	4	1	6	5	
	TOTAL GRADUATES	48	42	34	18	30	23	16	14	12	8	-83%
Bachelors	PHYSICAL SCIENCE	2	2	2	0	0	0	0	0	0	0	
Bachelors	PHYSICAL SCIENCES	17	15	8	5	10	8	8	4	7	4	
Bachelors	PHYSICAL SCIENCES,GENERAL	0	0	0	0	0	0	0	0	0	0	
	Subtotal	19	17	10	5	10	8	8	4	7	4	-79%
	TOTAL GRADUATES	19	17	10	5	10	8	8	4	7	4	-79%
Bachelors	GEOLOGY	0	0	0	0	0	1	2	5	3	3	
Bachelors	GEOLOGY	14	11	6	10	9	10	5	7	4	9	
	Subtotal	14	11	6	10	9	11	7	12	7	12	-14%
Masters	GEOLOGY	1	6	4	6	3	1	6	3	0	4	
	Subtotal	1	6	4	6	3	1	6	3	0	4	300%
Doctorate	GEOLOGY	3	1	0	2	1	1	1	0	3	0	
	Subtotal	3	1	0	2	1	1	1	0	3	0	-100%
	TOTAL GRADUATES	18	18	10	18	13	13	14	15	10	16	-11%
Associate	SCIENCE	0	0	0	0	0	0	0	1	6	10	
	Subtotal	0	0	0	0	0	0	0	1	6	10	
	TOTAL GRADUATES	0	0	0	0	0	0	0	1	6	10	

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Associate	CHEMICAL TECH	0	0	0	0	0	0	0	0	0	0	
Associate	CHEMICAL LABORATORY TECH	0	1	0	0	0	0	0	0	0	0	
	Subtotal	0	1	0	0	0	0	0	0	0	0	
	TOTAL GRADUATES	0	1	0	0	0	0	0	0	0	0	

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Bachelors	MATHEMATICS	9	9	8	13	6	7	5	8	7	3	
Bachelors	MATHEMATICS	4	6	3	1	2	4	1	4	7	4	
Bachelors	MATHEMATICS	4	2	2	1	1	0	0	1	0	1	
Bachelors	MATHEMATICS	4	7	9	2	25	0	7	1	1	3	
Bachelors	MATHEMATICS	15	12	12	13	5	11	8	7	7	8	
Bachelors	MATHEMATICS	2	4	5	3	3	2	4	7	3	3	
Bachelors	MATHEMATICS	5	8	5	8	3	3	3	3	6	4	
Bachelors	MATHEMATICS, GENERAL	5	7	8	8	5	9	5	6	10	8	
Bachelors	MATHEMATICS	10	3	7	4	6	3	4	7	5	7	
Bachelors	MATHEMATICS,GENERAL	8	1	8	4	4	7	6	4	5	4	
Bachelors	MATHEMATICS	21	24	22	21	16	27	12	22	24	22	
Bachelors	MATHEMATICS	7	16	20	22	11	12	11	13	10	6	
Bachelors	MATHEMATICS	36	30	31	36	35	33	25	30	23	27	
Bachelors	MATHEMATICS	35	38	30	21	22	28	16	26	18	30	
Bachelors	MATHEMATICS	0	2	2	1	2	0	4	2	6	2	
Bachelors	MATHEMATICS	51	34	33	38	32	43	59	73	65	77	
Bachelors	MATHEMATICS	4	2	3	6	5	5	3	2	6	6	
	Subtotal	220	205	208	202	183	194	173	216	203	215	-2%
Masters	MATHEMATICS	1	2	1	0	0	0	1	2	1	2	
Masters	MATHEMATICS	7	5	12	10	3	7	4	6	12	11	
	Subtotal	8	7	13	10	3	7	5	8	13	13	63%
Doctorate	MATHEMATICS	8	8	8	8	8	8	8	8	8	6	
	Subtotal	8	8	8	8	8	8	8	8	8	6	-25%
	TOTAL GRADUATES	**236**	**220**	**229**	**220**	**194**	**209**	**186**	**232**	**224**	**234**	-1%
Bachelors	STATISTICS	0	0	0	0	0	0	0	1	2	5	
Bachelors	APPLIED STATISTICS	0	0	0	0	0	0	0	0	0	0	
Bachelors	APPLIED MATHEMATICS & STATISTICS	8	4	7	3	6	3	4	5	19	17	
	Subtotal	8	4	7	3	6	3	4	6	21	22	175%
Masters	STATISTICS	4	4	5	1	3	10	3	2	4	4	
Masters	MATHEMATICAL STATISTICS	3	5	5	6	2	2	4	9	12	2	
Masters	APPLIED MATHEMATICS & STATISTICS	11	12	4	4	8	3	3	7	7	12	
	Subtotal	18	21	14	11	13	15	10	18	23	18	0%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Doctorate	STATISTICS	4	3	3	2	3	3	3	3	0	5	
Doctorate	MATHEMATICAL STATISTICS	0	1	4	3	1	3	0	0	0	5	
Doctorate	APPLIED MATHEMATICS & STATISTICS	4	5	3	4	4	5	2	4	4	5	
	Subtotal	8	9	10	9	8	11	5	7	4	15	88%
	TOTAL GRADUATES	**34**	**34**	**31**	**23**	**27**	**29**	**19**	**31**	**48**	**55**	62%
Bachelors	APPLIED & COMPUTATIONAL MATHEMATICS	7	5	8	10	12	10	16	12	6	10	
Bachelors	APPLIED MATHEMATICS	0	0	0	0	0	0	0	2	1	1	
Bachelors	MATHEMATICAL SCIENCES	17	14	13	11	15	13	11	12	15	13	
	Subtotal	24	19	21	21	27	23	27	26	22	24	0%
Masters	APPLIED & COMPUTATIONAL MATHEMATICS	14	11	5	7	12	11	9	12	12	13	
Masters	APPLIED AND COMPUTATIONAL MATHEMATI	0	0	0	0	0	1	1	0	0	1	
Masters	APPLIED AND INDUSTRIAL MATHMATICS	0	0	0	0	0	0	3	1	2	3	
Masters	APPLIED MATH & SCIENTIFIC COMPUTATI	2	7	12	12	12	6	4	5	14	17	
Masters	APPLIED MATHEMATICS	6	5	4	7	3	7	2	4	4	3	
Masters	NUMERICAL SCIENCE	26	13	18	10	8	14	5	10	8	18	
	Subtotal	48	36	39	36	35	39	24	32	40	55	15%
Doctorate	APPLIED & COMPUTATIONAL MATHEMATICS	1	4	3	5	7	2	2	3	2	2	
Doctorate	APPLIED MATH & SCIENTIFIC COMPUTATI	7	6	10	6	4	4	6	9	4	11	
Doctorate	APPLIED MATHEMATICS	2	2	1	2	0	2	1	1	4	3	
	Subtotal	10	12	14	13	11	8	9	13	10	16	60%
	TOTAL GRADUATES	**82**	**67**	**74**	**70**	**73**	**70**	**60**	**71**	**72**	**95**	16%
Post Bac. Cert.	LARGE SCALE ASSESSMENT	0	0	0	0	0	0	0	8	0	1	
	Subtotal	0	0	0	0	0	0	0	8	0	1	
Masters	MEASUREMENT, STATISTICS AND EVALUAT	5	1	6	4	2	3	1	4	5	5	
	Subtotal	5	1	6	4	2	3	1	4	5	5	0%
Doctorate	MEASUREMENT, STATISTICS & EVALUATIO	4	1	3	4	2	1	3	1	4	1	
	Subtotal	4	1	3	4	2	1	3	1	4	1	-75%
	TOTAL GRADUATES	**9**	**2**	**9**	**8**	**4**	**4**	**4**	**13**	**9**	**7**	-22%

