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An Assessment of Education and Training Needs in the Ohio Aerospace Industry

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Cleveland State University
Maxine Goodman Levin College of Urban Affairs

Prepared for:
The Ohio Aerospace Institute

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April 2006

AN ASSESSMENT OF EDUCATION AND TRAINING NEEDS IN THE OHIO AEROSPACE INDUSTRY

The Ohio Urban University Program

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Center for Economic Development

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EXECUTIVE SUMMARY

The Ohio Aerospace Institute engaged the Center for Economic Development at the Maxine Goodman Levin College of Urban Affairs at Cleveland State University to conduct an assessment of the education and training needs of Ohio aerospace companies, with an emphasis on knowledge workers. The study used a comprehensive mail and Internet survey to gather information from Ohio aerospace companies on their demand for knowledge workers, the quality of the pipelines that channeled workers to the industry, their training resources, and their skill needs. The survey had a 9.6 percent response rate out of a total population of 375. The findings, documented below, therefore can only be suggestive, rather than definitive.

DEMAND FOR LABOR

- The Ohio aerospace industry will create jobs next year.
- The job positions in the highest demand are Mechanical Engineers, Electrical Engineers, Aerospace Engineers, and System Engineers.
- Overall, Ohio firms did not rate the recruitment of knowledge workers as difficult. However, there were several occupations for which some firms had trouble recruiting—these include Research Scientists, R&D Managers, Materials Engineers, Senior Managers, and Mechanical Engineers. Notably, firms with less than 50 employees did not indicate they had recruitment difficulties for these positions.

PIPELINE ASSESSMENT

- The majority of the firms did not offer internships, fellowships, or residence programs nor were they interested in offering the latter two. However, 25 percent of the firms in the sample expressed an interest in offering undergraduate internships.
- The Ohio aerospace firms felt that Ohio had a sufficient number of university programs in core engineering and science curricula. Access to knowledge workers in Ohio appears to be satisfactory.

TRAINING RESOURCES

- Aerospace companies did not invest significantly in human capital development. Half of the sample (50%) invested one percent or less of their total payroll in training. Best practice is considered 4 percent and over.
- Managers and Professionals receive the highest training investment. On average, managers receive 31 hours of training per year and professionals receive 32 hours.
- When asked what methods firms had used to deliver training last year, the majority (69%) cited informal on-the-job training. Private firms (50%), product suppliers (44%), and colleges and universities (42%) also were used by a substantial proportion of responding firms.
- The most common training provided in house was safety (31%).

SKILL NEEDS

- Half of the firms noted general skill deficiencies in their employees. Of those noting deficiencies, 75 percent had over 50 employees.
- When asked to rank the quality of specific skills, however, employers overall felt each skill area of their employees was satisfactory. These seemingly contradictory findings may be the result of the small size of the overall sample and the even smaller sub-set of firms that completed all questions of the questionnaire. While half (about 18 firms) noted skill deficiencies, each company noted deficiencies in different skill areas. So when asked to evaluate individual skills, only one or two firms would have expressed dissatisfaction in the individual skill area, resulting in an overall satisfactory average for the survey as a whole.

The report drew five general conclusions.

- There are five common areas of training demand: management, leadership, communication, business skills, and computer skills. These areas were assembled by a review of the open-ended questions that asked firms about the training they had provided and the skill deficiencies they faced.

- Although the data is not conclusive, a careful review of the open-ended questions suggests Ohio may not be prepared for some of the newer technologies (e.g., fuel cells) that will be emerging in the not-too-distant future and may have a strong impact on the industry.

- A review of the data suggests there may be a need to emphasize and build up internship programs in the industry.

- Most training provided seems to be reactive, which means it is a direct response to a specific need such as a new technology or customer request, or simply part of the job (e.g., safety). Only a few firms considered training as an integral component for strategically maintaining their competitiveness.

- Generally, firms with over 50 employees seemed to have more difficulties recruiting good workers and were less satisfied with their skills. We recommend targeting small to medium firms for training (50-200 employees).

INTRODUCTION

The Ohio Aerospace Institute engaged the Center for Economic Development at Maxine Goodman Levin College of Urban Affairs at Cleveland State University to conduct an assessment of the education and training needs of Ohio aerospace companies, with an emphasis on knowledge workers.

In a globalizing world, a focus on workforce skills is a particularly important one. The confluence of several trends makes a need for continuous oversight of workforce skills a priority agenda item for the aerospace industry. Those trends are demographic changes, an increasingly competitive market, flattening corporate structures, and rapidly shifting technologies.

CHANGING DEMOGRAPHICS

The changing demographic characteristics of the American workforce have national leaders deeply concerned over the future of our science and engineering talent.[1] Several transformations are particularly worrying because they may indicate imminent labor shortages.

- The graying of this workforce. The professional engineers and scientists as well as skilled technicians critical to manufacturing are aging, and young people do not seem to be choosing these career paths in sufficient numbers to close the gap created by approaching retirements. By 2008, forecasts predict that about 26% percent of the aerospace workforce will be eligible for retirement[2].
- The shift from a predominantly white male workforce to a predominantly female and minority workforce. If the demographic trends revealed in the 2000 census continue, forecasts indicate the percentage of the non-Hispanic white population will fall from 74 percent in 1995 to 53 percent in 2050.[3]. Traditionally, non-Hispanic white males have formed the bulk of the science and technology workforce (65 percent in 1997), while the labor force of the future will be predominantly women and minorities.[4] These patterns

[1] National Science Board. 2003. *The Science and Engineering Workforce: Realizing America's Potential*, *NSV 03–69.* Arlington, VA: National Science Foundation.
[2] *Final Report of the Commission on the Future of the United States Aerospace Industry.* 2002. Arlington, VA.
[3] Business-Higher Education Forum. 2001. *Investing in People: Developing All of America's Talent on Campus and in the Workplace*. Washington, DC
[4] National Science and Technology Council. 2000. *Ensuring A Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st Century: A Report of the Committee on Science of the National*

suggest a need to encourage women and minorities to pursue science and technology fields generally, and aerospace particularly.

- An increase in the difficulty of hiring foreign workers in this country. Foreign workers, often trained here, have provided a substantial proportion of our science and engineering workforce. Foreign students earn 40% of our science and engineering Ph.Ds. In 2000, 2,200 U.S. citizens earned engineering doctorates while 2,444 foreign students on temporary visas did. At the undergraduate level, the U.S. saw a 47 percent drop in the number of students pursuing aerospace engineering between 1991 and 2000[5]. The increase in educational opportunities abroad coupled with the increasing difficulty of entering, remaining in, and getting security clearance in the U.S. put this pipeline to talent under threat.
- All these trends are compounded by an overall concern about the quality of math and science training offered by U.S. K-12 education.

In sum, although these trends do not guarantee a gap in U.S. labor supply in the near future, they do put the question on the table. Taken together, they do suggest that active educational recruitment strategies to encourage and enable more U.S. students to seek advanced science and engineering degrees, with an emphasis on encouraging women and minorities, are in everyone's best interest.

AN INCREASINGLY COMPETITIVE MARKET

Fierce foreign competition requires U.S. companies to implement strategies to increase their competitiveness. The growing skill base of the international labor force not only makes the market more competitive, but also makes it easier to outsource abroad.

Moreover, although the aerospace industry is marked by large corporate entities, a significant proportion of Ohio aerospace companies are small companies. Small companies are often the least able to afford training (in terms of both time and money) and often find it difficult to develop a training plan or conceptualize (and therefore implement) training as a strategic input to increasing their competitiveness in a more volatile market place[6]. Training, therefore, is

Science and Technology Council's Interagency Working Group on the U.S. Scientific, Technical, and Engineering Workforce of the Future. Washington, DC.

[5] *Final Report of the Commission on the Future of the United States Aerospace Industry.*

[6] Creticos, Peter, and Robert Sheets. 1989. *State Financed Workplace-Based Retraining Programs: A Joint Study of the National Commission for Employment Policy and the National Governors' Association, Research Report #89–01*. Washington, DC: National Commission for Employment Policy.

often reactive to immediate needs, rather than a strategic input implemented to increase the competitive position of companies.

