Aerospace Manufacturing Skills

Supply, Demand, and Outcomes for Washington's Aerospace Training Programs

Annual Report – 2014

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This report and other aerospace-related information can be viewed at: www.wtb.wa.gov/aerospace.asp

BACKGROUND

The Aerospace and Advanced Materials Manufacturing Pipeline Advisory Committee monitors the workforce needs of Washington's aerospace industry. The 16-member committee pays close attention to emerging trends in manufacturing and production, pinpoints training required of today's aerospace workers, and looks ahead to retirement and other factors that will impact the talent pipeline. In particular, the committee works to better align the state's community and technical college system and apprenticeship training with industry demand.

The committee was formed in 2012[1] and issued a preliminary report in September of that year. The committee's inaugural report was distributed in December 2012, making this the third annual report. All of the reports were jointly written by the state's Workforce Training and Education Coordinating Board (Workforce Board) and the State Board for Community and Technical Colleges (SBCTC).

The 2013 and 2014 reports have included the following analysis:

- Evaluation of the number of persons trained in community and technical college aerospace programs as well as employment and earnings outcomes.
- Employment and earnings of students trained by apprenticeship programs.
- Assessment of industry hiring needs as identified by Washington's aerospace employers.
- Employer perspectives on their satisfaction with the skills of aerospace program graduates.

EXECUTIVE SUMMARY

Key Themes

Industry Outlook

- At the same time forecasters see modest overall job declines (0.5 percent per year), there is strong demand for certain occupations.

Pipeline Issues

- High anticipated retirement rates necessitate a stronger pipeline.
- Worker personal qualities and soft skills in areas such as attendance, problem solving, communication, and work ethic need improvement.

[1] The committee was formed to implement Chapter 50, following the passage of 2SSB 2156 (2012).

Summary of Findings

Washington is an aerospace industry hub

- Washington's aerospace manufacturing and supporting industries are comprised of 1,361 firms, with 186 of these firms located in the core industry.[2]
- The core of Washington's aerospace industry is Aerospace Manufacturing and Parts (NAICS 3364), employing 96,012 as of 2013.[3] Surrounding that core are an array of aerospace-related industries comprised of materials and parts suppliers, air transportation and related infrastructure employing over 135,700 Washingtonians as of 2013.
- Washington accounts for nearly 20 percent of the nation's aerospace jobs.
- Washington outpaces other leading states in both specialization and overall employment. With a location quotient of 8.9, aerospace employment is nearly nine times more concentrated in Washington than across the rest of the nation.
- Just over 80 percent of industry employment is concentrated in production, engineering, business/finance, and computer and mathematical occupations.

Training is accelerating in apprenticeships and at community & technical colleges

- As of November 2014, 294 apprentices were enrolled in the Aerospace Joint Apprenticeship Center's four-year track.
- The number of students served in the five aerospace community and technical college programs selected for review increased 53 percent over the five-year period between 2009 and 2014.
- All community and technical college training programs, aside from drafting and design technician, experienced increases. Plastics Engineering Technician (also known as Composites Manufacturing Technician or Composites Fabricator) has seen the most significant increase as composites become increasingly important in manufacturing.

Current hiring trends solid, but forecast is flat

- Of the aerospace and aerospace-related firms surveyed, 92 percent indicated they hired new employees in the last 12 months, with the largest group being those hiring one to 10 workers (47 percent).
- Survey respondents' outlook for the next five years is mixed, but demand is high for certain occupations. At the same time, macroeconomic forecasts project moderate job declines.
- Respondent demand for selected occupations is expected to grow robustly, including Airframe Mechanics, CNC Programmers, Engineering Technicians, Assembly Mechanics, and Machinists.

[2] Retrieved from Employment Security Department's quarterly census of employment and wages.

[3] NAICS 927000 - Space Research and Technology was also identified in the core of Washington's aerospace industry, yet employment data are sparse for this industry; therefore when the report refers to the "core" it's generally referring to NAICS 3364 – Aerospace Manufacturing and Parts. Data for Space Research and Technology are included wherever possible.

Hiring difficulties and skill shortages

- Firms had the hardest time filling vacancies for Manufacturing/Production, Engineers, Assemblers, Machinists, Quality Assurance/Inspector, and CNC Programmer/Operator.
- The most common strategies for shortages were to increase overtime work for current employees and to concentrate on recruiting efforts.

OVERVIEW OF WASHINGTON'S AEROSPACE INDUSTRY

Firms and Employment

Washington's first aerospace industry was established nearly 100 years ago in 1916. Since then the industry has expanded to include 1,361 firms, with 186 of these firms located in the core industry.

The core of Washington's aerospace industry is the "Aerospace Manufacturing and Parts" (NAICS 3364) industry, employing 96,012 in 2013.[4] Surrounding that core are an array of aerospace-related industries comprised of materials and parts suppliers, air transportation and related infrastructure employing over 130,200 Washingtonians as of December 2013. Appendix B shows detailed employment trends for both the core and broader aerospace-related industries.

Figure 1: Aerospace Employment Trends, Washington, December 2004-2013

Industry Description	Dec-04	Dec-05	Dec-06	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13	Trendline
Total "Core Aerospace" Employment (NAICS 3364)	62,833	70,390	75,979	82,745	85,323	81,198	81,865	90,991	96,450	94,406	
Total "Aerospace-related" Employment*	96,340	104,224	110,848	119,494	121,055	113,643	115,848	126,953	129,620	129,423	

*See Appendix B for a complete list of industries included in the aerospace-related group.
Source: Washington State Employment Security Department

Relative Concentration

By most measures, Washington is the nation's aerospace industry leader. One useful measure is the state's relative concentration in the aerospace industry. Relative concentration is measured using the location quotient (LQ), which is simply a ratio of the regional (in this case, statewide) share of employment in a certain industry compared to national share of employment in the same industry.

[4] 2013 Annual Average Employment, Washington State Department of Employment Security.

