Machining Employer Report
Amarillo College ACP Project Program Report

The West Texas Office of Evaluation and Research (WTER) provides external evaluation services for Amarillo College's Department of Labor Grant, *Accelerated Career Pathways* (ACP) project. On December 5, 2013, WTER Associate Director Judy Kelley and Research Associate Kris Drumheller collected surveys and conducted focus groups to get perspectives from potential employers in the Panhandle area. Seventeen participants representing 11 different potential employers responded to the survey and focus groups. The following report provides survey data collected from the employers as well as the results of the focus groups.

Part I: Survey Results

Employers' Perceptions of the Importance of Various Competencies for AC Machining Students
The following four tables provide the data machining employers share in response to questions about the importance of various technical competencies to be accomplished through the Amarillo College Machining Program. The employers were asked to think about their organizational expectations for beginning employers and asked to rate the importance of competencies for meeting their expectations.

How important is it that beginning workers know the following about DC and AC Circuitry?							
	Not Sure	Not at all Important	Only a Little Important	Somewhat Important	Important	Very Important	# Responses
1. DC: Ohm's law	5	4	2	1	1	0	13
2. DC: Kirchhoff's law	5	4	2	1	1	0	13
3. DC: circuit analysis techniques	2	4	2	4	1	0	13
4. AC: series circuits	2	4	3	4	1	0	14
5. AC: parallel circuits	2	4	3	4	1	0	14
6. AC: capacitive networks	2	4	2	4	1	0	13
7. AC: inductive networks	2	4	2	4	1	0	13
8. AC: phasors	3	4	2	4	0	0	13
9. AC: transformers	2	4	3	5	0	0	14
10. AC: resonance	3	4	2	4	0	0	13

How important is it that beginning workers are able to use the following basic machine tools?							
	Not Sure	Not at all Important	Only a Little Important	Somewhat Important	Important	Very Important	# Responses
11. Lathe	0	0	3	2	3	9	17
12. Milling machine	0	0	3	1	2	10	16
13. Drill press	0	0	2	3	2	10	17
14. Power saw	0	1	2	2	5	7	17
15. Bench grinder	0	0	2	3	2	10	17
16. Hand tools	0	0	0	4	2	11	17

How important is it that beginning workers understand the following welding metallurgy components?							
	Not Sure	Not at all Important	Only a Little Important	Somewhat Important	Important	Very Important	# Responses
17. Metal alloys	0	1	1	3	5	5	15
18. Heat treating	0	0	6	2	5	3	16
19. Hard surfacing	1	1	5	4	2	3	16
20. Welding techniques	0	3	1	7	2	3	16
21. Forging	0	5	3	3	2	3	16
22. Foundry processes	0	6	3	4	2	1	16
23. Mechanical properties of metal hardness, machinability, and ductility	0	1	0	5	5	6	17

How important is it that beginning workers have the following knowledge, skills, and abilities?							
	Not Sure	Not at all Important	Only a Little Important	Somewhat Important	Important	Very Important	# Responses
24. Knowledge of mathematics including fraction and decimal manipulation, percentage and problem solving, ratio/proportion.	0	0	0	1	7	9	17
25. Ability to collect statistical data.	0	3	6	4	4	0	17
26. Ability to analyze and interpret statistical data.	0	3	7	3	4	0	17
27. Ability to present statistical data and interpretations.	0	5	6	4	2	0	17
28. Knowledge of statistical methods (including correlation, analysis of variance, dispersion, sampling, quality control, reliability, mathematical models, programming).	0	3	5	5	3	1	17
29. Ability to read working drawings for fabrication processes and associated trades.	0	0	0	4	5	8	17
30. Ability to use sketching techniques to create pictorial and multiple-view drawings.	0	0	2	5	5	5	17
31. Understanding occupational safety and health codes.	0	0	1	2	7	7	17
32. Knowledge of pneumatic and hydraulic systems, fluid power symbols, operating theory, components, vacuum and hydraulics, basic electrical and manual controls.	0	0	5	4	7	1	17
33. Application of precision measuring instruments.	0	0	0	1	4	12	17