FLATTENING CORPORATE STRUCTURES

Corporate structures are shifting from vertical to more horizontal labor-management patterns, which require different skill sets from managers, supervisors and employees. These more flattened structures, also known as knowledge-driven work systems, rely on global network alliances, team-based work, information systems, and flexible specialization[7]. A 2002 study of the national aerospace industry undertaken at MIT noted that aerospace lags behind other industrial sectors in its implementation of knowledge-driven work systems and the type of labor-management relations that support them. The study found that U.S. aerospace companies are still overly reliant on hierarchical command and control structures.[8]

RAPIDLY SHIFTING TECHNOLOGIES

In this global economy, the development and adoption of new technologies is accelerating. Some technologies, like a new database, may be easy to integrate into a firm through simple training. Other technologies, like IT, can transform the nature of industry. In fact, computer capabilities are shifting so quickly, they alone create the need for constant vigilance over labor skills.

In aerospace, for example, the emergence of advanced composite materials in the design and manufacturing of airplanes may be transformative within the industry. Aerospace workers are familiar with metal parts but may possess only a limited knowledge of composite materials. The new knowledge and skills required include not only a better understanding of materials used, but also new software skills such as Dassault's Product Lifecycle management and new business management practices including multicultural business skills[9].

The need for multicultural business skills is driven by other trends as well. The Commission on the Future of the U.S. Aerospace Industry cites: "[S]ince the 1970s, no large U.S. commercial aircraft or jet engine has been developed without major participation by foreign firms in

[7] MIT Labor Aerospace Research Agenda (LARA). 2002. "Developing the 21st Century Aerospace Workforce." Presentation to the Commission on the Future of the Aerospace Industry, http://mit.educ/ctpid/lara.
[8] Ibid.
[9] Richey, Michael, Barry McPherson, Russell Maguire, Dr. Peter Wu, Dr. Kuen Lin and Dr. Shanying Zeng. 2004. "A Global Workforce An Industrial Academic Perspective for Building Global Workforce Competencies." Presented at Exploring Innovation in Education and Research, Tainan, Taiwan, 1-5 March 2005.

technology development, manufacturing or marketing."[10] Moreover, as developing nations expand into the market, this will only increase.

Looking at Ohio's aerospace industry, as characterized by the OADAC database, we see that it is moderate in size (58,000 workers of which 16,900 are employed in manufacturing), but pays a significantly higher average wage--$62,000 in aerospace vs. $35,000 for other Ohio industries, and is spread across the State. Importantly, Ohio ranked first among 13 comparable states in aerospace and defense manufacturing at value-added per employee, which was $199,500, which is almost double the national average of $101,300. The aerospace industry in Ohio combines high value-added, high wages and significant employment concentration in several specific industries giving it a competitive advantage in three areas: aircraft engines and parts, military armored vehicles and tanks, and space research and technology.[11] See the report, "A Strategy for Growing the Ohio Aerospace & Defense Industry" for more details on the Ohio Aerospace industry.

Given the strategic importance of education and training to the future of the aerospace industry, OAI felt it was essential to gather information from Ohio companies on their training patterns and needs.

[10] Commission on the Future of the U.S. Aerospace Industry, p. 8-4.
[11] Kleinhenz, Jack, Ziona Austrian, Robert Sadowski, and Ed Morrison. 2005. " A Strategy for Growing the Aerospace and Defense Industry," prepared for The Ohio Defense Advisory Council and The Ohio Department of Development, Technology Division.

STUDY METHODOLOGY

To conduct this study, the Center for Economic Development designed a comprehensive mail survey to capture the following information:

- The demand for and availability of knowledge workers in Ohio
- Pipeline needs—specifically whether Ohio has sufficient educational programs and work-based opportunities for students
- The broad and specific skill needs of aerospace companies
- Training management practices, specifically the resources most companies used to meet their training needs.
- Firm demographics including size, industry sector, and geographical location to give a finer edge to the evaluation of the data.

The draft survey was reviewed by five companies and pre-tested by one. Changes were made to the survey in response to their comments. The revised survey was mailed with a stamped, addressed return envelope to a list of 421 firms. The list was identified using Dun and Bradstreet Data, Harris Data, ES202 Data, participants in the earlier OADAC aerospace study and a list of additional recommendations from OAI. The survey was also made available online. To encourage participation, CSU and OAI made multiple rounds of phone calls to the list of respondents.

Thirty-six firms responded to the survey, comprising 9.6% of a population of 375.

Table 1: Sample Size

Total Companies Mailed/Called	438
Duplicates	-8
NA	-18
Bad Addresses	-37
Total Population	***375***
Surveys Received	**36**
Percentage response rate	9.6%

While almost 10 percent is a reasonable rate for a business survey, some questions were not answered by a significant proportion of the survey sample. The small number of responses provided in certain areas limits our ability to make reliable generalizations from the data. Thus, our findings can only be suggestive and not definitive. To better understand these dynamics, core questions were broken down and analyzed by size and sector as well as by the sample population as a whole.

DATA RESULTS

FIRM DEMOGRAPHICS

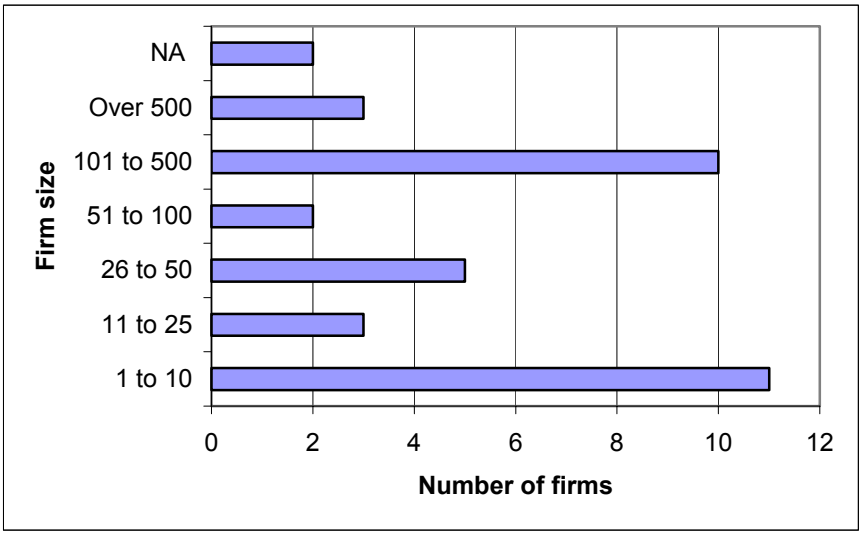
The firm sample represents a reasonably good spread of firm sizes. Almost one third (30.5%) of the sample comprises microfirms (10 and under employees) and over half (52.6%) have 50 or less employees. While the survey appears biased toward small firms, it actually mirrors the Ohio aerospace industry. Looking at the statistics for the Ohio aerospace population, 39.5% would be classified as microfirms and 57.5 percent have 50 or fewer employees.

Table 2: Firm Size of Survey Sample

Range of employees	# of firms responding	% of firms responding
1-10	11	30.5
11-25	3	8.3
26-50	5	13.8
51-100	2	5.5
101-499	10	27.7
Over 500	3	8.3
NA	2	5.5

(NA=no answer or no state workforce figures provided)

Figure 1: Firm Size of Respondent Firms



The survey is geographically biased, with over half (55.5%) of the respondents coming from Northeast Ohio (NEO). While NEO is an important aerospace center in Ohio, a study by Dr. Edward Hill of industry drivers suggests that the aerospace industry is relatively larger in

Cincinnati-Dayton[12]. A 2005 study of Ohio aerospace firms found that the heaviest concentrations of firms were in Cleveland-Akron, Columbus and Cincinnati-Dayton[13]. In this survey, Cincinnati-Dayton firms comprise only 25 percent of the sample, while Columbus firms insufficiently represent only three percent (1 firm). The database of firms surveyed did not contain a bias toward Northeast Ohio or any other region. The ensuing sample bias may be a result of strategies used to increase the sample size numerically by using personal contacts or a greater awareness of OAI in NEO.