Figure 2: Aerospace Core Industry Employment and Location Quotients, 2013, Washington and Other States*

State	NAICS 3364 Aerospace product & parts manufacturing			Location Quotient	
	2008	2013	Percentage Change	2008	2013
U.S. TOTAL	*502,892*	*497,809*	*-1%*	*1.0*	*1.0*
Washington	82,932	96,012	16%	7.7	8.9
Kansas	43,290	31,725	-27%	8.7	6.6
Connecticut	32,375	28,877	-11%	5.1	4.7
Arizona	27,900	26,258	-6%	2.9	2.8
Alabama	13,507	12,519	-7%	1.9	1.9
Missouri	14,549	17,689	22%	1.4	1.8
Georgia	19,754	21,499	9%	1.3	1.5
Utah	8,685	5,798	-33%	1.9	1.3
Vermont	1,453	1,364	-6%	1.3	1.2
California	73,135	71,614	-2%	1.3	1.2
Oklahoma	5,595	6,687	20%	1.0	1.2
Texas	48,356	47,285	-2%	1.2	1.2

Source: Bureau of Labor Statistics, QCEW

**Note: South Carolina ranked just behind Texas in terms of 2013 location quotients*

As seen in Figure 2, Washington's 2013 LQ was 8.9 – up from 7.7 in 2008. What this means is that the share of aerospace employment in Washington was almost nine times the aerospace share nationally. Not only is this the highest LQ among states, but Washington added more aerospace jobs since 2008 (over 13,000 jobs).

The 96,012 aerospace workers in Washington accounted for nearly one in five aerospace workers nationwide in 2013. From 2008 to 2013, aerospace and related employment growth in Washington significantly outpaced the nation. In Washington it grew by 16 percent, compared to a 1 percent decline for the nation as a whole.

Occupational Composition

The majority of aerospace positions were held by either production (30.8 percent) or architecture and engineering workers (23.5 percent). Business/financial operations (15.6 percent) followed by computer/mathematical (11.1 percent) occupations round out the top for major occupational groups found in aerospace. Overall, these

occupations account for over 80 percent of industry employment. See Appendix D for details on the top 50 occupations in Washington's aerospace industry and the extent to which they're concentrated in aerospace compared to all other industries.

Figure 3: Aerospace Core Industry Occupational Composition, NAICS 3364, 2013, Washington

Major Occupation Group	% of Total Aerospace Employment	2013-2nd Quarter Employment
Production	30.8%	29,721
Architecture and Engineering	23.5%	22,689
Business and Financial Operations	15.6%	15,038
Computer and Mathematical	11.1%	10,725
Subtotal	**81.0%**	**78,173**
Installation, Maintenance, and Repair	5.3%	5,160
Management	4.0%	3,891
Transportation and Material Moving	3.5%	3,351
Office and Administrative Support	3.2%	3,092
All other major occupation groups	3.0%	2,849
Total	100.0%	96,516

Employment Forecasts

In terms of employment, aerospace is forecast to see modest job losses over the next 10 years.[5] The Washington State Economic and Revenue Forecast Council also predicts mild job losses,[6] primarily due to efficiency gains as opposed to production cuts.

There are, however, limitations to this forecast such as the independent cyclical nature of aerospace employment and the significant contribution to employment trends by one employer (The Boeing Company). It also should be noted that the projected job declines are a net figure and given the age of the workforce, it is expected that there will still be a significant number of openings due to turnover and retirements. The Boeing Company reports an average retirement rate of 2.8 percent a year, with expectations that the rate will remain steady or rise.

[5] Washington Employment Security Department, Long-Term Industry Employment Projections, May 2014.
[6] http://www.erfc.wa.gov/publications/documents/nov14pub.pdf

Figure 4: Washington State Employment Projections, Aerospace and Selected Manufacturing Industries, 2012-22

Industry	Estimated employment			Average annual growth rate			
	2012	2017	2022	2012-2017		2017-2022	
TOTAL NONFARM	**2,874,500**	**3,169,100**	**3,376,900**	**2.0%**		**1.3%**	
MANUFACTURING	**280,200**	**294,200**	**299,800**	**1.0%**		**0.4%**	
Durable goods	204,500	215,400	218,600	1.0%		0.3%	
Fabricated metal product manufacturing	18,700	23,200	25,300	4.4%		1.7%	
Machinery manufacturing	13,700	18,400	20,400	6.1%		2.1%	
Computer and electronic product manufacturing	20,200	20,300	20,500	0.1%		0.2%	
Electrical equipment and appliance mfg	4,600	6,200	6,800	6.2%		1.9%	
Aerospace product and parts manufacturing	**94,300**	**89,400**	**87,000**	**-1.1%**		**-0.5%**	
Other transportation equipment	10,000	9,000	8,500	-2.1%		-1.1%	
Other durable manufacturing	16,300	17,400	18,200	1.3%		0.9%	

Source: Employment Security Department, Long-term Industry Employment Projections.

EDUCATION AND TRAINING

The aerospace industry plays a significant role nationally and is an even more dominant player in Washington's economy, where it is a key industry. Aerospace-related jobs require a variety of specific skills and pay well. Training programs that help fill these jobs have grown over the past few years. Undoubtedly, meeting the workforce needs of the aerospace industry is important to the economic vitality of the state, as well as the economic wellbeing of Washington residents and their families.

However, our workforce is aging with more workers reaching retirement age each year, while changing technology has required more advanced skills. This has put more pressure on our state's education and training system to meet the needs of the aerospace industry and ensure a sufficient supply of skilled workers.

Washington has responded to this challenge by investing heavily in several aerospace-focused training programs:

- *The Aerospace Joint Apprenticeship Committee (AJAC)* is a statewide, State registered apprenticeship program which combines structured on-the-job training with related supplemental instruction which is college-credited.
- *The Air Washington Initiative* represents a consortium of 11 Washington community and technical colleges and one apprenticeship program that received a federal grant of $20 million to train students in aerospace skills in areas throughout the state. The consortium far exceeded its target of training more than 2,600 workers, reaching 3,806 in the fall of 2014.
- *The Washington Aerospace Training & Research* (WATR) *Center* at Edmonds Community College offers innovative short-term aerospace training based at Paine Field in Everett.[7] Since its inception in June 2010, over 1500 WATR graduates are now working including 1300 in the aerospace industry.*

[7] Outcomes data for the WATR Center were not available at the time of publication.

- Washington's community and technical colleges have continued to invest in expanding programs and updating curriculum and equipment in aerospace-related programs to meet industry needs.

This report analyzes training activities, employment, and annual earnings of state-funded efforts in Washington.

Aerospace Apprenticeship Programs

Aerospace apprenticeship combines supervised on-the-job training experience with college-level classroom instruction. This enables:

- Employees to earn a living wage while they learn on the job from a mentor and attend class one night a week at a local community or technical college.
- Employers to increase their workforce skills without disrupting production.

