Program Review
Machine Tool & Manufacturing Technology

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I. PROGRAM OVERVIEW

Summary

The machine tool and manufacturing technology programs are both designed to prepare students for employment and to upgrade and expand the skills, knowledge, and abilities (SKAs) of those currently employed in these endeavors and related fields.

Many of the SKAs developed in these two programs may seem similar but they differ in focus. The focus of machine tool program is to develop skills and competency within the job shop, tool room, or laboratory environment where a small number of specialized items are designed, created, or tested whereas the focus of the manufacturing technology program develops skills that are conducive to mass production, highly automated machining equipment, and automation used in the manufacturing environment.

Mission Statements

Machine Tool Technology:

The machine tool technology program prepares students for employment in machine shops, tool rooms, and instrument and experimental laboratories and provides upgrade opportunities for employed industrial personnel. Students gain proficiency in the set-up and operation of drilling machines, lathes, mills, grinders, electrical discharge machines, computer numerical control (CNC) lathes, CNC milling machines, and computer aided manufacturing systems. Competencies will be assessed regularly in accordance with skill standards established by the National Institute of Metalworking Skills (NIMS). Students completing the program may enter industry as an advanced apprentice machinist or machine operator and anticipate advancement to machinist, tool and die maker, experimental machinist, or numerical control programmer.

Manufacturing Technology:

The manufacturing technology program prepares students for employment in fields related to manufacturing. By completing the degree or certificate requirements, students acquire a foundation in computer aided design, machining, electronics, technical mathematics, and welding. Students also select a career field in which to specialize or broaden their knowledge. These fields include computer aided design/drafting, electronics, environmental technology, machine tool technology, quality assurance, or welding. Competencies are assessed regularly by student performance in the classroom and laboratory.

Degree and Certificate Programs

Students may earn an Associate of Science (A.S.) degree and/or a Certificate of Achievement in both the machine tool and manufacturing programs. The A.S. degree programs are most applicable to students who desire to satisfy the educational breadth requirements of a degree program or who are pursuing higher education. The certificate program fulfills the needs of students who have returned to college to augment their SKAs. It is not uncommon for accomplished machinists, engineers, and designers to take these fabrication skills classes.

Presently, students earning an A.S. degree in machine tool technology may choose between (or earn both) machinist or numerical control programmer options. Those pursuing a Certificate of Achievement may also add an additional computer numerical control (CNC) operator option. Student competency evaluations in each of these options are in accordance with National Institute of Metalworking Skills (NIMS).

Students earning an A.S. degree and/or a Certificate of Achievement in manufacturing technology acquire a foundation in computer aided design, machining, electronics, technical mathematics, and welding. During their course of study, students may take additional classes to specialize in computer aided design/drafting, electronics, environmental technology, machine tool technology, or welding. Competencies and performance are assessed regularly in the classroom and laboratory.

Status of Prior Program Review Recommendations

There were four recommendations from the prior program review conducted in 2006.

1. Improve marketing efforts of machine tool and manufacturing programs.
2. Strengthen relationships with feeder schools.
3. Strengthen relationships with local industry.
4. Update facilities to include automation and robotics.

1. *Improve marketing efforts:*

In 2006, the economy and the community seemed to be pursuing service sector jobs over technical design and manufacturing. At the time, we concluded that we needed to improve our marketing efforts in these two programs. These marketing efforts were improved through regular collaborative efforts with other technical programs such as the Space Day and New Student Day events where machine tool, automation, robotics, and manufacturing market their programs with displays and exciting mechanical and automated devices that were fabricated by students and faculty in our programs. These displays show the excitement of students in the program and capture the imaginations of students who aspire to create and work with metals and machines.

The Women in Technology (WIT) program has contributed greatly to these marketing efforts. Through these programs women gain a network of mentors and assistance to help women pursue and enter non-traditional vocations in machine tool technology and manufacturing. Many women pursuing engineering degrees find that these programs provide opportunities to work with tools and machinery used in fabrication; functions traditionally dominated by men.

During the summer of 2011, a new Robotics Club was established. The club was a spin off development of the programs. A grant made it possible to compete with nearby high schools, colleges, and universities—Hosted at California State University Northridge. Students created robots to compete in Olympic style games. El Camino ranked second in those competitions. This was quite an accomplishment when you consider it was a new club and a first attempt.

2. *Strengthen relationships with feeder schools.*

Relationships with feeder high schools have been improved through off-campus activities with local high schools such as:

National competitions such as FIRST Robotics provide opportunities to forge many new relationships with faculty and students. The event involves many sponsoring companies and nine local high schools who have an interest in developing future Science, Technology, Engineering, and Mathematics (STEM) students. Robots fabricated at ECC have done exceptionally well in the competitions in recent years. Four of the six finalists were from El Camino College District, out of sixty high school teams that entered the Los Angeles regional trials competition. Last year, out of 3,000 competing teams, an El Camino College associated team won the National Competition in Atlanta, Georgia. El Camino College District teams have attended regional competitions in San Diego, Denver, Hawaii, San Jose, Washington D.C., Las Vegas.