Table 3: Geographical Distribution

MSA	# of firms responding	% of firms responding
Cleveland MSA (NEO)	20	55.5
Cincinnati-Dayton MSA (SW)	9	25.0
Toledo MSA	2	5.5
Columbus	1	3.0
Other	4	11.0

(Scattered throughout the state: Lima, Mansfield, Lisbon, Amesville)

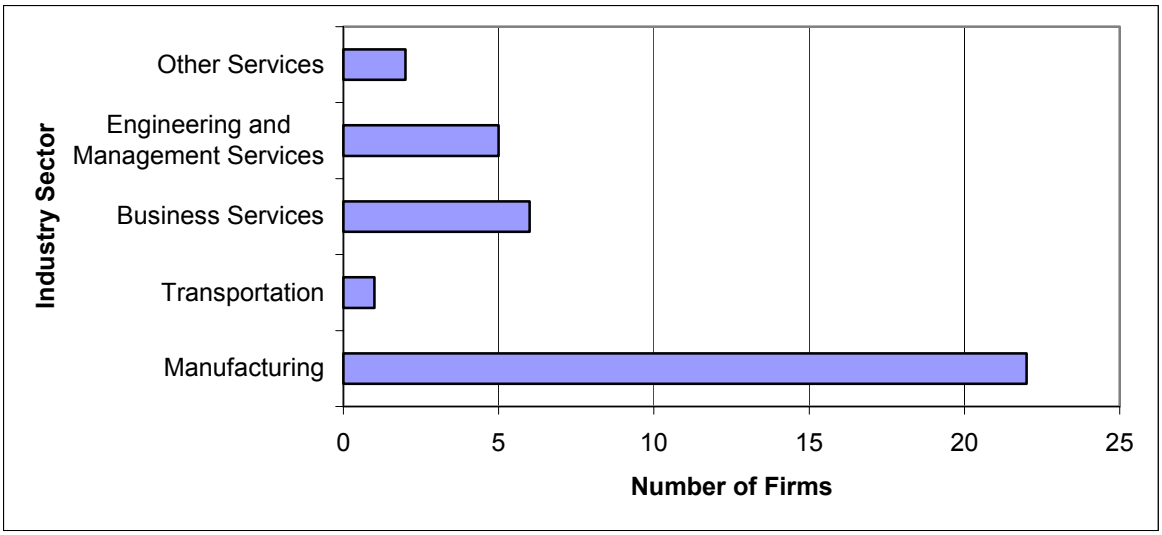
To determine industry sector, we used two-digit SIC codes for analysis because two of the data sources we used to identify companies, Dun and Bradstreet and Harris Directories, used only SIC codes. ES202 used both classifications. We used two-digit codes because at the four-digit level there is very little common categorization, but at two we could create several reasonably large groups for later analysis. We used the following sectors: Manufacturing; Transportation; Business Services; Engineering and Management Services; and Other services. The sample is comprised predominantly of manufacturing firms (61%). The rest are chiefly from business or engineering and management services.

[12] Personal communication. October 17, 2005.
[13] Kleinhenz, Jack, Ziona Austrian, Robert Sadowski, and Ed Morrison. 2005. " A Strategy for Growing the Aerospace and Defense Industry," prepared for The Ohio Defense Advisory Council and The Ohio Department of Development, Technology Division.

Table 4: Industry Sector

SIC	# of firms responding	% of firms responding
Manufacturing	22	61.1
Transportation	1	2.8
Business Services	6	16.7
Engineering & Management Services	5	13.9
Other Services	2	5.6

Figure 2: Industrial Sector of Respondent Firms



Looking at the relationship between size and industry sector, the majority of firms with more than 50 employees are manufacturing firms (75%), which is larger than their proportion in the survey as a whole. The overlap between size and sector is an important one, and the subsequent findings suggest differences in terms of demand for education and training.

LABOR DEMAND IN THE OHIO AEROSPACE INDUSTRY

Employment in the Aerospace Industry

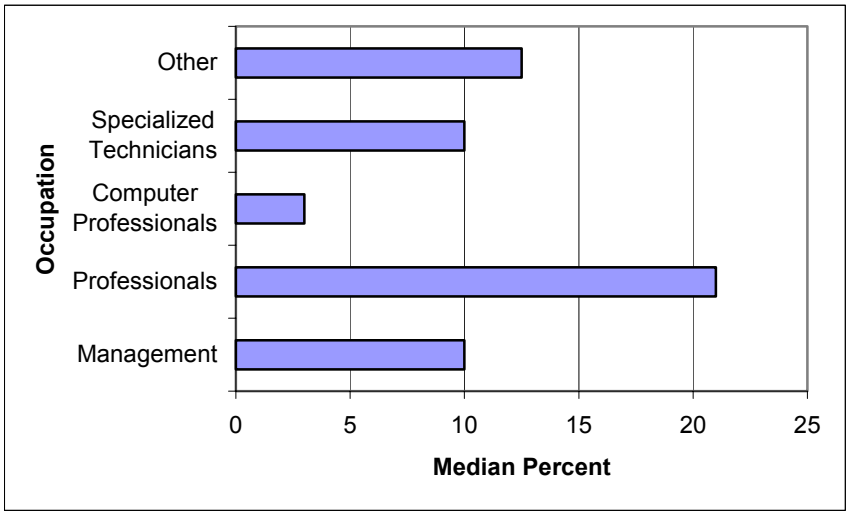
Of the 36 participating firms, 32 reported both current employment and estimated employment in one year. Of those, only three estimated job losses for a total loss of 159 jobs. Eight firms reported no change in employment sizes. A total of 19 companies estimated that they would be creating jobs in one year's time although the lion's share (12 firms or 37.5 percent) expected to create between one and 10 jobs. Only one company expected to create over 100 jobs. Total predicted job growth was 563 jobs (minus the 159 loss), pointing to 404 new jobs in the aerospace industry or 5.7 percent growth next year. Job losses occurred in firms

categorized as engineering or business services and may be related to changes in NASA Glenn Research Center budget prospects. Growth was most prominent in the large manufacturing companies.

Employment Structure

To gain an understanding of the proportion of knowledge workers employed in the industry, the survey asked firms to estimate what proportion of their workforce fell into several occupational categories. Given the large range of firm sizes, we use the median averages to summarize the employment structure of Ohio aerospace companies. The largest category of workers, in fact, is knowledge workers (professionals), which comprise 21 percent of the average company's workforce. The second largest sector (12.5%), Other, is composed predominantly of administrative/clerical positions and labor/manufacturing/production workers.

Figure 3: Median Employment Structure of Ohio Aerospace Categories



Generally speaking, there is an inverse relationship between firm size and employment structure. Larger firms have a smaller percentage of management, professionals, computer professionals, and specialized technicians. Conversely, smaller firms generally have a higher percentage of knowledge workers in their employ. There is a positive relationship between the proportion of other workers and firm size. Large firms have a larger percentage of other workers and small firms a smaller percentage.

Labor Demand and Availability

Firms were asked to quantify the number of positions they were currently seeking and would be seeking in one year. They were also asked to rate the ease of recruiting for each position. Table 5 summarizes that data. Given that this represents only firms that are or will be searching for new employees, it never intended to present material from the full sample. Its purpose is to indicate what positions are in high demand and if those positions are difficult to fill. However, often only those firms needing labor ranked the ease of its availability. Thus the number of responses to the question on the ease of recruitment is also small—the data is suggestive only.