The following section analyzes apprenticeship dynamics, enrollments, and a snapshot of completers at AJAC, since it started in 2008.[8]

AJAC combines a dual-training method of structured on-the-job experience with related supplemental classroom instruction which is college-credited. This enables:

- Apprentices to begin or continue an educational and career pathway, gaining the necessary industry knowledge and skills to become the next generation of master tradespeople.
- Apprentices to "Earn While They Learn," working full-time and earning a livable wage with benefits.
- Apprentices to attend class one night a week at an employer site, local high school or skill center or at a local community or technical college while earning college credit.
- Apprentices the opportunity to earn a nationally recognized industry credential and earn college credits towards an associates' degree or build into a four-year degree.
- Employers to build and train their workforce without disrupting production.
- Employers the opportunity to tap the knowledge and skills of their most experienced trades people and pass this expertise to the next generation of employees.

Snapshot of AJAC Apprenticeship Completions and Outcomes

As of November 2014, 294 apprentices were enrolled in AJAC's four-year track. A total of 42 participants completed AJAC's apprenticeship program as of November 2014.

*** WATR Center employment results are reported by the program for this report. Subsequent reports will include WATR Center employment results measured in Employment Security Wage records.**

[8] Note: The Seattle Machinists Apprenticeship Program is not part of AJAC's program but included in the analysis of completion outcomes in this section.

The average number of months to completion was 42 months[9] for AJAC, while the median time to completion for all apprenticeship programs (as shown in Figure 5) was 50 months.

For the program year 2013-14, 84 people completed an apprenticeship program. Of that number, AJAC trained 68 individuals, the Seattle Machinists Apprenticeship program trained nine, the IAM/Boeing program trained six, and the Port Townsend Paper Corp In-Plant trained one. Overall, 86 percent of participants completed apprenticeships in machinist programs (SOC code 51-4041). Another seven percent trained to be press machine operators (SOC code 51-4031), four percent trained as Aircraft Mechanics and Service Technicians (SOC code 49-3011), and two individuals trained as composite manufacturing technicians (SOC code 51-9199).

Figure 5: Snapshot of Select Aerospace Apprenticeship Program Completions Washington State, 2013-14

Aerospace JAC	68
IAM/Boeing JAC	6
Port Townsend Paper Corp In-Plant	1
Seattle Machinists Apprenticeship	9
Total All Programs	**84**
For All Programs Listed Above	
Median months to completion	50
Median annual wage (adjusted 2014 q1)	$71,605
Median quarterly hours	532

Source: Washington State Department of Labor and Industries

Median annual wages for those who found work was $71,605, (the lowest wage was $41,627, and the highest was $164,474). In 2013-14, apprenticeship completers clocked a median 532 hours per quarter, a little higher than the normal full-time 522 hours clocked during a three-month period.

Community and Technical College Programs

Second Substitute House Bill 2156 sets guidance for the program evaluation to be conducted by the Workforce Board, working with the State Board for Community and Technical Colleges. The programs selected for evaluation are to be recommended by the aerospace and advanced materials manufacturing pipeline advisory committee. The committee identified five programs for review in the community and technical college (CTC) system to be reviewed on an ongoing basis to allow for report tracking over time. The five programs identified for continued evaluation included:

- Engineering Technician
- Plastics Engineering Technician

[9] This is an unweighted average of the four occupational programs offered by AJAC: machinist (48 months), Tool and Die Maker (60 months), Manufacturing Precision Metal Fabricator (24 months), and Aircraft Mechanic (36 months).

- Drafting and Design Technician
- Aircraft/Frame/Powerplant Mechanic
- Machine Tool Technician

FTES and Student Headcounts

As shown in Figure 6 below, the number of full-time equivalent students (FTES) served in the selected programs has gone up 49 percent over the five-year period between 2009 and 2014. A full-time equivalent is the number of students divided by the total number of credit hours for a full-time load in fall, winter, and spring quarters (45 credits). All programs, aside from Drafting and Design Technician, experienced an increase. Plastics Engineering Technician (also known as Composites Manufacturing Technician or Composites Fabricator) is a relatively new program for the colleges as composites have become important in manufacturing. The most significant portion of the falloff in Engineering Tech FTES between 2012-13 and 2013-14 was a result of a needed coding correction at the WATR Center. A number of these FTES were re-coded in 2013-14 as Airframe Mechanics. These FTES are included with Aircraft/Frame/Power Plant Mechanics.

The federal funding that has supported aerospace training at the consortium of community and technical colleges known as Air Washington is noteworthy. This $20 million federal grant provided an infusion of resources that directly and indirectly affected a number of schools with programs reviewed in this report. The grant is scheduled to conclude September 30, 2015.

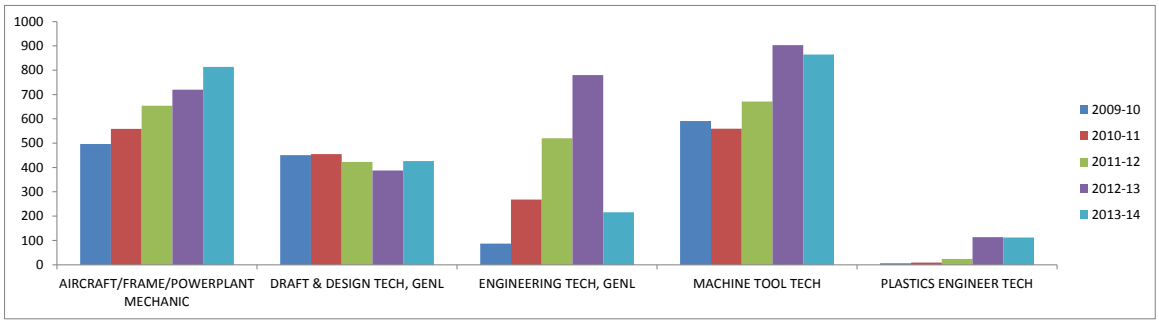
Engrossed House Bill 2088, passed in November 2013 appropriated additional funding to the community & technical colleges for the express purpose of increasing high demand aerospace enrollments by an additional one thousand full-time equivalent students. Through a competitive process college proposals were reviewed by a ten member review panel made up of industry, labor, education and government agencies. As result of the deliberations 21 colleges received funding for 35 programs. The funding became available July 1, 2014. Information relative to these efforts will be reported on in future reports.