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Associate	MATHEMATICS	0	0	4	3	2	5	5	6	2	4	
	Subtotal	0	0	4	3	2	5	5	6	2	4	
	TOTAL GRADUATES	0	0	4	3	2	5	5	6	2	4	

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1995 - 2005
Certificate	AVIATION MAINTENANCE TECH	0	0	0	0	0	0	0	0	0	0	
Certificate	AVIATION MAINTENANCE TECH	10	9	8	11	8	11	12	8	0	1	
	Subtotal	10	9	8	11	8	11	12	8	0	1	-90%
Associate	AVIATION MAINTENANCE TECH	0	0	0	0	0	0	0	0	0	0	
Associate	AVIATION TECH	1	8	6	3	2	2	1	2	1	1	
	Subtotal	1	8	6	3	2	2	1	2	1	1	0%
	TOTAL GRADUATES	**11**	**17**	**14**	**14**	**10**	**13**	**13**	**10**	**1**	**2**	-82%
Certificate	AVIATION MANAGEMENT	0	0	0	0	0	0	1	2	2	6	
	Subtotal	0	0	0	0	0	0	1	2	2	6	
Associate	AVIATION MANAGEMENT	3	7	2	2	3	0	0	0	0	0	
Associate	AVIATION MANAGEMENT	0	0	0	0	0	2	3	6	5	8	
	Subtotal	3	7	2	2	3	2	3	6	5	8	167%
	TOTAL GRADUATES	**3**	**7**	**2**	**2**	**3**	**2**	**4**	**8**	**7**	**14**	367%
Certificate	FLIGHT TRAINING	0	0	0	0	0	0	2	4	1	1	
	Subtotal	0	0	0	0	0	0	2	4	1	1	
	TOTAL GRADUATES	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**4**	**1**	**1**	
Certificate	AIR TRAFFIC CONTROL	0	0	0	0	0	0	0	2	4	5	
	Subtotal	0	0	0	0	0	0	0	2	4	5	
	TOTAL GRADUATES	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**4**	**5**	

Graduates of Selected Engineering and Engineering Technology Programs Offered By Maryland Higher Education

Level	Program Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	% Change 1996 - 2005
Post. Bac. Cert.	SYSTEMS ANALYSIS	0	0	0	0	0	2	6	6	9	5	
	TOTAL GRADUATES	**0**	**0**	**0**	**0**	**0**	**2**	**6**	**6**	**9**	**5**	
Bachelors	TELECOMMUNICATIONS	63	52	47	60	49	50	62	83	84	89	
Bachelors	TELECOMMUNICATIONS ENGINEERING TECH	7	16	23	20	7	9	12	12	9	7	
	Subtotal	70	68	70	80	56	59	74	95	93	96	37%
Post. Bac. Cert.	TELECOMMUNICATIONS. AND INFO. SYS.	0	0	7	24	28	54	40	28	21	3	
Post. Bac. Cert.	TELECOMMUNICATION SYSTEMS	0	0	0	0	3	5	2	1	1	31	
Post. Bac. Cert.	TRAINING AT A DISTANCE	0	0	0	0	0	0	9	5	13	3	
Post. Bac. Cert.	TELECOMMUNICATIONS MANAGEMENT	3	0	0	0	0	1	4	8	5	3	
	Subtotal	3	0	7	24	31	60	55	42	40	40	1233%
Masters	TELECOMMUNICATIONS MANAGEMENT	72	30	34	38	47	61	50	44	57	57	
Masters	INFORMATION & TELECOMMUNICATION SYS	83	124	156	160	147	145	180	152	145	135	
Masters	INFORMATION AND TELECOMM SYS MGMT	4	11	14	22	32	35	34	34	34	17	
Masters	TELECOMMUNICATIONS	0	0	0	0	0	0	0	7	14	2	
Masters	TELECOMMUNICATIONS	6	12	14	14	16	21	28	30	38	46	
	Subtotal	165	177	218	234	242	262	292	267	288	257	56%
	TOTAL GRADUATES	**238**	**245**	**295**	**338**	**329**	**381**	**421**	**404**	**421**	**393**	**65%**
Certificate	TELECOMMUNICATIONS ENGINEERING TECH	0	0	0	0	0	0	0	0	0	0	
Certificate	TELECOMMUNICATIONS ELECTRONICS	0	0	0	0	0	0	0	0	4	0	
	Subtotal	0	0	0	0	0	0	0	0	4	0	
Associate	TELECOMMUNICATIONS ENGINEERING TECH	1	4	4	3	1	3	4	3	0	2	
	Subtotal	1	4	4	3	1	3	4	3	0	2	
	TOTAL GRADUATES	**1**	**4**	**4**	**3**	**1**	**3**	**4**	**3**	**4**	**2**	**100%**