Table 5: Labor Demand and Availability

Occupation	LABOR DEMAND				LABOR AVAILABILITY	
	# Workers Needed Now	# Firms in need	# Workers in 1 Year	# firms in need	Rank Experience Recruiting Quality Ohio Applicants 1=Difficult 2=Average 3=Easy (average)	Don't Recruit In-State Number of Firms Selecting this Option
PROFESSIONALS						
Aerospace Engineers (all degree levels)	42	5	36	9	2 (67% chose avg.)	1
Industrial Engineers (all degree levels)	8	4	8	3	2 (100% chose avg.)	1
Electrical Engineers (all degree levels)	43	4	38	6	2 (75% chose avg.)	1
Electronic Engineers (all degree levels)	3	3	4	3	1.7 (71% chose avg.)	1
Mechanical Engineers (all degree levels)	25	10	81	15	1.7 (50% chose avg. but 35% chose difficult)	1
Chemical Engineers (all degree levels)	0	0	1	1	2 (100% chose avg.)	1
Materials Engineers (all degree levels)	22	2	19	7	1.6 (57% chose avg. but 43% chose difficult)	2
Research Scientists (all degree levels). Please specify disciplinary areas**, Fuel Cells, Carbon Friction**	7	5	11	4	1.3 (67% chose difficult)	1
Other, please specify**: Metallurgical**	2	1	3	1	1.7	2
Computer Professionals						
Software Engineers (all levels)	20	1	28	5	2.5 (50% avg., 50% easy)	1
Systems Engineers (all levels)	22	3	34	6	2.18 (64% avg.)	1
Systems analysts	0	0	5	4	2.09 (73% avg.)	1
Programmers	1	1	6	4	2.4 (45% avg., 45% easy)	1
Other, please specify_____	0	0	2	1	***	***
Specialized Technicians						
Electrical and Electronic Engineering Technicians	2	2	6	4	2.3 (50% avg., 40% easy)	1
Avionics Technicians	0	0	2	2	2 .4 (57% avg.)	1
Aircraft Mechanics and Service Technicians	5	1	7	3	2.5 (50% easy, 50% avg.)	1
Other, please specify: **Manufacturing Line Technicians**	0	0	2	1	***	1

MANAGEMENT						
Senior Managers	11	6	8	5	1.9 (40% difficult, 33% avg.)	1
R&D Managers	1	1	5	4	1.8 (50% difficult, 20% avg.)	1
Project Managers	8	6	10	8	1.9 (50% avg.)	1
Operations/Production Managers	3	2	11	6	2 (60% avg.)	1
IT and Data Management Managers	7	2	1	1	2.2 (75% avg.)	2
Other, please specify: **Production** (no numbers given)						

**** insufficient data.*

The data suggests that the positions facing the highest demand are:

- Mechanical Engineers (total estimated demand: 106)
- Electrical Engineers (total estimated demand: 81)
- Aerospace Engineers (total estimated demand: 78)
- System Engineers (total estimated demand: 56)
- Software Engineers (total estimated demand: 48)
- Materials Engineers (total estimated demand: 41)

Positions facing the least demand are:

- Chemical Engineers (total estimated demand: 1)
- Avionics Technicians (total estimated demand: 2)
- Systems Analysts: (total estimated demand: 5)

On average, responding firms did not find recruitment difficult. However, some challenges are suggested if we look more deeply at the data.

Looking at high-demand professions,

- Of the seven firms evaluating recruitment of materials engineers, 43 percent (three) noted recruitment difficulty. All those firms were located in Northeast Ohio.
- Of the 14 firms evaluating recruitment of mechanical engineers, five (36%) noted that mechanical engineers were difficult to recruit. All five firms had over 50 employees.

In all other high-demand areas, most firms did not find it difficult to recruit. Notably, some computer professional positions were considered easy to recruit. Looking at other critical positions, we find:

- Of the six firms evaluating recruitment of research scientists, four or 67 percent found them difficult to recruit. All four firms had over 50 employees.

- Of the 15 firms evaluating recruitment of senior managers, 6 or 40 percent of firms found it difficult. All six firms had over 50 employees and were located in all geographic regions in the study except Cincinnati-Dayton.
- Of the 10 firms evaluating recruitment of R&D managers, five (50%) firms found it difficult. All five firms had over 50 employees and were located in Northeast Ohio and Toledo.
- About 28 percent of the 18 firms recruiting project managers found it difficult; all of the firms had over 50 employees.

Notably, by adding size into our analysis, we find that firms that noted that recruitment was difficult almost always had over 50 employees. Smaller firms were much less likely to assess labor recruitment in Ohio as difficult. It also appears that firms in Northern Ohio, including Toledo, face more recruiting difficulties than those in the southern portion of the state, but given the survey bias and small number of responses, we cannot be sure of this.

The respondents were than asked to identify specific recruiting challenges. They revealed:

- 42 percent of the full sample noted that skills of job applicants don't match company requirements (two-thirds of the respondents selecting this challenge are located in Northeast Ohio. The proportion noting difficulties is higher then the proportion of the firms in the sample, suggesting that this is a bigger problem in the Northeast);
- 33 percent noted that new workers lacked work experience;
- 25 percent noted that an inadequate preparation of post-secondary or college students;
- 17 percent felt that graduate students received inadequate preparation.

This data suggests that preparation of college students, including job search skills, and lack of work experience could be improved in Ohio. The importance of internships and career development skills are suggested by the survey findings. This information dovetails with the findings revealed in the section on pipeline needs.

PIPELINE NEEDS

The survey asked firms to quantify the number of internships and other work-based learning experiences they currently offer and would be offering within one year. It also asked firms that did not offer opportunities if they would be interested in doing so. The results are summarized in Table 6.

Table 6: Internships and Work-based Opportunities Available

Pipeline Needs*	# of Positions Offered	# of Firms Offering Positions	# of Positions Available Within 12 Months	# of Firms Offering Positions in 12 Months	No Positions Offered Currently	Interested in Offering	Not Interested in Offering
Undergraduate internships/co-ops	200**	10	190**	10	10	9	5
Graduate internships/co-ops	14	3	22	7	11	2	11
Undergraduate fellowships/scholarships	4	2	6	2	12	3	11
Graduate fellowships/ scholarships (including Post-Docs)	0		0		11	3	13
Faculty fellowships	0		0			4	10
Industry residence programs for faculty	0		2	1	12	5	11

***** Answers include only those respondents who answered the questions. In many cases, the firms did not respond to the question.
******One company, which offered 150 internships, aggregated both undergraduate and graduate figures. These figures include graduate internships as well.

Two companies provide the bulk of available internships (180 currently, and 170 in one year). The other responding firms offered between one and five. However, nine firms did express interest in starting an undergraduate internship. There is little interest in fellowships/scholarship programs and industry residence programs. The primacy of small firms in the sample may partially explain the lack of engagement in pipeline development activities. Of the 10 firms offering internships, seven had more than 50 employees. Of the nine firms interested in offering undergraduate internships, seven have over 50 employees.

The firms were then queried as to why they did not have any pipeline programs. In all questions, 80 percent of all firms did not respond. The most common responses from those firms responding were an insufficient budget (17% of sample), lack of suitable positions (17%),

and insufficient manpower to train/supervise (11%). Other responses were less than 10 percent of the sample size. Specific reasons offered by commenting firms include:

- Does not pertain to us
- Need for security clearance
- Use only independent contractors
- Present need is developing; had several prior to 9/11
- Done through NASA Glenn Research Center
- Microfirm and our work equals second career professionals

Firms were then asked if the state of Ohio provided sufficient educational resources for training knowledge workers for the aerospace industry. The responses are presented in Table 7. Of the respondents answering the question, they agreed there were sufficient university degree programs in core engineering and science disciplines. Very few respondents selected "insufficient."

Table 7: Assessment of the Availability of University Degree Programs

Degree Programs	**B.A./B.S.**	**M.A./M.S.**	**Ph.D.**
Aerospace Engineering	85% Sufficient	88% Sufficient	87% Sufficient
Aviation	86% Sufficient	86% Sufficient	86% Sufficient
Chemical Engineering	100% Sufficient	100% Sufficient	95% Sufficient
Computer Engineering	56% Sufficient	95% Sufficient	90% Sufficient
Electrical/Electronics Engineering	87% Sufficient	91% Sufficient	86% Sufficient
Industrial Engineering	95% Sufficient	90% Sufficient	89% Sufficient
Materials Engineering	95% Sufficient	95% Sufficient	93% Sufficient
Mechanical Engineering	96% Sufficient	92% Sufficient	96% Sufficient
Software Engineering	95% Sufficient	90% Sufficient	85% Sufficient
Systems Engineering	87% Sufficient	86% Sufficient	86% Sufficient
Chemistry	100% Sufficient	95% Sufficient	95% Sufficient
Mathematics	100% Sufficient	95% Sufficient	95% Sufficient
Physics	100% Sufficient	95% Sufficient	90% Sufficient

Interestingly, one respondent wrote in:

> We recruit from local schools, mostly University of Cincinnati and Ohio State and sporadically from the rest of state and from a regional perspective, from the top engineering schools including Purdue, Notre Dame, Rose Hulman, Michigan, etc..