Local events such as the Solar Cup competitions, Student Summit Day at Westec, and Sony Rocket Project at CAMS High School provide opportunities to build relationships with local schools. As a result of these local events, we have been able to build relationships with local feeder high schools, which include Hawthorne, CAMS, Palos Verdes and North Torrance.

Grant programs such as STEM and Career Technical Education Act (CTEA) grant programs have furthered efforts to market our programs.

Clearly, today we realize more than before that a strong manufacturing sector is a crucial element in a sustainable vibrant economy. Because of this understanding, community desire to improve employment prospects, government stimulus, and increased discussion

and interest to revive the manufacturing sector, these programs will continue to be popular and classes have remained full.

3. *Strengthen relationships with local industry.*

We have established excellent industry partnerships with Northop Grumman and many local small job shops. They attend our advisory board meetings regularly.

Faculty and staff have entered ads in local free websites. Instructors are involved in maintaining a MTT and Manufacturing Technology presence on school websites. Several instructors contribute to other industry and trade websites such as the Haas Technical Education Center[1]. El Camino Instructors support and mentor clubs such as the ECC Robotics Club and Southern California Home Shop Machinists Club. During the past four years, instructors have discussed the possibility of other clubs such as an SME and Automation club.

In general, faculty and staff have been very active in marketing the program.

4. *Update facilities to include automation and robotics.*

Over the last four years, machine tool and manufacturing technology have begun sharing lab space with the engineering technology department. As a result of this collaboration, we have experienced some economies of scale with regard to purchasing equipment. We have been able to add automation and robotics equipment[2] and allow engineering students to appreciate fabrication and machine tool and manufacturing students appreciate engineering design. This particular cross-discipline appreciation has evolved into a "learning synergy" in the lab environment. There are great advantages for students seeing and appreciating the bigger, more collaborative, and inter-disciplinary industry picture.

[1] http://www.htecnetwork.org/

[2] New added equipment include a number of CNC vertical milling machines, a CNC sheet router, two robot arms, and other equipment.

II. ANALYSIS OF INSTITUTIONAL RESEARCH DATA

The following institutional research is provided and analyzed:

1. Course grade distribution; success and retention rates
2. Enrollment statistics with section and seat counts and fill rates
3. Scheduling of courses (day vs. night, days offered, and sequence)
4. Improvement rates (when applicable)
5. Additional data compiled by faculty

1. Course grade distribution; success and retention rates

The table at right shows summarized statistics for Machine Tool Technology (MTT) and Manufacturing Technology (MTEC) in comparison with the Industry and Technology "Division," and the "College" at large. The table is an average of fall semester's grade distributions during years 2006 through 2009 (inclusive).

	MTT	MTEC	DIVISION	COLLEGE
"A"	31%	50%	28%	25%
"B"	26%	19%	20%	18%
"C"	10%	4%	11%	13%
CREDIT	3%	1%	14%	7%
"D"	0%	1%	3%	4%
"F"	10%	4%	8%	8%
Success	71%	71%	73%	64%
Retention	81%	75%	85%	79%

Moving from left column to right, the table demonstrates that, in general, MTT grade distribution, student success and retention rates are consistent with the Industry & Technology (I&T) division and the college. That said, we note that the I&T division has about three percent higher incidence of "A" and "B" grades than the college and MTT has another three percent higher incidence than the division. MTT and Manufacturing also have less "C", "D", and credit grades as a percentage than both the division and the college. We believe that this is to be expected in machine tool technology classes because students must perform well in the class in order not to constitute a safety hazard in class or require excessive instructor supervision.

Of special interest is the abnormally high incidence of "A" grades in Manufacturing. The manufacturing program is a new program which essentially began in 2006. Two manufacturing classes were offered during the years 2006 through 2009: Manufacturing Technology 70 (MTEC70—a basic robotics class), which was offered during the fall of each year, and Manufacturing Technology 75A (MT75A—an integrated robotic and automation class), which was offered in the last two of the four semesters studied. The factors contributing to the variances can be explained as follows.

- ✓ MTEC70 was attended by both high school and college students. As a result, the curriculum requirements and grading rubric were adjusted accordingly. A

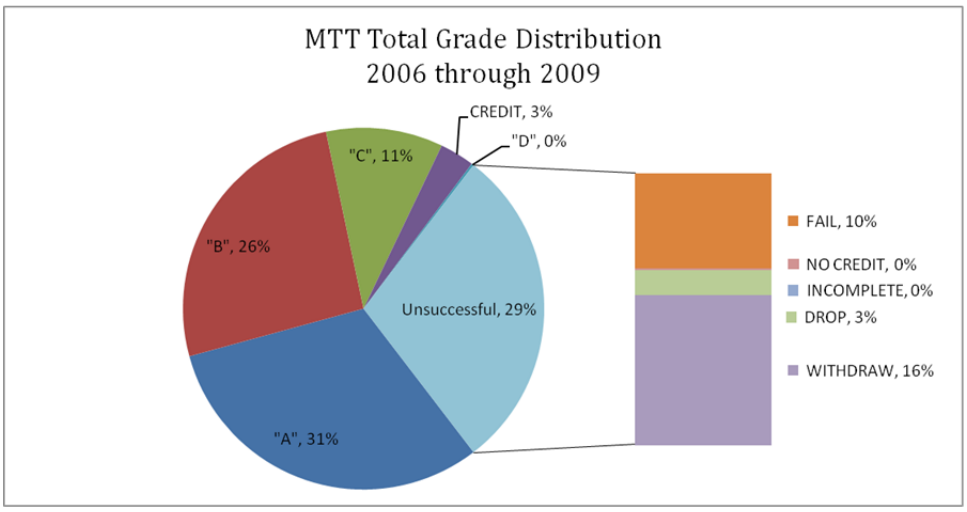
chronological review of the incidence "A" grades, as in the table at right, reveals a correction taking place as instructors assessed and adjusted their student performance expectations. In actuality, the percentage of "A" grades in MTEC70 were: 2006 – 63%, 2007 – 41%, 2008 – 32%, and in 2009 – 37%.