Appendix B. Current Initiatives

National and Statewide Practices to Grow or Improve the Aerospace Workforce

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Index

Executive Order: Strengthening Processes Relating to Determining Eligibility for Access to Classified National Security Information

Recruitment/Retention

National

NASA Academy
Sponsoring Diversity at ATK Aerospace Group
Space Exploration Alliance

State Initiatives

Georgia's Quick Start Job Training Program
Oregon Space Program Showcased at the Oregon State Fair
Washington State's Edmonds Community College's Triad Initiative

Training/Professional Development/Higher Education

Maryland

The Goddard Space Flight Center (GSFC) Office of Higher Education
NASA Goddard Center for Astrobiology Summer Undergraduate Internship Program
Space Operations Institute and Capitol College

National

Project Lead the Way (PLTW)
The National Space Grant College and Fellowship Program
The Space Foundation

State Initiatives

Arkansas Space Grant Consortium Workforce Development Fellowship Program
California Space Grant Consortium Student-mentor Aerospace Workforce Development Scholarships/Training Grants
Florida's Advanced Learning Environment for the Aerospace Industry
Florida's SpaceTEC Receives $3 million from NSF to Advance Aerospace Workforce Program
Maine Aerospace Workforce Development Program
North Dakota Space Grant Consortium Awarded $100,000 Grant to Design Mars Planetary Suit
Oklahoma's Aerospace Training and Educational Opportunities
The Tennessee Space Grant Consortium

Introduction

The Governor's Workforce Investment Board's Aerospace Industry Steering Committee has narrowed the list of issues impacting the Aerospace industry to five focus areas: pipeline development, policy, recruitment and retention, security clearance and training/professional development/higher education. In order to identify opportunities for improvement and ways to address these four areas, it is important to look at some of the existing best practices in Maryland, nationally and in individual states.

Pipeline Development

MARYLAND

Honeywell Technology Solutions provides Maryland students with educational opportunities

Honeywell Technology Solutions continues to give Maryland students opportunities through scholarships and grants to get them interested in Aerospace. Its Honeywell Hometown Solutions program provides grants, mentors and guest lecturers to the Cooperative Satellite Learning Project (CSLP) – a nationwide joint venture with NASA/Goddard that teaches hands-on satellite mission operations to high school students. Laurel High School in Laurel, Maryland, is the flagship school for CSLP. Honeywell also covers material and transportation costs for a local, Columbia, Maryland, high school rocketry team that regularly places high in regional and national competitions. For many years, Honeywell has been a member of the Independent College Fund, partnering with the NSA on NSA's National Security Scholars program.

The Maryland Mathematics, Engineering, Science Achievement (MESA) Program

The Johns Hopkins University Applied Physics Laboratory (JHU/APL) sponsors the Maryland Mathematics, Engineering, Science Achievement (MESA) program. MESA, established in 1976, is a structured, multi-year, pre-college program that prepares students for academic and professional careers in the fields of mathematics, engineering, science and technology. The program's goals are to 1) increase the number of students interested in pursuing careers in engineering, science, mathematics, and related professional fields, and 2) serve as a driving force in encouraging and assisting minorities and females in achieving success in these fields. These goals are accomplished by partnering with school systems, colleges and universities, industry and business, government, community organizations, families, and alumni. These partnerships enable MESA to provide enriching academic activities and programs for students during the school year and over the summer break. Maryland MESA provided services and programs to over 2100 students and 180 teachers in Baltimore City and 11 Maryland counties in 2005. Over 24,000 Maryland students have been served since the program's inception. For more information on this program, go to: http://www.jhuapl.edu/mesa/content.htm.

The Maryland Space Business Roundtable (MSBR)

The primary goal of the MSBR is to promote educational initiatives that will help to build the workforce for tomorrow, especially in the areas of science and technology. Below are examples of some of its programs:

Central Maryland Physics Olympics – High school physics students participate in events that challenge their physical and engineering skills.

Final Frontiers Competition – A science and engineering competition held annually for students in grades 5-12 in Montgomery and Prince George's Counties.

Technology Education Alliance with Middle Schools (TEAMS) – Provides a framework for educators to teach and foster effective teaming skills in middle school students and focuses on the importance of teamwork as an enabler in solving technology problems. The program uses robotic games where students form teams to build and operate robots for competition and relates this concept to the design and construction of spacecraft in support of space exploration.

(http://mdspace.org/outreach.htm)

Maryland Space Grant Consortium (MSGC)

MSGC is Maryland's implementation arm of NASA's National Space Grant College and Fellowship Program. It meets objectives through a wide variety of activities that target higher-education, pre-college, research and public outreach. It provides:

- Scholarships and fellowships to graduate and undergraduate students.
- Seed money for pre-college programs.
- Interdisciplinary, graduate-level education in Earth/space science and research opportunities for K-12 math and science teachers.
- Weekly observatory "Open Nights" and other events for the public that highlight ASA's current scientific missions.

(www.mdspacegrant.org)

Project Lead the Way in Maryland

Project Lead the Way (PLTW) is a national pre-engineering program where high schools partner with institutions of higher learning and business/industry to increase the quantity and quality of engineers graduating from two and four-year colleges. Students in the high school program enroll in challenging courses in Principles of Engineering, Introduction of Engineering Design, Digital Electronics, Computer Integrated Manufacturing, Civil Engineering and Architecture, Aerospace Engineering, and Engineering Design and Development. Schools that offer the middle school program called Gateway to Technology (GTT) provide instruction on Design and Modeling, the Magic of Electrons, the Science of Technology and Automation and Robotics.