How important is it that beginning workers have the following knowledge, skills, and abilities?							
	Not Sure	**Not at all Important**	**Only a Little Important**	**Somewhat Important**	**Important**	**Very Important**	**# Responses**
34. Knowledge of general safety rules common to industrial field, including lock-out/tag-out	0	0	0	0	6	11	17
35. Knowledge of basic layout and piece part measurement using standard tools.	0	0	0	2	7	8	17
36. Ability to develop job process plan to include operation of lathes, milling machines, drill presses, and power saws.	0	0	3	1	6	7	17
37. Knowledge of shop safety and preventative maintenance.	0	0	1	1	4	11	17
38. Knowledge of machine terminology.	0	0	2	1	4	10	17
39. Ability to do the housekeeping and preventative maintenance in the shop.	0	0	1	3	7	6	17
40. Knowledge of G & M codes to program Computer Numerical Controlled (CNC) Machines	0	0	4	3	4	6	17
41. Recognition and application of pumps (installation, repair, troubleshooting)	0	1	6	5	5	0	17
42. Advanced lathe and milling operations.	0	0	5	4	3	5	17
43. Knowledge of basic welding processes: oxyfuel and cutting.	0	4	3	5	3	2	17
44. Knowledge of basic welding processes: shielded metal arc (SMAW).	0	4	4	5	2	2	17
45. Knowledge of basic welding processes: gas metal arc (GMAW).	0	3	5	6	2	1	17
46. Knowledge of basic welding processes: gas tungsten arc welding (GTAW).	0	3	4	7	2	1	17
47. Knowledge of ferrous and nonferrous metals from the ore to finished product.	0	3	7	3	4	0	17

Employers were given the opportunity to list three other technical competencies that they believe are important for machinists to have. The survey asked them to list these as Competency 1, Competency 2, and Competency 3. Their responses of additional competencies were:

Competency 1

- Basic flame/cold spray techniques
- Being able to run conventional lathes
- English speaking and comprehension
- Hand tool sharpening (drills, lathe tools)
- Mathematics # 1 Safety
- Speeds and feed rates for metal cutting

Competency 2

- Basic math skills
- Being able to run conventional mills
- Knowledge of finishes
- Real working page
- Surface grinding
- Tool types for lathes and mills

Competency 3

- Aesthetics of finished parts
- Being able to read and interpret drawings
- Knowledge of lean manufacturing
- Milling lathes drilling

Employers were also asked to indicate how important they believed various soft skills are for machinists to have. The following table provides the employers' responses about the importance of these soft skills.

How important do you believe it is for machinists to have these soft skills?

	Not Sure	Not at all Important	Only a Little Important	Somewhat Important	Important	Very Important	# Responses
48. Interviewing skills	0	0	2	9	5	1	17
49. Resume Writing skills	0	1	1	9	5	1	17
50. Active Listening skills	0	0	0	0	8	9	17
51. Conversational skills	0	0	0	3	12	2	17
52. Ability to fill out an application	0	1	1	1	13	1	17
53. Clear/Concise Writing	0	0	0	8	8	1	17

As with the technical competencies, employers were given the opportunity to list three other soft skills that they believe are important for machinists to have. The survey asked them to list these as Soft Skills 1, Soft Skills 2, and Soft Skills 3. Their responses of additional soft skills were:

Soft Skills 1

- Ability to get along or be a leader
- Basic computer skills (Microsoft products)
- Good communication skills
- Good eye sight (not a skill but manageable)
- OSHA standards

Soft Skills 2

- Ability to learn and follow instructions
- Ability to work with others
- Imagination
- Personal responsibility

Soft Skills 3

- Dependability
- Follow directions

- Good work ethics

Part II: Focus Group Results

The following themes were discussed in two different focus groups; one hosted by Judy Kelley and the other by Kris Drumheller. Together, at least 4 employers had hired AC graduates. The focus groups were very complimentary of the AC graduates they had employed now or in the past, as well as of the instructor of the machining courses. Both groups gave very similar answers providing additional validity to the findings, and will be addressed as singular group for the purposes of this report.

The employers acknowledged there is a great need for machinists in this area. Although CNC operators are needed, individuals who have basic machining skills are in demand. At least one of the companies represented uses only machinists. The group felt that many come in as CNCs but can't actually do machining which is a problem for the industry. Additionally, shop floor math skills are often lacking in employees.

Needed Skills

Some of the skills identified that students will need coming out of a machining program and into industry included: GD&T, math, reading and understanding blueprints, and basic manual skills. A notable point made by the group is that many can read the blueprint, but they can't create one. The don't know how to do the "napkin" blueprint and figure out what is needed if a print is not in front of them. Machinists have to be able to "figure it out."

They also noted that it is easier to take someone from the machinist's world to CNC than it is the other way around. CNCs do not have the manual skills necessary to do machining. One individual quipped that good machinists can "start immediately and fill out the paperwork later."

Some also noted that they have to farm out sharpening, because no one has this basic skill anymore. Similar skills were lacking in today's employees. They need to understand cutting and how to minimize waste. One employer requires machinists use a notebook to show the steps for achieving the end product.