Grades	"A"	"B"	"C"	CREDIT
2006	63%	6%	3%	0%
2007	41%	19%	6%	0%
2008	50%	29%	2%	2%
2009	46%	20%	3%	0%
Total	50%	19%	4%	1%

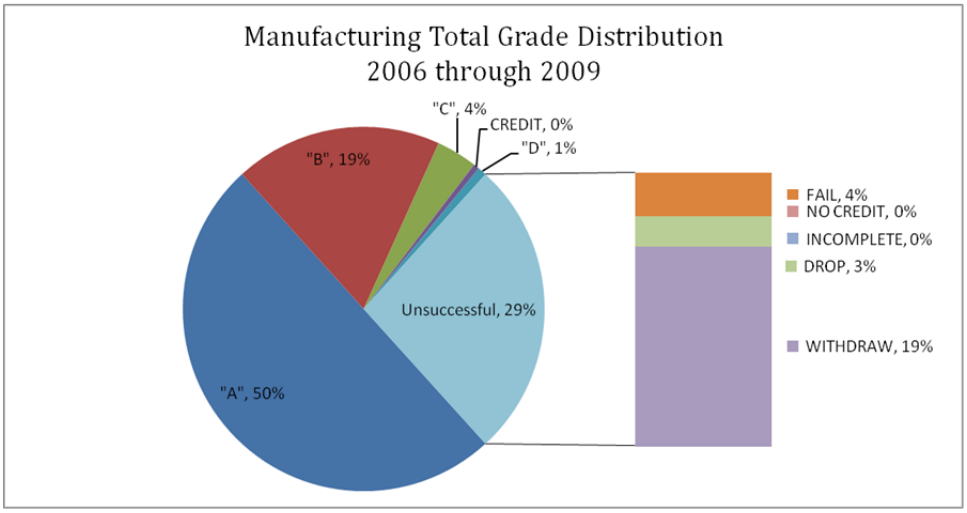
- ✓ MTEC70 was attended by students who have exceptional abilities in the science, technology, engineering, and math (STEM) programs, Journey-level machinists who were interested in automating their shops, a number of degreed professionals who were very interested in robotics, and robotics enthusiasts from the Los Angeles Robotics Club.
- ✓ MT75A was offered in 2008 and 2009. The relative increase in the incidence of "A" grades in 2008 and 2009 is a result of adding this class. This class echoes a similar learning curve as was observed in MTEC70 above.
- ✓ The manufacturing program is new. This program is taught by part-time faculty and as a result does not reflect the rubric and grading consistency of the established MTT program.

Although these classes have been attended by truly remarkable students, we expect that the variances will settle out as the program matures.

The Total Grade Distribution charts that follow below provide a visual four-year summary grade distribution and success rate for Machine Tool and Manufacturing Technologies. The chart also shows that MTT has a 71 percent average success rate (29 percent unsuccessful) over the 2006–9 year period. Success rates for all MTT courses for each individual year were 62, 74, 73, and 69 percent, during the 2006–9 year period, respectively. The retention rate for MTT courses is about one percent higher than the college. We believe a higher success and

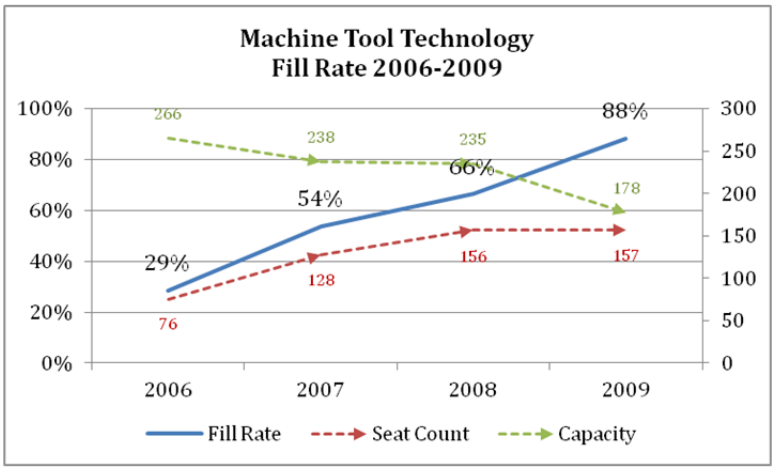


retention rate to be reflective of student motivation. The Manufacturing Total Grade Distribution chart at right provides an at a glance summary of the 2006 – 2009 period. Success rates in Manufacturing were almost identical to those experienced in Machine Tool Technology.