Maryland has 43 schools in 15 school systems participating in the high school and middle school programs (35 high schools and 8 middle schools). Through a competitive grant process, the Maryland State Department of Education (MSDE) has awarded more than $2.5 million in Tech Prep incentive funds to implement this high-quality career and technology education program. The University of Maryland, Baltimore County (UMBC), serves as the State's PLTW Affiliate University providing training to PLTW teachers and guidance counselors and overseeing the PLTW College Certification process in the State. Currently nine schools have applied and received college certification allowing students to participate in a process in which they can receive transcripted and/or articulated credit at a number of PLTW affiliated colleges and universities throughout the country. Maryland has a PLTW State Partnership team consisting of representatives from business/industry, associations, postsecondary institutions, and other State agencies.

www.marylandpublicschools.org

The WORTHY Program

In 1998, Northrop Grumman's Electronic Systems, headquartered near the Baltimore/Washington International (BWI) Airport, introduced the WORTHY (Worthwhile To Help High School Youth) mentoring program to assist in developing tomorrow's technical talent. Baltimore City high school students have benefited from mentoring by some of Northrop Grumman's many talented employees. WORTHY participants are encouraged to pursue a college degree in engineering, physics, computer science, or math.

Each mentee is assigned two mentors. Mentees spend several hours each month with their mentors who provide an introduction to the business world, keys to achieving success, career guidance, and academic advice. Mentees have the opportunity to assist their mentors with projects.

Mentees in the WORTHY Program are eligible for available part-time summer employment opportunities at Northrop Grumman. These opportunities assist them with preparing to compete in the job market after college graduation. Upon successful completion of the program, Northrop Grumman provides the mentees with multi-year, partial scholarships to attend an accredited college or university. (worthy@ngc.com)

Discover "E"

Northrop Grumman sponsors a program called Discover "E"(E for engineering), a nationwide student outreach program, started in 1990, to expose elementary, junior, and senior high school students to engineering and cultivate their interest in math, science and engineering. Thousands of engineers throughout the United States participate in the program every year by serving as role models and illustrate the importance of education in math and science, not only for a career in engineering, but simply as preparation for living in our increasingly complex world. Participating employees are provided with educational materials and student prizes (Northrop Grumman logo articles) and they work together as a network to share ideas for student hands-on activities and engaging competitions. In the Maryland area alone, more than 250 volunteers visited more than 120 schools in 2005. In addition to the educational benefit to the schools, Northrop Grumman makes a cash donation to each participating school in support of the schools' Math or Science Department initiatives.

www.ngc.com

Sojourner-Douglass College, Kids College in Atmospheric Science (KCAS) Program

The KCAS program represents a collaborative effort between Sojourner-Douglass College and the U.S. Department of Commerce, NOAA and the National Weather Service (NWS). The program is designed to attract and engage under-represented students at an early age to become enthusiastic regarding this course of study and to ultimately pursue the profession of atmospheric science. This initiative consists of four overall components: Kids College, Hands-on-Science, Summer camp, and Teacher Training Program. The ultimate goal of the program is to establish an accredited undergraduate degree in atmospheric science and to create professional training programs for persons who wish to further their knowledge and skill sets in this career field. The proposed course offerings will broaden the knowledge of current and future students and create a multi-level pipeline of students who are motivated and academically prepared for any area of science. Students eligible for this program are those in grades K-12 who attend Thomas G. Hayes Elementary School, Paul Laurence Dunbar Middle School, Lombard Middle, and St. Francis Academy and Thurgood Marshall, which are high schools.

www.sdc.edu

National

Civil Aeronautics Patrol's MARS program

Civil Aeronautics Patrol, the volunteer auxiliary of the U.S. Air Force, is helping develop tomorrow's Aerospace workforce. Through its award-winning MARS program, it offers teachers:

- Free national standards-based Aerospace education materials (for homeschoolers too).
- Awards for schools that adopt Aerospace education into their curricula.
- Low-cost Aerospace textbooks for grades 6-12.
- Aerospace education newsletters containing useful information.
- Orientation flights in powered aircraft.
- Aerospace-oriented summer workshops and encampments.
- Aerospace education speakers and resources nationwide.
- Scholarships for teachers and students interested in Aerospace and aviation careers.
- The nation's premier Aerospace education conference for teachers.

(http://level2.cap.gov/visitors.programs/Aerospace_education/Aerospace_education-members)

For Inspiration and Recognition of Science and Technology (FIRST)

FIRST is a multinational non-profit organization, that aspires to transform culture, making science, math, engineering, and technology as interesting for children as sports are today. It was founded in 1989, by Dean Kamen, inventor of the Segway Human Transporter. FIRST operates the FIRST Robotics Competition in which teams of high school students, sponsored and assisted by local companies and volunteers, design, assemble and test a robot capable of performing a specified task in competition with other teams. FIRST also runs the FIRST LEGO League, for children 9-14 years old, and FIRST Place, an innovative science and technology center, including a hands-on children's science museum. FIRST was founded on partnerships with businesses, educational institutions, and government. More than 25,000 volunteer mentors, professional engineers, teachers, and other adults work with students across the country. In addition to the thousands of volunteer team mentors, FIRST competitions and other events were organized and staffed by over 14,000 event and committee volunteers. Through these volunteers, FIRST programs engaged over 70,000 young people during the last year.

www.usfirst.org/about

Honeywell Hometown Solutions is Inspiring the Next Generation and Enabling Once-in-a-Lifetime Learning

Honeywell Technology Solutions, Inc., has been conducting activities to get K-12 students interested in Aerospace careers for the past 50 years. The Honeywell Hometown Solutions Inc., is inspiring the next generation and enabling once-in-a-lifetime learning in the following ways:

- Sponsors 50 middle school math and science teachers each year to attend the Honeywell Educators at Space Academy in Huntsville, Alabama. These teachers return to the classroom with new tools to engage thousands of children in science and math. **Seven teachers from Maryland have attended Space Academy since its inception in 2004**. Honeywell is now accepting applications for 2006.

  (http://www.honeywell.com/sites/hhs/)

- Sends 100 children of Honeywell employees each year to attend the weeklong Honeywell Scholars @ Presidential Classroom program in Washington, DC, giving them a behind the scenes look at how public policy vis-à-vis science and technology gets developed.

- Underwrites the production and tour of FMA Live – the first multi-media hip hop musical to travel the nation—middle school by middle school – bringing live heart-pounding rhythms and hard core science. The show, which has been seen by hundreds of Maryland middle school students, explores Isaac Newton and his Laws of Motion through interactive demos (involving students and teachers), daring dance moves and music videos.

  www.honeywell.com

Lockheed Martin's Excellence in Education

Excellence in Education, from elementary school to the university level, is an important part of the company's corporate citizenship initiatives. Here are some examples of its programs:

Space Day – A national celebration dedicated to encouraging young people to explore the boundaries of what is possible. Employees from across the Corporation participate in hands-on Space Day programs at their sites and at local schools and museums.