Students also need to know safety. They need to understand how to lift properly, for example. They also need to understand that quality is better than speed. It is better to be safe and minimize waste. One noted: "I can afford for him to be a little slower to get it right more than I can afford for him to do it wrong."

Strengths & Weaknesses

The instructor was seen as a good asset. He is very responsive to suggestions. One suggested that students need to be screened to see if they have math and mechanical aptitude.

In identifying strengths, this group continued to return back to the differences between machining and CNC. Ultimately it seems this group leans heavily toward the need for hands on machining skills, even for those who become CNCs. "Everyone should have the basic machining skills, not just the programming, but that is what is happening." The students need the GD&T skills, learning the manual skills as a foundation for being successful in the workplace. The group noted that they don't feel many kids are growing up doing manual labor and so they have no aptitude for using tools. The group was open to the idea of having different levels for the degree, such as a Level 1 with machining skills and a Level 2 for CNC. "It seems like machining at AC is all lumped into one and maybe focusing on one aspect where we are looking at journeymen who have to manufacture things with their own hands as opposed to production shops with hundreds of thousands of workers so you have just button pushers. A good machinist may not be a good programmer." The group argued that students will be better programmers with the basic machining skills.

The employers were also in favor of "apprentice-type programs" to help students get the skills they need before entering the workplace. Some, like Pantex, already have something similar, and several had a training program that included job shadowing. In most cases, employees can move more quickly through these training programs based on how developed their skills are. These apprenticeships might also help students work with larger equipment than what they are trained on at AC.

Soft Skills
In the area of soft skills, work ethic was a big concern. They want individuals who are ready to work and to show up for work regularly and on time. Students need to have realistic expectations of the pay scale for machinists as well as recognize that the more skilled they become, the better they get paid. They need to recognize that they are in an "honorable profession" and be proud of the work they are doing. It can take several years to start making good money in this industry.

Students need to learn how to perform and dress for an interview. They need to be able to articulate and talk about themselves in an interview; the need to sell themselves. Although some interview well, they bring a different personae to the workplace, often with poor work ethic. They need to have enthusiasm for the job and not be "intimidated by the machine or task given, but have confidence" so they don't shy away from difficult tasks.

Some also have difficulty with the aptitude tests given at some of the workplaces. One noted that they give a welding test and some students are "pretty humbled when they leave" because they realize they aren't as good as they thought they were.

Other Suggestions
There was some discussion about the high schools needing to provide better and more widely available training. Having a machining program at one high school is not going to capture other students interested since no student is likely to transfer for the one program. One stated that some high school applications are better than college applications. One mentioned that Vega is doing amazing projects, selling their products to make the program self-sustaining. This group was very high on vocational education in high schools.

Shortcut books were suggested: Carr Lane and Illinois Tools book (both trigonometry books)

The group was asked about the NIMS program credentialing. The group appeared a bit lukewarm on whether it would be valuable or necessary. "It is OK, but not as important to some companies as others."

The group also suggested that AC do a better job of marketing specifically to high school students who are already good at math.

Part III: Recommendations

Based on the findings of the survey and focus groups, WTER makes the following recommendations:

- Both groups heavily emphasized the need for what they were calling "shop floor math." AC should look at how these math skills are being infused in the program and if students are getting the right kinds of math through core courses. (formulas, geometry, trigonometry, etc.)
    - There doesn't seem to be a great need for the statistics class. AC might consider creating a specific math course to handle "shop floor math" in place of the statistics course. This course might still include basic statistics to address the few who did see value in the stats portion of the curriculum.
- The need for math and hand tool skills was very key for this group, so AC could consider identifying students who really have an aptitude for math and mechanical skills for recruiting and selection purposes.
- Help students understand the importance of having a good work ethic and provide them with realistic expectations of the pay scale in the workplace. They need to understand that the harder they work and the better they get over time, the more likely they will see higher pay.
- It was recommended that AC work closely with high schools to create awareness about the opportunities in machining and to encourage high school students to get the math skills needed. They also encouraged marketing to college graduates looking for a field, such as math majors getting into machining.
- Although it seems employees are familiar with blueprints, students need to be able to create a "napkin" blueprint. If plans are lost or they have a product that needs a blueprint, the students should be able to create one, so the courses might consider implementing blueprint exercises in the classes. For example, a course could have an exercise on the 10-minute blueprint before several different class periods as a quick exercise in blueprint creation.

- If AC is truly interested in implementing NIMS, it would benefit AC to find out which employers really look for NIMS credentialing and which do not since the group was lukewarm about the credential overall.
- Creating levels of training could add “steps” in the career path, which is a focus of the DOL grant, and potentially fill the demand for machinists while improving the programming skills of those in CNC.