The actual course grade distribution and success and retention rate data can be found in Appendix 1 at the end of this report.

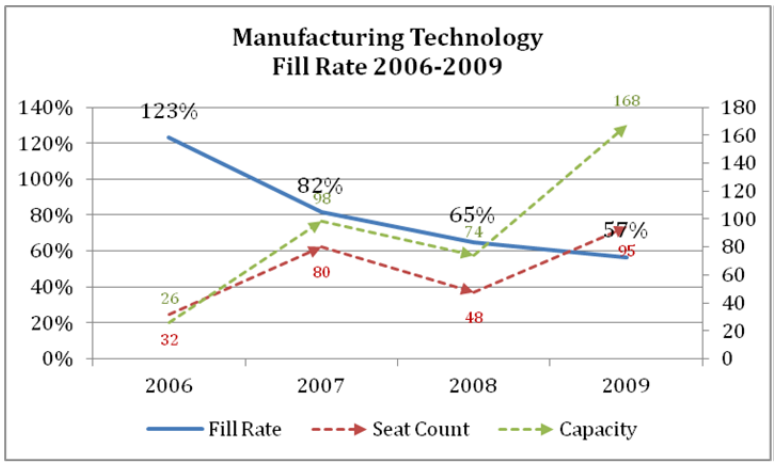
2. *Enrollment Statistics with section and seat counts and fill rates.*



The two Fill Rate charts are for Machine Tool Technology, at right, and Manufacturing Technology, on the following page. The Fill Rate is shown as a solid blue line. The fill rate is a percent ratio between the number of seats taken, seat count, expressed as in dotted red line divided by the capacity, shown as a dotted green line.

Machine Tool Technology is an established program. Seat count and capacity are fairly predictable and, as a result, easier to forecast. Capacity and fill rate are converging to produce higher fill rates.

Manufacturing Technology is a relatively new program. Variances are expected. Capacity in 2006 was not sufficient to handle demand. Adjustments were made in subsequent years; however, capacity adjustment exceeded seat count and fill rate decreased from 123 percent in 2006 to 57 percent in 2009.



3. Scheduling of courses (day vs. night, days offered, and sequence)

Although the data in the Time of Classes table (below) shows that the Manufacturing courses have shifted from evening to daytime, it should reflect that the Manufacturing courses were offered in the daytime on Saturday. This scheduling better fit

Time of Classes		2006		2007		2008		2009		ECC	
MTT	Daytime	29	27%	23	21%	32	26%	45	35%	19,337	71%
	Evening	71	67%	82	73%	87	72%	82	64%	5,084	19%
	Unknown	0	0%	0	0%	0	0%	1	1%	2,850	11%
MANU	Daytime	5	16%	55	69%	41	85%	97	86%	19,337	71%
	Evening	27	84%	25	31%	7	15%	16	14%	5,084	19%
	Unknown	0	0%	0	0%	0	0%	0	0%	2,850	11%

the community's need. were offered primarily at night. High school students attending these course have evening obligations for homework, family, and jobs. Saturday offering provided a "best fit" for daytime workers, high school students, and robotics enthusiasts.

4. Improvement rates (when applicable)

According to the Bureau of Labor Statistics, the number of machinist positions is decreasing in the United States. However, if one considers age demographics, there are a number of very positive developments especially if one considers employment internationally. A large segment of the machinist work force is reaching retirement age. They will need to be replaced. Many machinist positions are being replaced through automation. New machinists who are equipped to enter the computer numerical control (CNC) design and fabrication will be in high demand and will be able to demand higher wages. See chapter IX for additional demand information.

5. Additional data compiled by faculty

Aerospace and high technology companies make up a large segment of the local economy here in the South Bay and Torrance area. As they see increasing standards of life in supplier countries, they also see increasing manufacturing costs. Oil and shipping cost are

increasing as well. Increasing fuel and import costs bode well for our local economy. Consequently, we can predict with certainty that local manufacturing will be on the rise.

As a result, El Camino's effort to combine engineering, design, automation, and machining is appropriate and timely.

Internationally, it may not be feasible for one to migrate to Asia to find employment. However, South American countries such as Brazil demand welders and machinists to satisfy a need for those involved in design and fabrication. Brazil has become an oil rich supplier and exporter of raw materials to Asia. Brazil is heavily involved in building infrastructure to support this trade.

List related recommendations (when applicable)

Program Integration:

Continued integration of the Machine Tool, Manufacturing, and Engineering Technology programs continues to produce benefits in terms of cost, facility improvement, and student preparedness. Students who are prepared in multiple aspects of this trade are better prepared and better able to compete in this market.