This quote does indicate an important point overlooked in the survey: that Ohio benefits from its proximity to other top schools located in the midwest. Access to qualified workers in Ohio seems to be quite good.

In addition, another firm noted that their main recruitment problem came from a difficulty in "attracting talent to Canton." This is a different kind of problem than lack of educational resources. Rather it suggests that certain regions in Ohio may lack lifestyle resources that can make Ohio attractive to talented young workers, which hinders recruitment.

When asked about whether existing associate degree programs were deficient in any ways, 41.7 percent of the sample answered that they did not know, while 33.3 percent answered no. A small percentage (13.9 percent) did answer yes. Deficiencies listed include:

- Hands-on experience.
- High technology—two-year programs such as lab technicians
- High technology manufacturing technicians
- Industrial engineering
- Lack of security clearance

Respondents generally agreed (77.8%) that there were no degree programs, including associate's degrees, from which they would like to hire that were unavailable in Ohio. Of those who felt that Ohio lacked degree programs, they identified the following program gaps:

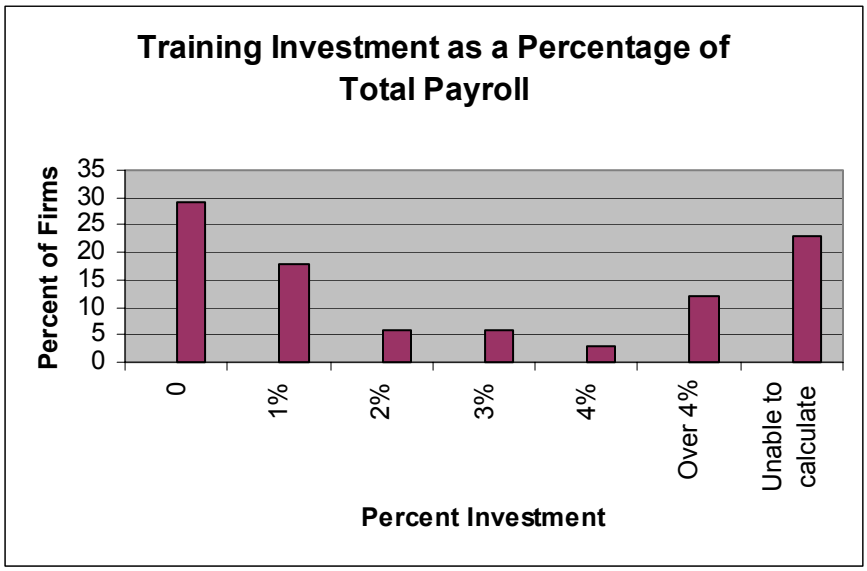
- Metallurgy
- Nano-Mems fabrication, assembly and packaging
- Mechanical engineering
- Materials management with an emphasis in master scheduling

Training Resources

The survey asked a number of questions to better understand how firms allocate training resources. The first question asked was the extent of investment in training. Firms were given a choice of sharing the real figures or percentage of total payroll. The firms shared percentages. Overall, there does not seem to be a large investment in skills training. The largest group, 29 percent, of the respondents to this question did not invest in training. The next largest groups,

23 percent, could not calculate the percentage. About 18 percent invested one percent. However, best practice minimum for training investment for industries seeking world class status is four percent or over[14]. Using that standard, 15 percent of respondents to this question invested four percent or over, which is very good. Notably, three out of the five firms investing four or more percent were small firms, with under 50 employees.

Figure 4: Training Investment as a Percentage of Total Payroll



Firms were asked to estimate, on average, how much training different types of employees received. Table 8 displays the results of those who responded to the question.. Of the sample, 22 percent of firms did not respond.

Table 8: Average Training Hours by Occupational Category

Occupational Category	Average Training Hours Received Per Year
Managers	31 hours
Professionals	32 hours
Specialized Technicians	21 hours
Computer Professionals	14 hours

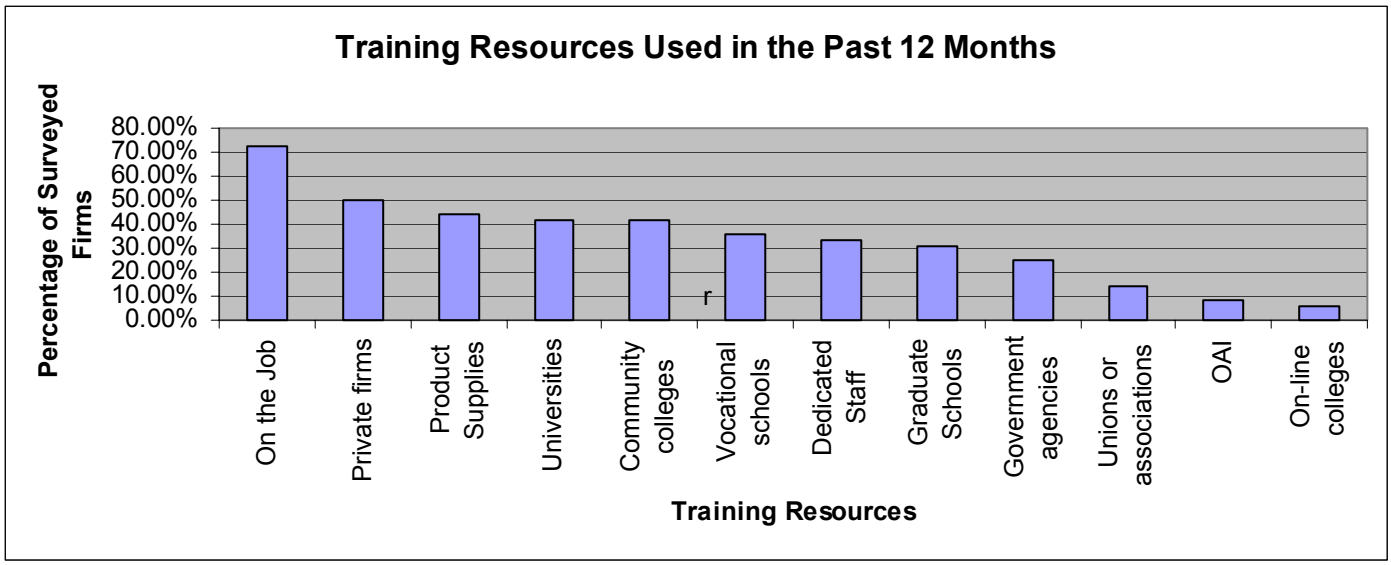
[14] Cirillo, Patricia, Ed Sylvestre, and Diane Coleman. 2002. *Survey of Employers in Three Industries: Advanced Manufacturing, Biosciences and Information and Communication Technology*. Cincinnati, OH: Cypress Research Group.

Ohio training investment patterns generally mirror national patterns, although they fall a tad short. An MIT study found that, on average, aerospace companies provide 32 hours per year to management and 39 hours to what they termed professional/technical.[15]

Firms were also asked an open-ended question about how they assessed training needs (A full list is provided in the appendix). Of the 34 firms responding to this question, only one noted that it used a training plan related to the company's objectives. Many others reacted to specific needs when they arose (e.g., customer demand, new software, per job requirement). In terms of the long-term competitiveness of companies, this is a weakness. We will discuss this more in the conclusions.

Our survey also asked companies what training resources they used in the past 12 months. Businesses were allowed to select more than one. As the chart below illustrates, most firms (72%) used informal, on-the-job training for their training needs. When firms do contract external resources, they rely on private firms (50%) and product suppliers (44%). Four-year colleges and universities and community colleges also provided 42 percent of firms with training resources. Eight percent of the survey respondents used OAI training. Notably, two firms wrote in the online University of Phoenix in the "Other" category. Of the total sample, only five firms (14%) had not offered training in the past 12 months.

Figure 5: Training Resources Used in the Past 12 Months



[15] MIT Labor Aerospace Research Agenda (LARA). undated. "National Aerospace Survey I" http://mit.educ/ctpid/lara. (undated but dates in the survey suggests it was taken in 1999 or 2000).