Figure 6: CTC Select Aerospace Education and Training Program FTES, 2009-14

Program	2009-10	2010-11	2011-12	2012-13	2013-14	5 Year Change
AIRCRAFT/FRAME/POWERPLANT MECHANIC	497	559	654	719	814	64%
DRAFT & DESIGN TECH, GENL	451	455	423	388	426	-5%
ENGINEERING TECH, GENL	87	268	520	780	216	148%
MACHINE TOOL TECH	591	559	671	903	865	46%
PLASTICS ENGINEER TECH	6	9	24	114	112	1801%
TOTAL FTES SELECTED PROGRAMS	1632	1850	2291	2904	2433	49%

Source: State Board for Community and Technical Colleges

Figure 7: CTC Select Aerospace Education and Training Program FTES, 2009-14



Source: State Board for Community and Technical Colleges

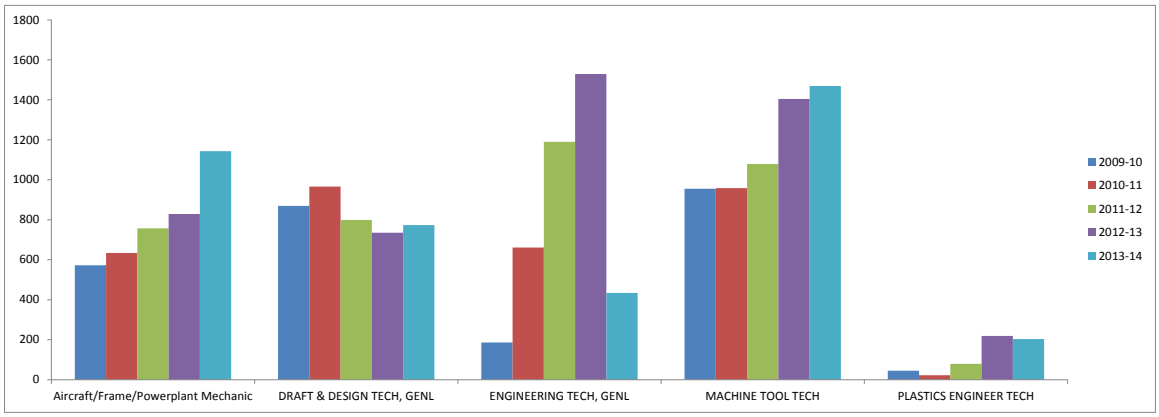
As shown in Figure 8 (following page), the number of students in the select programs has increased by 53 percent over the past five years, demonstrating the state and the CTC system's commitment to increasing the available workforce. FTEs and headcount trends are directly correlated, though it's important to note that it may take more than one student to generate an FTE, depending on the number of credits a student takes in a year.

Figure 8: Select Aerospace Education and Training Program Headcount, 2009-14

Program	2009-10	2010-11	2011-12	2012-13	2013-14	5 Year Change
Aircraft/Frame/Powerplant Mechanic	572	634	757	829	1143	100%
DRAFT & DESIGN TECH, GENL	869	966	799	735	773	-11%
ENGINEERING TECH, GENL	186	661	1190	1529	434	133%
MACHINE TOOL TECH	955	958	1079	1404	1469	54%
PLASTICS ENGINEER TECH	45	22	79	219	203	351%
Total HC Selected Programs	2627	3241	3904	4716	4022	53%

Source: State Board for Community and Technical Colleges

Figure 9: CTC Select Aerospace Education and Training Program Headcount, 2009-14

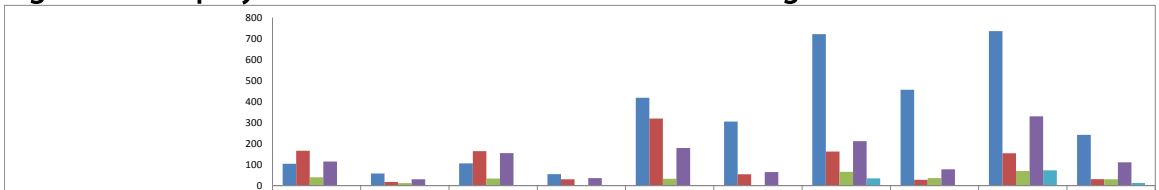


Source: State Board for Community and Technical Colleges

Student Employment in the Year After Leaving College

The chart below describes employment results in the year after leaving college for participants in the five select programs. The definition of "leaver" encompasses more than one student category including graduates and non-completions. Nearly four in 10 (39 percent) of all students leaving college from 2008-09 to 2012-13 went to work in the aerospace industry one year after exiting (2009-10 to 2013-14).

Figure 10: Employment for Leavers from CTC Select Programs



	All Employment 2009-10	Aerospace & Related Employment 2009-10	All Employment 2010-11	Aerospace & Related Employment 2010-11	All Employment 2011-12	Aerospace & Related Employment 2011-12	All Employment 2012-13	Aerospace & Related Employment 2012-13	All Employment 2013-14	Aerospace & Related Employment 2013-14
Aircraft/Frame/Powerplant Mechanic	104	58	106	55	418	305	721	456	735	242
Drafting and Design Technician	166	18	164	30	319	54	162	28	154	31
Engineering Technician	40	12	34	0	33	0	66	36	70	30
Machine Tool Technician	115	30	155	36	179	65	212	78	330	111
Plastics Engineering Technician							35		73	13

Source: State Board for Community and Technical Colleges

**Note: Programs with fewer than 10 students have been redacted due to privacy.*

When analyzing the most recent year of employment data, it's clear that students from these programs who *did not* go to work in the aerospace industry, found employment in a wide variety of occupations and industries in the state. Some 18 percent were employed in retail trade. Another 17 percent were employed in other manufacturing industries. Thirteen percent were employed in temporary services. The remaining students were employed across a broad cross section of industries.

Students who studied as Engineering Technicians had the highest wages and earnings followed by Drafting and Design Technician and Aircraft/Frame/Power Plant

Mechanic. For students who went to work in aerospace or related industries, wages were significantly higher, with Engineering Technicians earning nearly 90 percent more than those who worked outside of the aerospace industry. For those who went to work as machine tool technicians, there was just a 6 percent premium among those in the aerospace industry.

The greatest number went to work as Aircraft/Frame/Power Plant Mechanics, followed by Engineering Technician.