Entrepreneurship Programs:

El Camino College prepares students for employment and to continue their course of study at a university. There is a segment of the students who may be better prepared to bid on piece or contract work. In the present economy, contract piece work maybe a viable alternative both for businesses who are unable to justify a full-time employee and for the entrepreneurial graduate. The college does sponsor incubator programs. It may be time to combine some aspects of these programs to better prepare graduates to enter the small business market place on their own.

III. CURRICULUM

All courses offered in Machine Tool and Manufacturing Technology have been reviewed within the last 5 years. Three years ago, four classes were combined and reduced to two classes. The conventional lathe and CNC lathe classes were combined into one Conventional and CNC turning. Similarly, the conventional milling class and the CNC milling class were combined into one Conventional and CNC Milling class. This reduced the program requirement by six units. This combination is appropriate for the industry as it too is moving toward CNC programming and automation.

The curriculum for the prerequisite Introduction to Conventional and CNC Machining class was reviewed, updated, and rewritten.

One class was renamed "Advanced Process" to focus and use newer advanced technology equipment and processes.

A mini certificate was approved by the state and added to the program. A student can earn a mini certificate by completing four machine tool classes (MTT101abcd, MTT103abcd, MTT105abcd, and MTT107abcd).

The present economic climate has curtailed present program growth. No new classes are anticipated. Budget tightening has resulted in class cancellations. MTT 16 ab, a summer school class, has not been given for two consecutive summers. MTT 16ab is a required program course. The absence of MTT 16ab may adversely affect machine tool program certificate and degree completion. As a result of this concern, MTT 16 ab will be offered during the spring semester of 2012.

IV. STUDENT LEARNING OUTCOMES (SLO)

The Student Learning Outcomes (SLOs) for each class in the program follow.

MTT 2

The student will be able to correctly sketch a part in orthographic orientation.

MTT 10A

The student will be able to calculate the correct rotations per minute (RPM) for a high-speed steel end mill using the correct cutting speed and end mill diameter.

MTT 10B

The student will be able to input a program in to a Computer Numerical Control (CNC) machine.

MTT 10J

The student will be able to create geometric elements such as points, lines, and circles.

MTT 10K

The student will be able to correctly create a 3D solid model in CAD software and practice roughing the 3D surface using CAM software.

MTT 16ab

The student will be able to calculate the correct rotations per minute (rpm) for a high-speed steel end mill using the correct cutting speed and end mill diameter.

MTT 40

The student will be able to calculate the correct feed per minute for a high speed steel (HSS) end mill using the correct feed per tooth (CL), rotations per minute (RPM), and number of teeth.

MTT46

The student will be able to calculate the correct rotations per minute (rpm) for a high speed steel end mill using the correct cutting speed and end mill diameter. The student will be able to demonstrate setting the speed of the milling machine.

MTT 47abcd

The student will be able to calculate the correct rotations per minute (rpm) for a high speed steel end mill using the correct cutting speed and end mill diameter. Then the student will demonstrate setting the speed of the milling machine.

MTT 101abcd

Given a ground steel block of known and verified dimensions, the student will be able to measure and record the three dimensions of the block using a micrometer to a precision of 0.001 inches.

MTT 103abcd

The students will be able to turn a part on the lathe to a given drawing dimension to an accuracy of +/- 0.001 inches.

MTT 105abcd

Given a rough-cut aluminum block, square the block using a milling machine, cutters and measurement tools.

MTT 107abcd

Record the benefits and costs of cutting with the following processes: Water jet, EDM wire, Plasma and laser.

The Machine Tool and Manufacturing Technology programs are scheduled to be reviewed on a two-year cycle. This document fulfills the review requirement for 2010-2011. Beginning in 2012, program reviews will begin in spring and be completed in fall to keep them consistent with the college planning and budgeting cycle.

As of September 14, 2011, the status of Industry and Technology Division Student Learning Outcomes (SLOs) and course assessment are as follows.

Total Courses	Courses with an SLO	Percent Courses with an SLO	Courses Assessed	Percent Courses Assessed	Projected Spring 2011 Course Assessments	Projected TOTAL Courses Assessed by the 3rd Week of Fall 2011
242	238	98%	74	31%	38	41%

As of September 14, 2011, the status of Machine Tool and Manufacturing Technology assessments and 4-year timelines were reported “as needed” (past due). An excerpt from the report follows.

SLOs for each course were completed and submitted but need to be clarified. Many of the SLOs are duplicated in several classes. Future efforts should result in separate SLOs for each course. A failure to write a specific and distinct SLO(s) for each class may lead to an incorrect assumption that one need not take subsequent courses because the SLO has been satisfied.

Division	Program	Sub-Programs	Statement Needed	Assessment Needed	4-Year Timeline Needed	Comments
Industry & Technology	Machine Tool Technology			X	X	Report due by 3/01/11
Industry & Technology	Manufacturing Technology			X	X	Report due by 3/01/11

V. PROGRAM REVIEW & SLO ASSESSMENT SCHEDULE

Fall 2011: MTT 46, MTT101abcd

Spring 2012: MTT 2, MTT 99abc

Fall 2012: MTT 10A, MTT103abcd

Spring 2013: MTT 10B, MTT105abcd

Fall 2013: MTT 10J, MTT107abcd

Spring 2014: MTT 10K, MTT 16ab

Fall 2014: MTT 11abcd

Spring 2015: MTT 40

Fall 2015: MTT47abcd

2016: Next Program Review due

Spring 2016: MTT 48abcd

Fall 2016: MTT 50

Spring2017: MTT 95abcd

VI. FACILITIES, EQUIPMENT, AND TECHNOLOGY

Facilities, equipment and technology are adequate. A complete listing of lab equipment can be found in Appendix 3. The Math and Computer Science building is scheduled for remodeling next year. The remodeling is anticipated to take one year.