Partners in Education – Establishing mentoring teams and science lab programs at elementary schools in Marietta, GA.

Tomorrow's Engineers – Lockheed Martin has joined the University of Central Florida in Orlando to develop the Excellence in Engineering Program to attract promising students to a career in engineering.

Helping Children Succeed – Lockheed Martin in Houston is working with the Clear Creek Independent School District on a tutoring and mentoring program to help at-risk students excel.

(www.lockheedmartin.com)

NASA's The Educator Astronaut Program (EAP)

The EAP is one of four strategic or "pathfinder" initiatives of the Education Enterprise. It is directed at the K-12 portion of the NASA education pipeline, with emphasis on grades 5-8. NASA recognizes that our Nation's classroom teachers represent an enormous resource of professional expertise. The goals of the EAP are:

- To select a small number of outstanding educators to become permanent members of the Astronaut Corps.
- To use the visibility and educational opportunities created by the activities of these Educator Astronauts to inspire greater K-12 STEM (Science, Technology, Engineering, and Math) achievement, promote STEM careers, and elevate public esteem for the teaching profession.
- To develop original educational content based on Educator Astronaut training and flight activities.
- To engage the top tier educators, who applied for the Educator Astronaut program, establishing the Network of Educator Astronaut Teachers (NEAT).

  http://edspace.nasa.gov

The NASA Urban and Rural Community Enrichment Program (URCEP)

URCEP is a NASA Aerospace Education Services Program designed specifically to serve grades 5-8 in the education community of underrepresented and underserved populations in urban and rural sites. This customized program is planned, coordinated, and implemented in participating schools by the URCEP team, along with school representatives. Using motivating demonstrations and scale models of aeronautical and space hardware, the URCEP specialists explain how basic scientific principles are applied in the exploration of aeronautics and space. Major activities for students include lectures, demonstrations, and hands-on classroom activities that supplement the current curriculum. Professional development workshops and other activities are offered for educators.

http://www.nasa.gov/education/urcep

SpaceVision2005

In November 2005, the National Conference of Students for the Exploration and Development of Space (SEDS) was held at the University of Illinois at Urbana-Champaign. The conference's mission was to define the young generation's role in space development and offer several opportunities to become involved in the space industry. On the first day, the programs and technologies related to upcoming exploration missions will be highlighted. During the second day, the focus will be on career paths and opportunities in the space industry. SEDS is an independent, student-based organization that promotes the exploration and development of space. SEDS pursues this mission by educating people about the benefits of space, by supporting a network of interested students, by providing an opportunity for members to develop their leadership skills, and by inspiring people through involvement in student-led projects.

(www.space2005.org)

State Initiatives

The Arkansas Space Grant Consortium K-12 Outreach Program

This program provides funds for K-12 student space-related programs. It also funds trips to the U.S. Space and Rocket Center at Huntsville, Alabama, summer rocket camps and trips to NASA Centers by K-12 teachers and their students. It also awards grants to K-12 teachers for amounts up to $500. These funds may be used to travel to conferences for in-service training; library books and visual aids for the school library, telescopes for classrooms, school or community and curriculum development.

(http://asgc.ualr.edu/K-12a.htm)

Florida's Brevard Community College's Project Genesis Program

The U.S. Department of Labor awarded a $98,000 grant to Brevard Community College to provide hands-on learning opportunities for K-12 students to develop technical Aerospace skills and improve awareness of the skills required for Aerospace careers. The initiative includes support for the operation of launch facilities and conduct six suborbital launches at historic Launch Complex 47 at Cape Canaveral Air Force Station. Other project partners include the Florida Space Authority, Florida Space Institute, U.S. Air Force 45th Space Wing, the National Science Foundation's SpaceTEC (National Center for Aerospace Technical Education) and the Civil Air Patrol.

http://www.doleta.gov/BRG/pdf/Aerospace_BrevardCommunityCollege_Rebuilding%20the%20Aerospace.pdf

Florida Space Research Institute's Aerospace Workforce Development Pilot Project

The program provides two Aerospace mentors, covering seven counties and 25 summer employment opportunities for technology teachers to improve hands-on knowledge and awareness of the skills required for Aerospace careers in Florida. The goal is to reach approximately 2,500 K-12 students each year. The Institute received $355,628 from the Department of Labor, leveraging $174,703 from other sources.

http://www.fsri.org/Press_Releases_1st_Quarter_2005.htm

Florida's PRISM Project

To become tomorrow's Aerospace workers, today's elementary and secondary school students will need a strong foundation in math and science. That is one of the many reasons why eight school districts and several community organizations in Florida have joined together to launch The Prism Project, a 10-year campaign to elevate Central Florida schools to national and global leadership in math and science education.

www.floridaspaceauthority.com/partners.html

Florida's Rockets for Schools Aerospace Research and Engineering Systems Institute (ARES)

ARES is working to benefit and grow the Aerospace and engineering workforce of the future in the State of Florida. It develops and coordinates projects involving students at all levels, helping to inspire the younger generation to pursue science, math, and excellence. It sponsors a comprehensive program of engaging students and workers of all ages and skill levels in hands-on, real-world research projects. One example is the Rockets for Schools program. This will involve primary and secondary level students in the design, construction and flight of rockets and payloads.

(www.aresinstitute.org/ares/about.html)

Maine Space Grant Consortium (MSGC) K-12 Professional Development

In the spring of 2003, MSGC ran a K-12 Professional Development Competition to support programs and activities that contribute to Maine's K-12 teacher preparation and development in the space related sciences. This is an example of one of the awarded projects:

> Maine Mathematics and Science Alliance for their project titled "Sunspotters: A "Stellar" Approach to Improving Student and Teacher Learning." This project uses the context of the Sun to engage middle school teachers in a continuous cycle of content learning, inquiry and assessment, tied to the Maine Learning Results. It is designed to: 1) build middle school teachers' content understanding of the key space

science concepts needed to understand the Sun's characteristics and Sun-related phenomena, 2) help teachers experience the processes of inquiry that their middle school students will use to investigate, model and construct understanding of stellar content, and 3) explore the teaching and learning strategies that enable stellar concepts to be constructed through investigation and continuous assessment.