Figure 11: Percent Employed in Aerospace & Related Industries in the Year After Training

SELECT PROGRAMS	2009-10	2010-11	2011-12	2012-13	2013-14
AIRCRAFT/FRAME/POWERPLANT MECHANIC	56%	52%	73%	63%	33%
DRAFT & DESIGN TECH, GENL	11%	18%	17%	17%	20%
ENGINEERING TECH, GENL	30%	12%	21%	55%	43%
MACHINE TOOL TECH	26%	23%	36%	37%	34%
PLASTICS ENGINEER TECH					18%
TOTAL SELECT PROGRAMS	28%	27%	45%	51%	31%

Source: State Board for Community and Technical Colleges

**Note: Programs with fewer than 10 students have been redacted due to privacy.*

WATR Center

The WATR Center at Edmonds Community College serves the aerospace industry by providing short-term skills training in aerospace jobs. Students start with a four-week core program and move on to specialized certificates such as assembly mechanic, electrical assembler, tooling, composites and quality assurance. With the inception of the WATR Center in June 2010 a five-year look at the data isn't available at this time. For this report, FTEs and headcount for 2013-14 are available. In future reports, WATR Center outcomes will be provided consistent with the data records available.

Figure 12: Wages and Earnings for Students Leaving College in 2012-13 and Employed in 2013-14 in Aerospace & Related Industries

Program Title	All Students Inflation Adjusted Wage	All Students Inflation Adjusted Earnings (annual est.)	Aerospace & Related Inflation Adjusted Wage	Aerospace & Related Inflation Adjusted Earnings (annual est.)	% Earnings Difference between All and Aerospace & Related
AIRCRAFT/FRAME/POWERPLANT MECHANIC	$15.82	$30,942	$18.27	$39,008	26%
DRAFTING AND DESIGN TECHNICIAN	$17.79	$32,993	$25.46	$55,605	69%
ENGINEERING TECHNICIAN	$20.22	$41,028	$37.02	$79,054	93%
MACHINE TOOL TECHNICIAN	$16.96	$34,181	$17.09	$37,346	9%
PLASTICS ENGINEERING TECHNICIAN	$12.87	$24,191			

Source: State Board for Community and Technical Colleges

Figure 13: Edmonds Community College WATR Center Aerospace Education and Training Program FTES, 2003-14

Program	2013-14
AIRCRAFT ELECT FAB & INSTL	20
AIRFRAME MECH & AIRCRAFT	114
CAD DRAFT/DESIGN TECH	*
ENGINEERING TECH, GENL	102
QUALITY CONTROL	*
TOOL & DIE TECH	43
TOTAL	283

Source: State Board for Community and Technical Colleges

**Note: Programs with fewer than 10 students have been redacted due to privacy.*

Figure 14: Edmonds Community College WATR Center Aerospace Education and Training Program Student Headcount, 2003-14

Program	2013-14
AIRCRAFT ELECT FAB & INSTL	38
AIRFRAME MECH & AIRCRAFT	253
CAD DRAFT/DESIGN TECH	*
ENGINEERING TECH, GENL	212
QUALITY CONTROL	*
TOOL & DIE TECH	76
TOTAL	590

Source: State Board for Community and Technical Colleges.

**Note: Programs with fewer than 10 students have been redacted due to privacy.*

AEROSPACE EMPLOYER SURVEY

Employment, Hiring Expectations, and Satisfaction Survey

To gain a better understanding of both Washington's aerospace employers' hiring needs, and satisfaction[10] with existing training programs, the Workforce Board conducted a survey of the industry's employers. The survey can help the state better prepare the labor force to match industry needs over the coming years. The 2014 survey is the third survey targeted at Washington's core aerospace industry, providing a detailed forward-looking view to help in preparing tomorrow's aerospace workforce.[11]

Survey Results – Firm Participation & Characteristics

2014 Aerospace Employment and Hiring Expectations Survey

881	Firms surveyed
88	Valid responses
1	Removed - two responses from a single company
2	Removed - outside industry scope
1	Removed - invalid record
27	Removed - partial survey was not sufficient
10%	Response rate

Source: Workforce Board's 2014 Aerospace Employer Survey

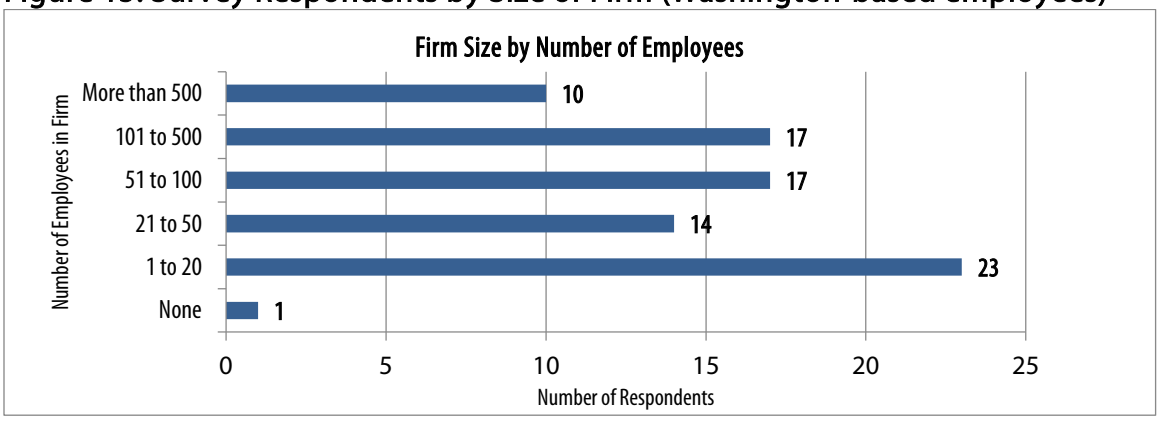
A survey was distributed to 881 firms from June through September 2014. A total of 88 employers responded to the survey for a response rate of 10 percent. This response rate was disappointingly low. However, there was a significant outreach effort to capture a larger response, including a targeted sequence of emails and postcards promoting the survey.

Based on an analysis of respondents' ZIP codes, more than three-quarters were from the Puget Sound region, five percent were west of the Cascades but outside of the Puget Sound, eight percent were from Eastern Washington, and 10 percent were from other states.

[10] Previous reports have conducted separate hiring needs and satisfaction surveys.

[11] Our ability to use survey results for year-over-year trend-spotting is limited because the survey was significantly revised from 2012 to 2013.