The lab is well equipped. The manufacture date of current equipment (milling and lathe machines) ranges from 1941 to modern present day. Older machines have reduced capacity and students have difficulty keeping cuts within tolerance. Engine lathes and surface grinders were installed prior to 1980. A prioritized list of equipment upgrades and replacements and anticipated costs is included in Appendix 3.

Technology is advancing. Long established manufacturers stay competitive by regularly upgrading equipment and developing new cost efficient production methods. As a result, industry outwardly seeks those best trained and equipped to exploit new methods and fabrication techniques. Our long-range purchasing and equipment replacement plans should keep up with new equipment and these improved techniques and processes.

The current industry trend is toward automation and robotics. Many fear that automated systems and robotics are replacing people and in effect jobs. Automated systems, the argument goes, work tirelessly twenty-four hours a day seven days a week. From this aspect, industry seems focused on production. In reality though, industry carefully considered their existing labor capability and the competitive marketplace long before purchasing the latest new technology machine.

Even the most advanced CNC turning and milling centers, need well trained engineers, programmers, and technicians to program them and support operation. Experienced machinists and CNC specialists advise us as educators to focus on the “old school” fundamentals because, they say, programming and automation just make errors bigger. It may be easier to relate this concept to our own experiences with office automation. For example, a sentence can be meaningless but, grammatically correct. We can use a computer to automate the output of meaningless sentences with a word processor, high-speed printer, and state-of-the art distribution system, but the sentences remain meaningless. The ability to write a meaningful sentence the conventional way remains a prerequisite to automation.

Haas Corporation is a large local producer of CNC machines. Hass invests considerable time and money educating its employees in metallurgy and machining processes. They do so because they know their customers (our student’s employers) will put function before form and quality before quantity.

Consequently, we have to consider facilities, equipment, and technology in terms of advancing technology, but at the same time we need to impart fundamentals.

Conventional machines play an important role in demonstrating how to work metal and control tolerances. Automated machinery does not give the same appreciation and "feel" of the work piece—the heat and pressure applied. It is said by the old school tool and die maker that accuracy is made by machinist, not by the machine. Newer automated machines enclose the work behind housings and essentially leave the beginning student outside the cutting area. It is important that new students receive a strong fundamental foundation on which they can add the automation, programming, and robotics "tools" to improve quality and output.

VII. STAFFING

Machine Tool and Manufacturing Technology Staff

Full-Time:

Eric Carlson
Harold (Ed) Hofmann

Part-Time:

Victor de la Torre
Matt Griffin
Ed Lugo

Program/department's current needs

MTT has had to reduce classes. As a result, student's need to attend both day and evening classes in order to finish the program. In some cases, students can not take all the required courses and graduation is delayed until classes are provided. Current students cannot complete the requirements for the MTT Certificate and A.S. Degree in the advertised timeframe.

If additional class cancellations are required, the MasterCAM programming classes may have to be cut. The advanced CAD/CAM classes are requested by the local manufacturing companies. They are very popular classes and students attend these classes to improve job skills. Currently, the MasterCAM (MTT 10J and MTT 10K) classes are required for the Programmer's option.

If the advanced CAD/CAM classes are eliminated the Programmer's option could not be completed as structured. The elimination of this option would severely impact machinists that desire enhance their skills and enter CNC programming careers.

VIII. DIRECTION AND VISION

Over the next four years there will be significant technical advancements in technology and process. We will be designing and making products faster, lighter, stronger, and processes will be streamlined. These technological advancements will affect the programs we teach, the processes we use, and the equipment we maintain.

Our vision of the future should consider:

1. Current budget and funding limitations.
2. Provide a foundation in conventional machine operations.
3. Prepare students for CNC machines.
4. Maintain a high quality training program.
5. Further integration of design, fabrication, and process improvement
6. Expand the curriculum to improve program-related verbal and written communication

Classes offered in this program are often sequential. One class cut from the program can delay student progress substantially.

At present, the machine tool program is without a tool crib attendant. We do have a lab technician; however, one person is not adequate to support the program. In this situation, it becomes too easy to postpone maintenance and repairs to address immediate classroom tool allocation needs. The number of part-time instructors has been reduced. As classes are combined, student teacher ratios are exceeded. Beginning students could benefit from additional supervision in the lab.

A good foundation in conventional machining provides opportunities to learn RPM calculations, feed calculations, depth of cut, type of cutting tool, position of cutting tool, sharpness of tool, and work holding.