Public Outreach: K-12 Outreach – the Consortium conducted its third annual essay competition for middle school students in Maine, with regional first prizes of a trip to Space Camp. The purpose of this annual contest is to encourage, excite, and inspire students to excel in the space-related sciences and education.

www.msgc.org

Policy/Security Clearance

National

The National Academy of Sciences (NAS) Releases its Report "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future."

The NAS report was requested by Congress and recommends ways to strengthen research and education in science and technology. The NAS makes four recommendations:

- Increase America's talent pool by vastly improving K-12 science and mathematics education.
- Sustain and strengthen the nation's traditional commitment to long-term basic research that has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life.
- Make the U.S. the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists and engineers from within the U.S. and throughout the world.
- Ensure that the U.S. is the premier place in the world to innovate; invest in downstream activities such as manufacturing and marketing; and create high-paying jobs that are based on innovation by modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access.

http://www.house.gov/science/hearings/full05/oct%2020/NAS%20ST%20and%20Econ%20Competitiveness%20Hearing%20Charter%20final.pdf

Workshop on National Security Workforce Challenges and Solutions Sponsored by the National Defense Industrial Association and the Aerospace Industries Association

In December 2004, this workshop developed recommendations for attracting, retaining, and training people. The recommendations were as follows:

- **Attract**: Create a shared vision, improve marketing and communication systems, improve compensation system and identify and market to non-traditional groups.
- **Retain**: Review best practices.
- **Train**: Identification and implementation of skills and requirements, develop or enhance professional development programs.

http://proceedings.ndia.org/534E/Best_Practices_Break_Out-Final.pdf

Industry Coalition Calls for Security Clearance Improvements

An industry coalition (comprised of the Information Technology Association of America, Professional Services Council, Security Affairs Support Association, Contract Services Association, Armed Forces Communications and Electronics Association, and the Northern Virginia Technology Council) recently recommended that the government make four changes that it said will enable the government to respond more quickly to security threats, save taxpayer dollars, and allow government projects to proceed on time. The coalition recommended that the government:

- Allow some people to be cleared who are not currently assigned to a project requiring a clearance. Currently only people requiring a clearance for a specific job are allowed to get cleared. Granting clearances to an additional 20 percent of workers above the base amount of cleared personnel would allow contractors to quickly and cost-effectively staff projects upon contract award.
- Increase the use of private-industry adjudicators until the current clearance backlog is eliminated and the processing delay is 30 days or less.
- Increase the reciprocity of clearances so that cleared workers can be shared among agencies and contractors. Currently, workers leaving a project and returning to the agency a few weeks later can wait months to get their clearances reinstated.
- Standardize the data and processes required for clearances, so that every agency has the same base process for the lowest-level clearance. The coalition believes that a standardized process would set the foundation for a tiered level of more advanced clearances.

http://www.itaa.org/es/docs/securityclearancewhitepaper.pdf

The NASA Flexibility Act of 2004 (Voinovich/Boehlert) PL 108-113

The bill gives NASA more flexibility to recruit and retain a highly skilled workforce. Among other things, it directs the NASA Administrator to establish a NASA Science and Technology Scholarship Program to award scholarships to individuals in return for contractual agreements under which such individuals agree to serve as full-time NASA employees for 2 years for each scholarship year. It also authorizes the Administrator to appoint directly to the General Schedule of Compensation for Federal Employees in GS-7 through GS-12 positions individuals in professional and research fields who meet specified educational requirements. It also provides for the consideration of veterans' preference eligibles who meet the criteria for appointment ahead of non-preference eligibles and requires public notice of vacancies.

http://thomas.loc.gov/cgi-bin/bdquery/z?d108:S.610:

HR 758 "To establish an interagency Aerospace revitalization task force to develop a National strategy for Aerospace workforce recruitment, training, and cultivation"

On October 26, 2005, The U.S. House of Representatives passed HR 758 (Sponsored by Congressman Ehlers ([MI]) and Congresswoman Tauscher ([CA]), legislation to create a Federal inter-agency task force on Aerospace workforce revitalization. The bill charges 11 executive branch agencies, including NASA and the Defense and Homeland Security departments, to identify new Aerospace workforce opportunities through a variety of scholarship, training, and recruitment programs in partnership with the private industry and State governments. Each year, the task force, under the leadership of the Labor Department, would report to Congress on the status of Federal policies designed to advance human capital development in the areas of science, engineering, technology, and mathematics, as well as vocational trades. After passing the House, the bill has been referred to the Senate Committee on Commerce, Science, and Transportation.

http://thomas.loc.gov/cgi-bin/query/D?c109:2:./temp/~c109nBsd4S:

PL108-458 The Intelligence Reform and Terrorism Prevention Act of 2004

Title III: Security Clearances: Directs the President to select a single Executive branch department, agency, or element (designated entity) to be responsible for security clearances and investigations. The legislation requires all Federal agencies to accept security clearance background investigations and determinations which are completed by an authorized investigative agency or authorized adjudicative agency. It also directs the director of the Office of Personnel Management to establish and operate an integrated secure database on security clearances. In addition, it requires the head of the designated entity to evaluate the use of available information technology and databases in security clearance investigations and adjudications. Finally it requires 1) the head of the designated entity to develop a plan to reduce the length of the personnel security clearance process 2) the plan to provide for determinations on at least 90 percent of all security clearance applications within 60 days; and 3) implementation of such plan within 5 years after enactment of the law. It also requires the head of the designated entity to report to Congress annually through 2011 on the progress in meeting the requirements of the act.

http://thomas.loc.gov

Executive Order: Strengthening Processes Relating to Determining Eligibility for Access to Classified National Security Information

On June 28, 2005, President Bush signed an executive order essentially designating the Office of Management and Budget as the designated entity for creating a plan to improve the security clearance process, as a result of PL 108-458. A hearing has been scheduled before the Senate Committee on Homeland Security and Government Affairs on November 9, 2005, to review the progress the Administration has been making on implementation of the legislation.