Figure 15: Survey Respondents by Size of Firm (Washington-based employees)



Source: Workforce Board's 2014 Aerospace Employer Survey

Firms of various sizes participated in the survey. Close to one-third of respondents were firms with 20 or fewer employees. Firms of between 51 to 100 employees and 101 to 500 employees each accounted for 21 percent of respondents (23 firms). Firms with more than 500 employees accounted for only 12 percent of those that responded (10 firms). To put this in context Figure 16 displays the number of firms and employment by firm size for the Aerospace Products and Parts industry. Within aerospace, firms of 1-20 were the most common (62 overall), but most employment was at firms of 500 or more. It should be noted that the survey respondents come from more than just the Aerospace Products and Parts industry and hence are not directly comparable.

Figure 16: Number of Firms and employment for all ownerships for 4-digit NAICS industry code 3364 (Aerospace Product and Parts Manufacturing) Washington state, 2013 Annual Averages

Firm Size	Count of Firms	Employment
Size 0	13	7
Size 1-20	62	460
Size 21-50	22	755
Size 51-100	15	1,176
Size 101-500	29	6,510
Size 500+	10	88,303

Source: Employment Security Department/LMEA, Quarterly Census of Employment and Wages

The industries represented by survey respondents include both the core aerospace industry (NAICS 3364 – Aerospace Product and Parts Manufacturing) and related supplier-distributor networks of supporting industries, as shown in Figure 17. Overall, participating firms reported that 88 percent of their business is part of or directly supports the aerospace industry.

Figure 17: Survey Respondents by Industry

4-digit NAICS	Industry	Respondents
3261	Plastics Product Manufacturing	1
3315	Foundries	1
3323	Architectural and Structural Metals Manufacturing	1
3327	Machine Shops; Turned Product; and Screw, Nut, and Bolt Mfg.	3
3328	Coating, Engraving, Heat Treating, and Allied Activities	2
3329	Other Fabricated Metal Product Manufacturing	1
3335	Metalworking Machinery Manufacturing	2
3344	Semiconductor and Other Electronic Component Mfg.	1
3359	Other Electrical Equipment and Component Manufacturing	1
3364	**Aerospace Product and Parts Manufacturing**	**39**
4235	Metal and Mineral (except Petroleum) Merchant Wholesalers	1
4238	Machinery, Equipment, and Supplies Merchant Wholesalers	1
4246	Chemical and Allied Products Merchant Wholesalers	1
5413	Architectural, Engineering, and Related Services	5
5417	Scientific Research and Development Services	2
	Blank	4
	Don't know	29
	Total	88

Source: Workforce Board's 2014 Aerospace Employer Survey

The major aerospace companies in Washington are important because of the direct role they play in employment and training, but also indirectly as a buyer from regional suppliers. Figure 18 shows the role that major aeropspace firms have in terms of buying intermediate goods and services. Only about 4 percent of survey respondents had no sales with the Boeing Company.

Figure 18: Approximately what percentage of your business is with the major aerospace firms or their subsidiaries

Firm	None	1-24 percent	25-49 percent	50-75 percent	75-100 percent
Boeing	4%	27%	27%	15%	26%

AirBus/EADS	21%	58%	19%	2%	0%
Bombardier	25%	75%	0%	0%	0%
Lockheed Martin	29%	69%	3%	0%	0%
Embraer	30%	67%	3%	0%	0%
Gulfstream	36%	61%	4%	0%	0%
Northrup Grumman	38%	59%	3%	0%	0%
Mitsubishi Aircraft Company	61%	39%	0%	0%	0%
Other	4%	36%	18%	9%	33%
total	1%	8%	3%	2%	85%

Source: Workforce Board's 2014 Aerospace Employer Survey

Survey Highlights Employment and Hiring Expectations

Figure 19: Approximately what percentage of your business is with the major aerospace firms or their subsidiaries?

Percentage range of respondent business conducted with major aerospace firms	Responents	Percent
None	1	1%
1-24 percent	14	16%
25-49 percent	5	6%
50-74 percent	12	14%
75-100 percent	56	64%
Total	88	

Note: Major aerospace firms include: the Boeing Company, Airbus/EADS, Bombadier, Embraer, Gulfstream, Lockheed Martin, Mitsubishi Aircraft, and Northup Grumman
Source: Workforce Board's 2014 Aerospace Employer Survey

A strong majority of the firms surveyed (92 percent) indicated they hired new employees in the last 12 months, with the majority of those hiring one to 10 workers (47 percent). On average, respondents hired 24 new employees in the 12 months preceding the survey.

Figure 20: How many new employees have you hired in the last 12 months?

New Employees Hired Last 12 Months	Number of Respondents	Percent
None	6	8%
1 to 10	35	47%
11 to 20	15	20%
21 to 40	8	11%
41 to 100	8	11%
100+	3	4%
Average Number of New Hires	24	

Source: Workforce Board's 2014 Aerospace Employer Survey

According to respondents, the most common occupations hired were engineers, composite manufacturers, and administrators/managers. Figure 21 details the expected employment trends for the most commonly employed occupations of survey respondents. Survey respondents' outlook for the next five years is fairly good: Overall, participating firms expect a 19 percent growth in employment from 2014 to

2019.[12] This is a very different picture than state forecasts give which have employment falling by about 8 percent between 2012 and 2022[13].

The survey indicated that the strongest future demand would be for the following occupations (in order of strongest in demand):

- Airframe Mechanics
- CNC Programmers
- Engineering Technicians
- Assembly Mechanic
- Manufacturing Planners/Manufacturing Engineers
- Machinists

Figure 21: Aerospace Employment and Retirement by Occupation: Current and Future Expectations, Washington State, 2014-19

Occupation	Current Employment		2019 Employment Expectations		2019 Retirement Expectations	
	Number of firms identifying occupation	Current Employees in Washington State	Employees in Washington State Expected to be Employed in 2019	Change Rate Based on Survey Expectations 2014-2019	Employees in Washington State Expected to Retire by 2019	Retirement Rate Based on Survey Expectations 2014-2019
Administrator/ Management	80	1512	1679	11%	160	11%
Airframe Mechanic	35	100	174	74%	9	9%
Assembly Mechanic	46	512	691	35%	45	9%
Electrical Assembler	44	711	764	7%	71	10%
CNC Programmer/ Operator	56	413	567	37%	29	7%
Composites/ Manufacturing	42	2101	2475	18%	62	3%
Computer Technician	48	132	146	11%	10	8%
Engineering Technician	52	409	555	36%	55	13%
Engineers	58	2115	2395	13%	188	9%
Machinist	54	758	969	28%	66	9%
Planner (Mfg Planner/ Mfg Engineer)	62	294	386	31%	56	19%
Quality Assurance/ Inspector	71	552	681	23%	73	13%
Tool Maker	41	314	331	5%	13	4%
Other (all others combined)	50	925	1145	24%	47	5%
Total - All Occupations		**10848**	**12958**	**19%**	**884**	**8%**

Source: Workforce Board's 2014 Aerospace Employer Survey

[12] The response rate for this survey is too low to provide reliable figures upon which to base employment estimates and projections. The authors strongly suggest survey findings be used as supplementary to other information sources.