The integration of Engineering Technology, Computer Aided Design (CAD), Computer Numeric Control (CNC) programming, provide a state-of-the- art realistic working environment for students. CNC programming will become a part of every design and fabrication process. Our program will prepare our students to work proficiently in the majority of situations they will encounter in the work place whether it is a one person shop or a large industrial fabrication shop. They will be able to design and understand plans, fabricate and improve quality parts, and be able to express their ideas in a manner consistent with the industry.

IX. PRIORITIZED RECOMMENDATIONS

Machine Tool and Manufacturing Technology

Priority #	Description	Units	Unit Cost	Estimate	Rate/Yr.
1	Replace 14 conventional lathes with 7 new CNC lathes and 7 new conventional lathes.	14	30,000	$420,000	NA
2	Replace 7 conventional vertical milling machines with 7 new conventional vertical milling machines.	14	30,000	$420,000	NA
3	Purchase 35 laptop computers for the MTT classes held in MCS 4 and 5. These are to be used for the lecture classes. Can also be used for the MT and ETECH classes.	35	1,200	$42,000	NA
4	Replace 16 computers in MCS 1A and other rooms with new computers and 21 inch flat screens monitors.	16	1,000	$16,000	NA
5	Replace all 5 surface grinding machines with 5 new up-to-date surface grinding machines.	5	18,000	$90,000	NA
6	Add 2 horizontal CNC milling centers (machines).	2	150,000	$300,000	NA
7	Replace the OD-ID grinder with a new OD-ID grinder.	1	125,000	$125,000	NA
8	Purchase consumable powders and binder for the Z-Corp RP machine. Cost is $430.0 per bucket of powder and $525.00 per gallon of binder.	1	1,000	$1,000	1/yr
9	Purchase consumable plastic and foam for the Dimension RP machine. Cost is $250.00 per cartridge and $14.00 per foam piece.	4	264	$1,056	4/yr
10	Add 3 new wire EDM machines. (new means new, not used)	3	300,000	$900,000	NA
11	Add 2 new (real) water jet machines.	2	100,000	$200,000	NA
12	Add more rapid proto-typing capability with z-corp, dimension and 3D printer machines. SLS and SLA rapid prototypers.	1	250,000	$250,000	NA
13	Add a center-less grinder.	1	150,000	$150,000	NA
14	Add laser cutting capability to existing CNC machine.	1	25,000	$25,000	NA
15	Add 3 more work cells (CNC machines with robots)	3	250,000	$750,000	NA
16	Add a 6-axis CNC tool and cutter grinder.	1	250,000	$250,000	NA

X. CTE PROGRAM REVIEW SUPPLEMENTARY QUESTIONS & ANSWERS

In the paragraphs that follow we used labor market data, advisory board input, and institutional data to respond to the following questions:

1. *How strong is the occupational demand for the program? How has the demand changed in the past 5 years and what is the outlook for the next 5 years?*
2. *What is the district's need for the program?*
3. *What is the state's need for the program?*
4. *How does the program address needs that are not met by other similar programs in the area?*
5. *Are the students satisfied with their preparation for employment? Are the employers in the field satisfied with the level of preparation of our graduates?*
6. *What are the completion success and employment rates for the students?*
7. *What impact does the advisory board have on the program?*

The occupational demand machine tool and manufacturing programs are strong and growing. El Camino College has an excellent program. The demand for the program has grown over the last five years and is expected to continue to grow over the next five years.

The Bureau of Labor Statistics Occupational Outlook Handbook (2010-11 Edition) projects the number of machinist positions to decline by five percent over the 2008–2018 decade. The decline is due in part to increasing efficiency of machinists brought about by advances in CNC machine tools and automated processes. Because the BLS estimates the number of machinists retiring or leaving the workforce to exceed the number of entrants, job opportunities for machinists continues to be good. Technology advances are not anticipated to affect machinist employment because they maintain their own automated systems and have a wide range of skills. California has the highest number of job opportunities in the nation. Machinist positions are expected to comprise 2.29 out of every 1,000 jobs in Los Angeles-Long Beach-Glendale and almost 4 out of every one thousand jobs offered in the Santa Ana-Anaheim-Irvine Metropolitan Area. The middle 50 percent of machinists earned between $13.66 and $21.85 with the median wage of $17.41 per hour.

The California State University engineering programs at Long Beach, Los Angeles and Northridge have limited machine tool and robotics equipment for students. Santa Monica and Harbor Colleges do not offer MTT or MTEC programs. Long Beach City College eliminated their machine tool program about three years ago. Currently Long Beach City College offers a limited mechanical maintenance program. Cerritos College machine tool program is well equipped. As a result of Long Beach City College closing their program altogether and limited laboratory capacity at local California State University programs,

demand has increased. Many CSU students are advised to supplement their education with MT and MTEC classes at Cerritos or El Camino Colleges.

Advisory committees play an important role in continuing to shape the MTT program. At the most recent engineering, machine tool, and manufacturing technology advisory meetings, Andy Roberts from Northrup Grumman in Redondo Beach, reported that the machinist training was good preparation for engineers and that we should expect educational needs to continue through an employee's typical 15-year career at Northrup Grumman. Don McKinzie, also from Northrup Grumman, stressed that we should augment our MTT and MTEC programs with office and communication skills. He was also concerned that the high schools no longer have vocational technology programs as a part of their curriculum.