The majority of firms (55.6%) have formal in-house training programs, although only 31 percent have dedicated staff for training purposes. Most common topics or courses provided by in-house programs include safety (11 firms), management and leadership (7 firms), basic skills (5 firms), quality (multiple types), specific technical skills (multiple types), and general business practices. A full list is found in the appendix.

SKILL AND TRAINING NEEDS

Firms were asked if they noted a deficiency in the skills of their employees. The survey sample split evenly on the final answer. Of the 34 firms answering this question, 50 percent said yes and 50 percent responded no. If we break down this variable by size, an interesting finding emerges. Of the firms that indicated skill deficiencies, 75 percent had more than 50 employees. Similarly, of the firms that noted no deficiencies, 76 percent were small firms with less than 50 employees. Moreover, a majority of those firms noting skill deficiencies are located in Northeast Ohio (65%). Some of the main deficiencies were indicated in the following areas (a full list is included in the appendix).

- Communication
- Management
- Computer (from basic literacy to specific software programs)
- Business (marketing, business development, legal)

Notably, this list is somewhat similar to the type of training companies had contracted external providers to deliver in the previous 12 months, which are listed below (a full list is provided in the appendix).

- Leadership
- Communication
- Computer skills
- Assorted technical skills

Looking at the assessment of specific skills, employers generally felt their employees' skills were satisfactory to good as the table below demonstrates. Firms were asked to rate the skills of their employees on a scale of 1 to 5 with 1 being "poor" and 5 being "excellent" so the averages between 3 and 4 demonstrate an overall satisfaction with the skills of their employees. Consequently, this exercise does not point to common gaps in skills specific to the aerospace industry. The only skill in which a sizeable percentage (27%) of respondents ranked as poor was language skills.

Table 9: Assessment of Skill Quality

Skills	Average Skill Ratings
Basic Skills	
Interpersonal/Verbal Communication	3.58
Written Communication	3.25
Reading Comprehension	3.70
Mathematical Reasoning	3.81
Presentation Skills	3.59
English as a Second Language	3.38
Proposal Writing	3.65
Foreign Language skills, please specify language, **Chinese, Spanish, Dutch**	3.18
Customer Service	3.74
Cognitive Skills	
Teamwork	3.82
Effective Collaboration with External Partners	3.64
Critical Thinking	3.66
Complex Problem-solving	3.78
Judgment and Decision-making	3.64
Time Management	3.13
Management Skills	
Team Development	3.54
Effective Supervisory Skills/Managing Personnel	3.41
Leadership Development	3.37
Project/Program Management	3.46
Total Quality Management (TQM)	3.64
Statistical Process Control (SPC)	3.28
Six Sigma	3.40
ISO Certification	3.95
Business Knowledge	3.69
Managing Change	3.45
Managing Development/Adaptation of New Technologies	3.69
Technology Roadmapping	3.30
Technology Portfolio Management	3.54
Computer Skills	
Auto Cad	3.91
HTML	3.65
Programming Languages, please specify, **C++, Visual basic.net**	3.64

Technical Skills	
Process Failure Mode Analysis	3.42
Design Failure Mode Analysis	3.45
Lean Manufacturing	3.45
Design for Manufacturing Assembly	3.29
Systems Evaluation	3.45
Advanced Engineering Skills	3.69
Advanced Scientific Skills	3.44

Training Styles and Preferences

Respondents were asked about the format and delivery style of training they had used in the last 12 months and those they would prefer to use. Short courses were the most used (50%) and the most preferred (61%) format selected by the majority of firms. No training delivery method was used or preferred by a majority of firms, but on-site delivery did receive the highest number of responses (39%) for both. Only one firm noted that it did not provide incumbent training.

Training Format	Used	Preferred
Short Courses	50%	61%
Certificate Programs	22%	14%
Academic Programs leading to a degree	33%	25%
Other	5.6%	

Training Delivery Method	Used	Preferred
Web-based courses	31%	36%
Distance Learning	11%	11%
On-Site	39%	42%
DVD or video based	14%	22%
Other, preferred includes internally provided, live presentations, with instructor at course site	11%	17%

At the conclusion of the survey, the respondent firms were asked if there were any topics, programs, or courses they were unable to find in Ohio. Only six firms (17%) of the survey answered "yes." The lion's share answered no. The firms noting a training gap listed the following as topics they searched for (there are more than six as some firms listed more than one):

- Negotiation
- Assertiveness for supply chain
- Eclipse (an open source technology platform written in the Java language for software development)
- Marketing
- Management
- Good product management skills training
- Advanced tech presentation/selling skills
- Good machining practices program

CONCLUSIONS: DETERMINING TRAINING AND EDUCATION NEEDS IN A VOLATILE MARKET

How do companies determine skill and training demand? The first and obvious answer is articulated demand. Articulated demand can be measured by:

- the type and number of open positions;
- the training needs required to implement new technologies or production processes;
- the responses required to meet governmental regulations (e.g., OSHA) or customer demands; and/or
- the activities undertaken to compensate for skill deficiencies (e.g., basic skills training).

These circumstances determine how firms invest in training to ensure that employees can do their jobs and ultimately add to the company's bottom line by increasing the overall competences and capabilities of the workforce.

The survey is the instrument we used to articulate the current demand for training and education in the Ohio aerospace industry. Our review of that survey suggested a number of areas of demand. To reiterate, the conclusions are only suggestive—given the small size of the sample.

First, combining the information we have on in-house training used, contracted training used, and noted skill deficiencies, broad commonalities do emerge in the following areas:

- Management
- Leadership
- Communication
- Business Skills
- Computer Skills

It seems a market does exist in these areas, and these skills are important to maintain the competitiveness of aerospace companies and their labor force. The categories are broad, and some additional research would be needed to develop more targeted courses. Moreover, the courses would have to be more in depth than those already provided in house by many companies.

Second, reviewing the evidence with a careful eye, some questions do emerge—and answers to those questions have important training implications. We must be very careful with

this data because of the small number of respondents, but this data may be predictive of the future. As noted in the introduction, recent research of the aerospace industry as a whole indicated that it lagged behind other sectors in terms of restructuring around knowledge-driven work. That begs the question: are they also behind in implementing new technologies? Some of the demand indicated by a few firms relate to emerging technologies. Specifically, while there was not a high demand at this time for research scientists, this was the only category in which the majority of respondents noted that these positions were difficult to recruit. The two firms that did write in disciplinary areas indicated a need for fuel cells and carbon friction, both emerging technologies. Moreover, one of the few programs identified as missing in Ohio was Nano-Mems fabrication, which is also an emerging technology. Finally, half of the respondents had difficulty recruiting R&D managers, which again hints at challenges around managing new technologies and innovation. While none of this data is conclusive, it is suggestive that Ohio may have to think about emerging technologies from the point of view of education and training in more substantial and concrete ways, even though it seems able to train and provide traditional knowledge workers at the present time.

Third, the evidence also suggests the need for a focus on internships. The overall recruiting problems noted lack of work experience, poor job-seeking skills, and insufficient preparation of undergraduates as measurable challenges. Internships are one way to improve the overall quality of the emergent workforce force. Moreover, 25 percent of the sample indicated an interest in offering undergraduate internship positions. There may be an opportunity embedded here. While it is one thing to offer an internship, it is another thing to know how to manage it and provide a quality experience to the intern and a value-added proposition to the sponsoring firm. The issue is greater than just recruiting internships, but also includes providing guidance and assistance to firms to help them manage the internship.

Fourth, a good proportion of training offered could be considered reactive (in response to a specific customer request or new technology) while another proportion is strategically neutral (e.g., safety, which is more a part of doing one's job, rather than increasing the overall competitiveness of the company). Only a few firms considered training as an integral part of strategic long-term planning for the future. Training not attached to strategic goals will not necessarily add value to the business.[16] This is a capacity gap that could be addressed by training.