www.whitehouse.gov/news/releases/2005/06/print/20050628-4.html

Recruitment/Retention

National

NASA Academy

NASA Academy is an intensive 10-week summer research program geared towards diverse undergraduate and graduate students interested in Aerospace-related fields. It gives its participants working knowledge of its programs in an environment that fosters creativity, personal growth, leadership, teamwork, appreciation of diversity, and professional development. Participating NASA Centers include Ames, Glenn, and Goddard.

http://www.nasa-academy.nasa.gov

Sponsoring Diversity at Alliant TechSystems (ATK) Aerospace Group

ATK Aerospace Group is part of ATK Thiokol Inc. The group designs, develops, and produces many Aerospace products. The average age of an ATK employee is 48 and has worked in Aerospace for 18 years. ATK says that diversity is a key initiative for its company. A major goal for the group is moving diversity on up the leadership ladder. Its senior leaders say that to compete beyond 2010 they need a more diverse workforce. Moving toward that goal, diversity assessments are issued every month showing talent pool increase and hiring and retention rates. Five-year goals have been established for every EEO category. The group is working on plans to identify and develop high-potential female and minority employees. Diversity training is required for all employees, including managers. Data from focus groups will show how accepting the work culture is in the company.

(www.diversitycareers.com/articles/pro/04-junjul/dia_atk.htm)

Space Exploration Alliance

The Space Exploration Alliance is a partnership of the nation's premier non-profit space organizations that have a combined membership of more than 1.2 million people throughout the U.S. It supports the Vision for Space Exploration as a bold and sustainable mandate for human and robotic exploration of the solar system that will help ensure American technological and scientific preeminence in the 21st century. The nation's premier non-profit space organizations will work together to communicate to the American public and elected officials that the Vision for Space Exploration is a compelling national priority that is technically and fiscally achievable, will inspire the nation's youth and public, reinvigorate the traditional Aerospace workforce and industrial base, and foster job-creating entrepreneurial activity across the entire economy.

www.spaceexplorationalliance.org

State Initiatives

Georgia's Quick Start Job Training Program

Georgia's Quick Start job training program has been credited with helping to stabilize the State's Aerospace industry workforce. Quick Start helps Georgia companies compete in the global marketplace by providing quality workforce training. It has worked extensively with the Aerospace industry to train workers because of an increase in military aircraft orders. As a result of a partnership with McDonnell Douglas, they had developed, along with the Macon Technical Institute, a redesigned Aircraft Technology Training Technical Certificate of Credit program – a short course that focuses on specific skills. The certificate program is offered at seven technical institutes and has had a major impact on the Aerospace workforce in Georgia. (www.dtae.org/public/results/results8.html)

Oregon Space Program Showcased at the Oregon State Fair

In 2004, the Oregon NASA Space Grant Consortium (OSGC) showcased the Oregon Space Program at the Oregon State Fair to illustrate the benefits of engaging students in science and math activities as well as encouraging team building experience to develop skills for the next generation Aerospace workforce. During the State Fair, they launched an altitude balloon satellite and provided an exhibit booth to engage students and the general public alike.

http://www.oregonspacegrant.orst.edu

Washington State's Edmonds Community College's Triad Initiative

This grant initiative focuses on developing an advanced Aerospace technician curriculum, career ladders and distance learning approaches associated with the Boeing 7E7 supply chain. This is a systems level curriculum roadmap with course materials on top of composite fundamentals, process methodologies, and cross-cultural learning for delivery to engineering and technology students in higher education and incumbent and transitioning workers.

http://www.doleta.gov/BRG/pdf/Aerospace-%20Edmonds%20One%20Pager_GRANTEE%20HAS%20REVIEWED.pdf

Training/Professional Development/Higher Education

Maryland

The Goddard Space Flight Center (GSFC) Office of Higher Education

The Office of Higher Education (formerly the Office of University Programs) oversees activities and programs at GSFC) designed to maintain and broaden the center's interaction with the higher education community. Special attention is directed to local colleges and universities along the northern and eastern seaboard and Aerospace-oriented institutions nationwide having programs of mutual interest to GSFC. The Office manages NASA-wide fellowships and grants programs at GSFC, provides programmatic support for other university-related programs, within the various laboratories at GSFC, and develops new programs to enhance the GSFC research and development missions through increased contact with the university community. NASA's programs deal with students at the graduate and undergraduate levels, faculty members, researchers, and in some cases the teachers of teachers.

http://university/gsfc.nasa.gov

NASA Goddard Center for Astrobiology Summer Undergraduate Internship Program

This is a program for undergraduate science or engineering majors who are interested in working with scientists on astrobiological knowledge. During the internship, each student will participated in a specific research program, working directly with one of the scientists at NASA's GSFC.

http://astrobiology/gsfc.nasa.gov/suia.html

Space Operations Institute at Capitol College

The Space Operations Institute at Capitol College is a partnership with education, industry, and NASA. Through the Institute, an Astronautical engineering student can intern for NASA as early as junior year. Students will work with the Upper Atmosphere Research Satellite (UARS) at NASA, one of four missions controlled by the Space Operations Institute, applying what they have learned in their specialized courses. Students will work with top NASA scientists to send commands to the $800 million satellite and turning on the instruments that gather the data scientists use to better understand global warming and ultraviolet radiation from ozone depletion.

http://www.capitol-college.edu/academicprograms/soi/index.shtml

National

The National Space Grant College and Fellowship Program

The National Space Grant College and Fellowship Program (also known as Space Grant) contributes to the Nation's science enterprise by funding research, education, and public service projects through a national network of 52 university-based Space Grant consortia. These consortia administer programs in all 50 states, the District of Columbia, and Puerto Rico. The consortia's 703 affiliates include 493 academic institutions and 62 businesses. Other partners include State and Local Government agencies, other Federal agencies, and nonprofit organizations. Space Grant celebrates its tenth year of service in 1999. Since its inception, Space Grant has awarded over 12,000 U.S. Citizens with tuition assistance in science, engineering, and related fields of study.

http://calspace.ucsd.edu/spacegrant/

The Space Foundation

Manages the on-site NASA Educational resource center, offers two distinct master's in Space Studies Degrees and trains teachers through Space Discovery graduate courses and national conferences.