[13] The Washington Employment Security Department projects job losses between 2012 and 2022. For more: https://fortress.wa.gov/esd/employmentdata/reports-publications/industry-reports/employment-projections

Hiring Difficulties and Turnover

The following occupations were top-ranked by firms having the most difficulty filling vacancies in the 12 months preceding the survey:

- Manufacturing/Production
- Engineers
- Assemblers
- Machinist
- Quality Assurance/Inspector
- CNC Programmer/Operator

The Boeing Company[14] continues to seek skilled aerospace workers to fill the following positions and is especially interested in the following skill sets:

- 30505 Assembler Installer Structures B
- 34107 Aircraft Test Technician A
- 97109 Aviation Maintenance Technician and Inspector - Flight Test
- 75506 Tool Maker C
- 87210 Electronic Technician Precision Machine Tool Maintenance
- 89509 Machine Repair Mechanic A

Figure 22: How have you responded over the last year to difficulty finding qualified applicants?

Response to difficulty finding qualified applicants	Respondents = 88	
	Firms Identifying Reason	Percent
Increased overtime hours for current workers	55	63%
Increased recruiting efforts	44	50%
Hired a less qualified applicant	37	42%
Did not fill the job opening	34	39%
Recruited directly from college and university training programs	31	35%
Outsourced work or purchased services from another firm	27	31%
Increased wages to attract more applicants	24	27%
Other	16	18%

Source: Workforce Board's 2014 Aerospace Employer Survey

Faced with hiring difficulties, firms have responded by increasing overtime hours for their current workforce (55 percent), increasing recruiting efforts (44 percent), hiring a less-qualified applicant (37 percent), and not filling the job opening (34 percent).

[14] The Boeing Company did not directly participate in the survey, but made this information available for this report.

Other strategies respondents used to cope with difficulties finding qualified applicants included:

- Contacting aerospace programs at colleges
- Using high school interns
- Providing in-house training

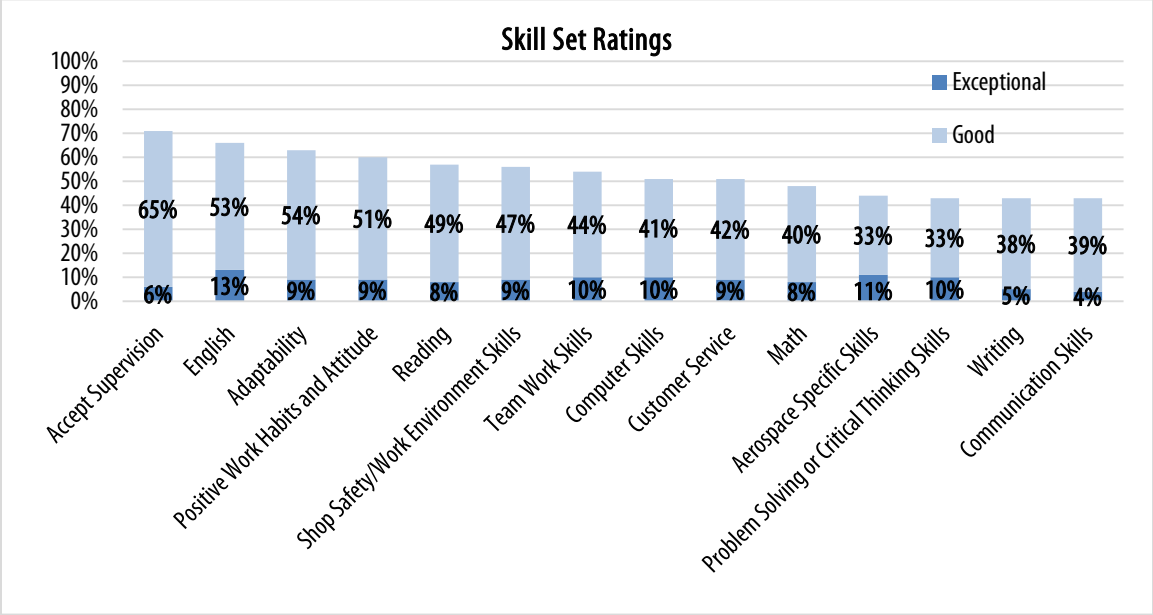
A number of reasons for high employee turnover were cited. While it is difficult to see strong trends, certain reasons for turnover appeared frequently. Those included issues with workers and those associated with competition from other firms, such as:

- Lack of qualified candidates
- Pay and/or benefits offered by small firms cannot keep up with what larger firms offer
- Poor work habits and/or bad attitude by workers
- Retirements
- Economic drivers
- Location
- Competition for workers from other aerospace and/or manufacturing firms

Skill Set Adequacies and Preparing for the Next Generation

Aerospace-specific skills were the most frequently cited skill lacking in candidates interviewed. Figure 23 shows in descending order the skill adequacy of those interviewed in the 12 months preceding the survey. The skill with the lowest positive response was communication skills – only 43 percent of respondents labeled candidates as either exceptional or good. Also lacking were writing and problem-solving/critical thinking skills. Acceptance of supervision, English, and adaptability skills were rated highest.