Finally, there are some important differences that emerged related to firm size and location. Firms with more than 50 employees generally were less satisfied with skills and the

[16] Creticos and Sheets.

ease of recruitment than small firms. One possible explanation is that larger firms have a larger proportion of other workers (production and administrative), and it is here where skill deficiencies may be stronger, which would be less important to the smaller companies, with a higher percentage of knowledge workers. Another is that they have a wider variety of occupational needs (e.g., specific research scientists, highly skilled management) making recruitment tougher. This suggests targeting training and education efforts to firms with over 50 employees. Additionally, the data hints that firms in Northeast Ohio experienced higher discontent with employee skills and found it harder to recruit. However, given the geographical bias of the sample and its small size, the geographic-based differences may be spurious. The data does suggest additional research might be warranted in this area.

It should be noted that articulated demand is not the only method of determining potential training and education needs. Training and education requirements also emerge from a comprehensive study of trends, competitive conditions, and long-term needs that firms either cannot acknowledge, cannot articulate, or do not have the resources to address currently. The discussion on trends in the introduction (and in the 2005 study *A Strategy for Growing the Ohio Aerospace and Defense Industry*) provides some strategic information for thinking about industry training and education needs. When things are on the horizon, it often takes leadership to move them forward on the ground. OAI is in a leadership position to work on issues that individual firms would have difficulty addressing on their own. In other words, OAI does not just need to respond to articulated demand, but also might focus on understanding where demand may be coming from in the near future. Our survey, at best, could only indicate short-term demand, not long-term changes. Broad-based research on issues such as emerging technologies, trends, and management practices that enhance competitiveness can also be used to define training needs even if the demand for some of it may not be widely recognized. With this in mind, there are several areas to consider for strategic long-term industry training and education needs. They are organized into three categories. The first is content, which offers a menu of ideas of potential industry training needs, based on wider trends, in which a market might be developed. These ideas could be considered proactive rather than reactive or strategically neutral, thereby adding to the overall competitiveness of the state industry. The second category is targets, which identifies potential markets in which training might focus. The last area is partnerships, in which OAI uses its role as network facilitator to create wider partnerships and understandings of strategic training for the competitiveness of the aerospace industry.

Content

Ideas for training areas indicated by trends and research are:

- Knowledge-driven work systems, including new management-labor relationships and other quality components that support them. Focus on methods to enhance the innovation process.
- Six Sigma, specifically.
- Composite materials processes.
- Leadership, particularly managing change.
- Multicultural management as a way of entering and managing a more global market.
- Development of training plans attached to clear business strategies. Studies have shown that incumbent training is most effective when it is linked to a strong business plan that identifies goals and monitors performance.
- Better supply chain management.
- Collaboration management, including at a global scale.
- Non-labor-based cost-cutting methodologies such as energy efficient, high-performance buildings. Finding ways to reduce long-term costs enhances the bottom line and allows for greater investment in training and research and development.

Targets

- Expand target training market to include lower-level technicians who can be developed into knowledge workers. This may include developing relationships between two-year post-secondary schools and universities to create pathways that support the upgrading of individuals into knowledge worker categories (e.g., the National Science Foundation Advanced Technology Education Program focuses on these issues).

- Enter the world of K-12 math and science education aggressively. Here is the key to the future workforce and the pipeline is decreasing. Although OAI focuses on higher education, it might find other organizational partners to concentrate on the K-12 pathway.

- Aggressive entry into the world of small firms (50 to 500 employees). As noted in the introduction, small firms are often the most in need of training resources and the least able to use training as a strategic vehicle to promote positive organizational change. Specifically, help smaller firms move away from pieces and parts manufacturing toward product development and systems integration.

- Market science, technology, and engineering pathways to women and minorities to augment the current pipelines.

- Design training as networking venues as well as education tools. Use it to make connections among companies and workers that stimulate innovation.

Partnerships

- Partner with other national leaders to offer new training and education opportunities. For example, Boeing has worked with the University of Washington's School of Engineering

to enhance the curriculum and address composite and product lifecycle management design-manufacturing. Recognize that aerospace is a global industry, which may mean opportunities to engage in larger, wider training enterprises available on a national scale. Partnerships may allow the combination of web-based training with instructor-led training. For short courses, there may be existing modules on key elements within core topics.

- Expand relationships with a wider pool of businesses to feed workforce needs more regularly into OAI and university members/partners. Given the relatively small size of the state industry, it would not be too onerous to develop regular feedback mechanisms to adapt training offerings over time.

- Work with university partners and national leadership to identify emerging trends, technology changes, and review Ohio training and education resources for their relevancy to those changes. Develop a think tank in one university to monitor industry workforce issues. As one respondent noted in the *A Strategy for Growing The Ohio Aerospace and Defense Industry*: "Training needs are relentless."[17]

- Work with partners to advocate for financing such as easy-to-use tax incentives to pay for training investments that meet the needs of the aerospace industry.

In conclusion, when strategically considering training and education needs for the Ohio aerospace industry, it might be prudent to combine the more immediate, articulated areas of demand with longer-term systems thinking of what may be needed in a longer time frame. The objective is to find a way to prepare for the opportunities and threats that loom on the horizon, because they are there.

[17] A Strategy for Growing The Ohio Aerospace and Defense Industry, p. 26.

APPENDIX

Appendix 1: Survey Challenges

Appendix 2: Written responses to open-ended questions

- Training Needs Assessment
- In-House Training Programs
- Employee Skill Deficiencies
- Training Provided by External Providers
- Courses Unavailable in Ohio
- Other Comments
- Contact Information of Respondents Either Wanting Study Results and/or Agreeing to a Follow-up Phone Call.

APPENDIX 1: SURVEY CHALLENGES

When designing the study, our initial goal was to obtain a 15 percent response rate. Generally, business response rates to surveys are small, and eight to nine percent is considered a decent rate.

The initial response was very poor—only 10 firms. The final survey was quite long, which may have been a deterrent, but pre-testing showed it took only about 20 minutes to complete, and we had indicated that on the survey cover. To bolster the rate, we called all firms twice and the response rate inched up to 18 firms. We then added some additional firms to the survey list from a set of aerospace roundtables undertaken during a previous study of the aerospace industry of which both OAI and the Center for Economic Development took part and through the diligence of OAI, which identified additional firms through their contacts. These additions increased the survey population to 438. These firms had been overlooked because they are not categorized as Aerospace in NAICS or SIC codes. We had targeted the following categories: Aerospace Products and Parts, Aircraft and Missile Propulsion, as well as several Aerospace Services. We did not include airline transportation-based services in the survey. The additional firms are categorized as business services or engineering services. While these firms undertake extensive aerospace work, they are not categorized as aerospace companies.

In partnership with OAI, we called the new additions to the list and called the initial list another time. By this time, we had been able to reduce our active list to 375 firms by eliminating bad addresses, duplicates, and firms not part of the aerospace industry as revealed by the phone calls. The final result was 36 responses, which is close to a 10 percent response rate and a reasonable rate for a business survey. However, not all firms answered all questions. A number of very small firms, which made up a significant part of the sample, did not find the survey on workforce training needs to be pertinent to their particular situation and often did not complete whole sections of the survey. As an example, one respondent commented, “This survey is not applicable to our business. We have four salesmen and my administrative assistant and myself working in Ohio.”

Similarly, some manufacturing companies that have a workforce comprised of predominantly production workers did not see the relevance of a survey focused on knowledge workers and did not fill out portions of the survey. For example, one respondent wrote in: “Manufacturing businesses (that our government hasn’t managed to put out of business) need knowledgeable Indians, not more chiefs to drive up costs.” As another example, another respondent noted, “This survey bears little relevancy to what we need. I guess I stop here.” This respondent stopped filling out responses when he reached the survey note indicating the focus on knowledge workers. OAI, however, chose to focus on knowledge workers because of its important relationships to universities and higher education

APPENDIX 2: WRITTEN RESPONSES TO OPEN-ENDED QUESTIONS

Training Needs Assessment

Q14: Please indicate how you assess your company's training needs.