www.spacefoundation.org

State Initiatives

Arkansas Space Grant Consortium Workforce Development Fellowship program

This workforce development initiative is a student/mentor program in Arkansas' higher education institutions. The Arkansas NASA Workforce Fellows will be better prepared for the Nation's Aerospace workforce after graduation by participating in the program. This program encourages college students to engage in science and engineering field studies, specifically Aerospace or closely related majors, and to provide a high level of internship experience for them. The program creators believe that: 1) providing a mentor to work with each student during their college experience 2) providing an Aerospace-related focus to their studies, and 3) placing them in a summer or fall Aerospace-related work situation provides them with many of the skills needed to succeed in the technology arena.

http://asgc.ualr.edu

California Space Grant Consortium Student-Mentor Aerospace Workforce Development Scholarships/Training Grants

The CaSGC has initiated and supports several Aerospace workforce development efforts that involve science, engineering and management student teams (graduate and undergraduate level) in hands-on Aerospace projects. These programs were created to provide students with practical experience and Scholarship/Training Grants while under the guidance of mentors from the industrial, academic and government industry.

http://calspace.ucsd.edu/casgc/sm_scholarships.html

Florida's Advanced Learning Environment for the Aerospace Industry

The Advanced Learning Environment (ALE) is an entirely Web-based virtual learning and collaborative effort funded by NASA and the State of Florida to address the issue of the aging Aerospace workforce. Produced by the Florida Space Research Institute (FSRI), ALE contains asynchronous Web-based training, synchronous Web classes, real-time collaboration tools, bulletin boards, chat functionality and a variety of performance support resources.

http://www.learningcircuits.org/2004/feb2004/metcalf.htm

Florida's SpaceTEC Receives $3 million from NSF to Advance Aerospace Workforce Program

SpaceTEC, the National Center of Excellence for Aerospace Technical Education led by Brevard Community College in Florida, has been awarded a $3 million grant by the National Science Foundation to implement a nationwide certification program for Aerospace technicians and a multi-institution curriculum to build the nation's Aerospace workforce. SpaceTEC, based at the Cape Canaveral Spaceport, comprises 14 community college and university partners located throughout the U.S. where Aerospace and defense-related technical activities are prevalent. The SpaceTEC Certified Aerospace Technician program provides assessment, professional development, and formal educational opportunities for the incumbent workforce; creates a national credential for Aerospace technicians; and offers industry a tool for identifying desired employment qualifications. Recognizing that technical and competitive changes in the industry are requiring broader skill sets for Aerospace technicians, major employers, including Lockheed Martin, the Boeing Company, and United Space Alliance are supporting the National Certification program. The SpaceTEC program utilizes partnerships among its member academic institutions, government agencies, and employers to promote improvement in the education and professional career development of technicians.

http://www.SpaceTEC.org

Maine Aerospace Workforce Development Program

The Maine Space Grant Consortium (MSGC) is conducting its third year of its "Maine Aerospace Workforce Development Program in which it funds undergraduate students attending Maine colleges/universities with a 10-week research experience at a NASA field center, working on viable research projects with NASA Mentors. The program is open to rising sophomores, juniors and seniors who are enrolled in an academic field important to NASA, including but not limited to, the physical sciences, life sciences, computer sciences, and engineering.

(www.une.edu/cas.abroad/lectures.asp

North Dakota Space Grant Consortium Awarded $100,000 Grant to Design Mars Planetary Suit

A NASA Aerospace Workforce Development grant of $100,000 has been awarded to the North Dakota Space Grant Consortium (NDSGC) to design and build a prototype Mars planetary suit. This is a year-long project involving multiple universities and colleges around North Dakota that will culminate in the production of a prototype spacesuit in March 2006. This project evolved from a collaborative effort between NASA Experimental Program to Stimulate Competitive Research (EPSCoR).

http://www.space.edu/spacegrant/

Oklahoma's Aerospace Training and Educational Opportunities

Oklahoma's Aviation and Education Alliance (OAEA) is a collaborative effort between technology centers, community colleges, and colleges and universities that help build a capable Aerospace workforce. Just a few of the OAEA partners include: American Airlines, Boeing Defense and Space Group, FlightSafety International, Nordam Group, Pratt-Whitney, Tinker AFB, Altus AFB, Lear Bombardier and Bizjet.

The State's nationally acclaimed Training for Industry Program (TIP) helps Aerospace companies by creating a customized workforce that is ready for operations from opening day. TIP is free and delivered through Oklahoma's CareerTech system with 54 state-of-the-art technology centers from across the State. The technology centers also provide ongoing, customized training for existing employees at significant cost savings. Programs at Oklahoma's technology centers, colleges and universities offer training, certificates and degrees in all the necessary specialties including: air frame and power plant technicians, transport aircraft training, flight simulator maintenance technician, avionics, piloting, aviation management, mechanical, and Aerospace engineering and aviation sciences.

http://www.okcommerce.gov/index.php

The Tennessee Space Grant Consortium (TSGC)

The mission of the TSGC is to enhance the space technology base in the State of Tennessee by working with industry, K-12 educational institutions and college and universities to enhance the Aerospace workforce, and with State government to facilitate this objective. The TSCF also has plans to do the following:

- Develop new Aerospace-related research and education programs in the State.
- Develop a Space Management Program in the State to train people to manage large Aerospace projects (to become Aerospace project managers).
- To develop an educational and training program in Space Medicine that concentrates on deep space missions and planetary explorations.

http://tsgc.vuse.vanderbilt.edu/strategy.htm

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Appendix E. Abbreviations and Acronyms

Acronym	Definition
AIA	Aerospace Industry Association
AP	Advanced Placement
BLS	Bureau of Labor Statistics
BRAC	Base Realignment and Closing
CEO	Chief Executive Officer
CFO	Chief Financial Officer
DBED	Department of Business and Economic Development
DLLR	Department of Labor, Licensing, and Regulation
DoD	Department of Defense
DOL	Department of Labor
DSS	Defense Security Service
GSFC	Goddard Space Flight Center
GWIB	Governor's Workforce Investment Board
HR	Human Resources
NAICS	North American Industrial Classification System
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NSA	National Security Agency
OPM	Office of Personnel Management
PLTW	Project Lead The Way
R&D	Research and Development
SCI	Sensitive Compartmented Information
SSAI	Science Systems and Applications, Inc.
UAV	Unmanned Airborne Vehicles

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