Figure 23: Considering only those people who have applied and been interviewed/tested for jobs at your establishment in the past year, please rate each of the following skill sets:

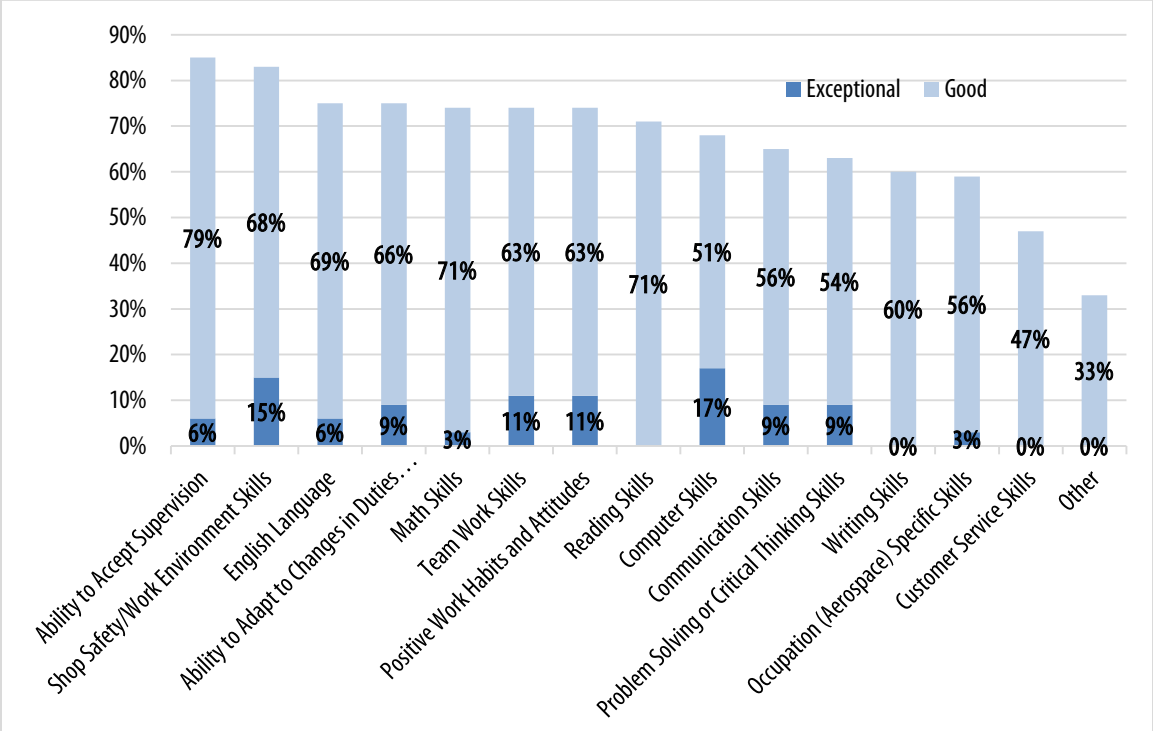


Source: Workforce Board's 2014 Aerospace Employer Survey

The strategy of employing interns from colleges and universities was the most popular (over half) in preparing the next generation of workers. The second most common strategy was using interns from high school vocational or technical programs, followed by participation in career fairs. In the year preceding the survey, 45 percent of respondent firms had hired workers from an apprenticeship program, community or technical college, and/or the WATR Center.

Of the workers hired from one or more of these training programs, respondents rated them higher on the whole than the workforce representing prospective employees in general (Figure 24 compared to Figure 23). The general pattern of skill adequacy, however, followed a consistent pattern, with aerospace-specific, writing, and problem-solving skills at the bottom and ability to accept supervision, English language, and adaptability at the top.

Figure 24: Of the workers that you have hired from one or more of these training providers (apprenticeship programs, community colleges, technical colleges, and/or the Washington Aerospace Training and Research (WATR) Center), on average how would you rate them on the following:



Source: Workforce Board's 2014 Aerospace Employer Survey

Of the respondents (43 overall) who describe their participation with training providers, 90 percent said it was satisfactory. Participation with training providers includes serving on program advisory committees, procuring contract training, and posting job announcements. Worth noting, despite its small number of respondents indicating participation, some aerospace firms have employees who are also instructors with training providers.

The story from these respondents seems to be that overall the system is serving them adequately but there are areas for improvement. When asked about the key job-related skills their recent hires demonstrate, employers rated them "exceptional" more frequently than "good." Problem-solving was a skill set consistently cited as needing improvement. When asked about skill sets needing improvement in new hires, employers explained that classroom trained students lacked hands-on experience and candidates overall lacked soft skills such as customer service.

Aerospace Outlook: Employer's Perspectives

It's no surprise that firms surveyed tied their industry's outlook to Washington's future relationship with The Boeing Company and, secondarily, to labor force dynamics including skills and costs. When asked how industry expansion will impact their workforce practices, narrative responses provide an insider's look at the industry.

In your opinion, will aerospace industry expansion over the next 5 years result in any other impacts on your employment practices, such as outsourcing?

- Actually we are doing more insourcing. Because of shortened lead times, we are bringing more processes in-house so that we can control lead times and do more expediting.
- Additional networking with technical colleges, college student tours, coordinating AJAC program to be able to have more in the program.
- Because of growth in the industry, we are building a new facility and expect to employ approximately 100 people. We are trying hard not to outsource anything else. It has not worked for us in the past.
- Expansion in the Aerospace Industry usually means that we will be competing for machinists in our area.
- I do not expect to see significant industry expansion over the next 5 years. All indications are that we are flat during that time. We expect to continue to gain market share and will continue to expand our capabilities to assure growth.
- Most likely will result in an internal training curriculum being developed and deployed.
- The larger aerospace companies, with the help of government tax breaks and subsidies, will suck up all the trade and craft talent, with higher pay and benefits, leaving smaller firms faced with higher costs to find skills, and fewer available qualified candidates for positions.
- We are a clearly defining our core competencies and focusing on going only after those jobs, honing our current business practices with more in house on-going training for our employees, setting up specific SOP's.
- We are a global business and the limited availability of skilled manufacturing workers and engineers has us looking at other locations to supplement our team.
- We are looking into starting up new work shifts such as grave or weekend shifts to accomplish delivery schedules.
- We expect the aerospace business to continue to grow and depending on our ability to find trained employees will determine how much outsourcing of work that we need to do.
- We need to get far more aggressive with college recruiting and creating a more diverse workforce.
- We see less of a focus on the NW region as a result of Boeing's move eastward. Additionally, downward cost pressures, and competition from Southern US States are forcing off-shore resourcing alternatives to remain competitive.
- When we outsource, our general option is to a local company. We have strict ITAR/EAR and Security concerns that make outsourcing difficult.
- Yes, prime customers now requiring "in-kind" country sourcing for foreign sales and lower prices. These drive us to have to look for sources outside of US. This is becoming a major issue as prime contractors drive for higher profit margin over use of local or US suppliers.
- Yes, we will continue to outsource and migrate to more program management.
- YES! Your training programs have spent all its resources on "machinists" and engineers that you have completely left out an integral part of the aerospace process. EVERY part, metal or composite (plastic), must receive a protective coating and/or a cosmetic finish, i.e. painting. There is almost NO ONE available in the workforce that has received formal training in this area. Anyone that has experience in area, has received it as OJT that started out as an entry level position.