- Training plan that supports the company's goals and objectives.
- Based on the skill development required for new programs or upcoming events/actions and on the assessment of current skill levels.
- In-house criteria specific to our industry.
- We consider new technologies that we will use and then do gap analysis against our workforce.
- By observing trends and responding to clients requirements.
- Generally a strong need answered by a strong plan to achieve both externally and internally.
- Ability to pass necessary certification for manufacturing employees. Training is done in-house.
- Personal observation and performance reviews.
- Needs analysis and training development.
- As a small company, training needs are determined on an individual basis.
- Needs are identified based on customer task requirements. If the task requires the application of a new or upgraded code or technology, we send the individual to the appropriate training.
- Mostly driven by company demand.
- Evaluate technology requirements, match them against current skills.
- Conduct gap analysis, focus groups, interviews and surveys.
- Employee feedback.
- Don't have a training need program.
- Informally.
- Mostly on-the-job individualized internal training.
- Management assessment of individual needs.
- Per the job requirements.
- Audit and gap analysis.
- Very informal. Also identify needs through performance appraisal processes. Most training is focused around continuous improvement. Soon leaders will be trained in innovation and talent development.
- By projects, by skill sets and by title or position.
- Training is monitored by a manager that reports to the president monthly. Programs are developed by this manager.

In-house training programs

Q18: Do you have any formal in-house training programs? If yes, for what topics, programs, or courses (e.g., safety, basic skills, general business, CAD/CAM computer)?

- Safety (provided by 11 respondents)
- Basic skills (provided by 5 respondents)
- Leadership (provided by 3 respondents)
- Management (provided by 2 respondents)
- General business practices (provided by 3 respondents)
- Specific technical skills (provided by 3 respondents)
- Quality (provided by 3 respondents)
- Six Sigma
- ISO Quality system
- Lean Manufacturing
- AS-9100
- Ethics
- Project management training
- Supervisory skills
- CAD/CAM Computer
- Technician certification
- Welding
- FPI
- Inspection
- Unigraphics
- Pro E
- General processes
- Security
- EHS
- In-house technical (CMMI)
- Communication
- MDT
- GD&T
- MS Office (Excel, Word, etc..)

Employee Skill Deficiencies

Q19: Have you noted a deficiency in skills in any of your employees? If yes, what is the most common deficiency?

- Communications (noted by two respondents)
- Program management
- Project management
- Time management
- Organizational
- Unique aerospace market we are in.
- Math
- Reading blueprints
- Marketing
- Business development
- Legal (intellectual property)
- Business communication
- Computer proficiency
- Interpersonal skills
- Java/Eclipse
- Lack of quality assurance methodology
- Computer literacy among factory workers
- Problem solving
- Varies by employee

Training Provided by External Providers

Q22: If you have provided training in the last 12 months using external training and education providers, please indicate the specific skills provided by the training.

- Leadership training (provided by 3 respondents)
- Leading change
- Supervisory/Managerial training
- Team development
- Accountability training
- Communication skills (provided by 2 respondents)
- Proposal writing and preparation
- Lean
- Sigma training
- Unix
- Various databases and programming
- Oracle DBA
- Eclipse (Java)
- Macromedia application development suite
- Technical/University training for engineering trainees
- Attending area colleges
- Using on-line colleges
- B.S. and Ph.D. programs
- Safety
- Defibulator
- Tow motor driving
- Hoist use
- Carbide grades and cutter technology

Q25: Are there any training topics, programs, or courses that you have been unable to find in Ohio? If yes, please specify what training topics, programs, or courses you could not find but would be interested in obtaining.

- Negotiation
- Assertiveness for supply chain
- Eclipse
- Marketing
- Management
- Technical
- Good product management skills training
- Advanced tech presentation/Selling skills
- Good machining practices program

Other Comments

Q27: If you have any additional comments or detailed information, please add them here.

- A large percentage of our business derives from DOD. Security issues mandate for many programs that only permanent citizens/U.S. residents may be users. This is a tough one to address.
- Survey may not have been designed for a small management-consulting firm that specialized in providing training, educational research and events planning services.
- We will need Java programmers in the coming years. Familiarity with Eclipse IDE is a plus. Unix system administration is another area. We will also need EE types familiar with digital signal processing fundamentals. Familiarity with synthetic aperture radar (SAR) is a plus.
- This survey is not applicable to our business. We have four salesmen and my administrative assistant and myself working in Ohio.
- (For a company that uses independent contractors). I've found that too many of my independent contractors rely too much on the computer for spelling/writing. Today's students are very poor spellers. They can't write a simple memo or name correctly.

CONTACT INFORMATION

At the conclusion of the survey, respondents were asked if they wanted a copy of the survey results and if we could contact them with any questions about the survey or the topics covered. The table below provides the contact information of those respondents indicating yes to either issue and notes if they want a copy of the survey results and/or if they agreed to be contacted.

Contact:	Wants Survey Results	May Contact
Raymond F. Laubenthal President **AeroControlex Group** 440-392-6691 rayl@aerocontrolex.com	Yes	Yes
Anthony J. Miranda Technical Director **AlphaPort** 216-441-4335 ajmiranda@alpha-port.com	Yes	Yes
Herbert Roder President **ARES** 419-635-2175 herb.roder@aresinc.net	Yes	Yes
Lee Watson President **Bescast** 440-946-5300 lwatson@bescast.com	Yes	No
Lee Cuilli Director of Distributor Sales **Checkpoint Systems** 216-464-3531 Lee.cuilli@checkpt.com	No	Yes
Scott Bromagan Human Resources Manager **Crane Aerospace Lear** 440-284-5420 scott.bromagen@craneaerospace.com	Yes	Yes
C. William Brougher President **Eagle Tool and Machine Co.** No phone number provided billb@eagletmc.com	Yes	Yes
Frank Svet President **Emtec** 937-259-1365 fsvet@emtec.org	Yes	Yes

Ron Pelfrey Directory, Military Sales **Enginetics** rpelfrey@enginetics. Com 937-754-3203	Yes	Yes
Joseph Murphy Chairman **Ferco Tech** 937-746-6696 jjmurphy@fercotech.com We received two surveys from Ferco Tech. Only one was input but both requested a copy of the study and agreed to a follow-up phone call	Yes	Yes
Lisa Wunn Human Resources Manager **Ferco Tech** 937-746-6696 lwunn@fercotech.com	Yes	Yes
James Kauppila Engineering Domain Manager **General Dynamics** 937-427-4440 james.kauppila@gd-ais.com	Yes	Yes
Christy Stringer HR Manager **Goodrich Landing Gear** 937-440-2349 Christy.stringer@goodrich.com	Yes	Yes
Lloyd Buckwell VP, Human Resources **Hawk Corporation** 216-861-3553 lbuckwell@hawkcorp.com	Yes	Yes
Gayle Freeman President **Manairco** 419-524-2121 G2Air@aol.com	Yes	Yes
Vinod Nagpal President **N&R Engineering** 440-845-7020 vnagpal@nrengineering.com	Yes	Yes
Dan Kalynchuk Director of Business Development **Orbital Research** 216-649-0372	Pre-test. This question not asked.	Yes
Gail Dolman-Smith President and CEO **Paragon Tec** 216-361-5555 gds@paragon-tec.com	Yes	Yes
Mark Jackson HR Team Leader **Parker Hannifin Corp** (Aerospace/Defense related division in Mentor, Avon and Elyria)	Yes	Yes

440-954-8190 mjackson@parker.com		
John Morton GESS Program Manager **QSS Group** 216-977-1313 jmorton@gssgess.com	Yes	Yes
Bill Ramsey Product Manager **Recom Technologies Inc.** 216-433-5255 William.T.Ramsey@grc.nasa.gov	Yes	Yes
Richard Staknaker Program Manager **RS Information System** 216-433-8113 Richard.a.stalnaker@grc.nasa.gov	Yes	Yes
Joseph Poddany Director, Operations, Engineering and Programs **Teledyne Continental Motors** 419-470-3183 jpoddany@teledyne.com	No	Yes
Lisa Aurand OA Manager-Technology **Timken** 330-471-3987 lisa_aurand@timken.com	Yes	Yes
Jeff Umbreit Accounting and Business Manager **Webcore Technologies** 937-435-2200 jumbreit@webcoreonline.com	Yes	Yes
D.H. Mathews President **Weldon Pumps** 440-232-2282 dmathews@weldonpumps.com	Yes	Yes
Michael Shoemaker Vice President **Zin Tech** 216-925-1166 Michael.shoemaker@zin-tech.com	Yes	Yes