Beyond advisory group participation local employers are very supportive of El Camino College MTT and MTEC programs. We have received grants and equipment from many employers. Successful El Camino Alumni have gone on to employ many of our students. David Lawson of Alcoa Aluminum is one such alumnus.

Seventy one percent of students complete their classes. Students in general seem happy with the program. Students are motivated. The introduction of a mini-certificate of achievement has encouraged students to continue with the program and helps students verify their qualification for employment.

Currently, government officials, economists, and industry leaders seem to have aligned and focused on industry and manufacturing as a sustainable solution to the problem of unemployment and a stalled national economy.

As a result of:

- High schools not offering vocational training,
- Local universities limited laboratory capacity,
- Local community colleges discontinuing their machine tool programs,
- Local industry's need for preparatory and continuing education,
- State and national need to replace machinists and related trade personnel,
- Rising international costs make local manufacturing more competitive, and a
- National desire to build a local sustainable manufacturing sector,

We expect that our engineering, machine, and manufacturing programs will continue to grow and remain very strong over the next five years.

APPENDIX 1

2006 – 2009 Course grade distributions

2006 – 2009 Success and retention rates

Machine Tool Technology
Fall 2006

Course	A	B	C	CR	D	F	I	NC	DR	W	Total Grades	Success Rate	Retention Rate
MTT-10J	9	6	3	0	0	5	0	0	0	1	24	75%	96%
	38%	25%	13%	0%	0%	21%	0%	0%	0%	4%			
MTT-11ABCD	3	1	1	0	0	4	0	0	0	0	9	56%	100%
	33%	11%	11%	0%	0%	44%	0%	0%	0%	0%			
MTT-13A	3	6	3	0	0	0	0	0	0	12	24	50%	50%
	13%	25%	13%	0%	0%	0%	0%	0%	0%	50%			
MTT-13B	3	2	0	0	0	0	0	0	0	0	5	100%	100%
	60%	40%	0%	0%	0%	0%	0%	0%	0%	0%			
MTT-46	0	3	0	0	0	0	0	0	0	7	10	30%	30%
	0%	30%	0%	0%	0%	0%	0%	0%	0%	70%			
MTT-47ABCD	0	0	0	3	0	0	0	0	0	0	3	100%	100%
	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%			
MTT-95ABCD	1	0	0	0	0	0	0	0	0	0	1	100%	100%
	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
Course Totals	19	18	7	3	0	9	0	0	0	20	76	62%	74%
	25%	24%	9%	4%	0%	12%	0%	0%	0%	26%			
Division Total/Avg.	1,392	1,060	609	576	159	328	25	37	0	876	5,062	72%	83%
	28%	21%	12%	11%	3%	7%	1%	1%	0%	17%			
College Total/Avg.	15,458	11,582	8,382	4,421	2,809	4,891	345	1,318	0	14,220	63,426	63%	78%
	24%	18%	13%	7%	4%	8%	1%	2%	0%	22%			

Machine Tool & Manufacturing Technology Programs

Machine Tool Technology
Fall 2007

Course	A	B	C	CR	D	F	I	NC	DR	W	Total Grades	Success Rate	Retention Rate
MTT-101ABCD	8	4	2	0	1	2	0	0	0	9	26	54%	65%
	31%	15%	8%	0%	4%	8%	0%	0%	0%	35%			
MTT-103ABCD	5	6	3	2	0	1	0	0	1	0	18	89%	94%
	28%	33%	17%	11%	0%	6%	0%	0%	6%	0%			
MTT-105ABCD	2	2	1	0	0	0	0	0	0	0	5	100%	100%
	40%	40%	20%	0%	0%	0%	0%	0%	0%	0%			
MTT-10A	7	6	4	0	0	4	0	0	0	1	22	77%	96%
	32%	27%	18%	0%	0%	18%	0%	0%	0%	5%			
MTT-10J	7	7	2	0	0	3	0	0	0	1	20	80%	95%
	35%	35%	10%	0%	0%	15%	0%	0%	0%	5%			
MTT-11ABCD	5	1	0	0	0	0	0	0	0	0	6	100%	100%
	83%	17%	0%	0%	0%	0%	0%	0%	0%	0%			
MTT-46	13	1	0	0	0	1	0	0	1	7	23	61%	65%
	57%	4%	0%	0%	0%	4%	0%	0%	4%	30%			
MTT-47ABCD	0	0	0	7	0	0	0	0	0	0	7	100%	100%
	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%			
MTT-48ABCD	0	0	0	0	0	0	0	1	0	0	1	0%	100%
	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%			
Course Totals	47	27	12	9	1	11	0	1	2	18	128	74%	84%
	37%	21%	9%	7%	1%	9%	0%	1%	2%	14%			
Division Total/Avg.	1,521	1,081	610	551	159	379	32	37	154	711	5,235	72%	84%
	29%	21%	12%	11%	3%	7%	1%	1%	3%	14%			
College Total/Avg.	16,244	11,674	8,356	4,788	2,743	5,030	360	1,322	2,566	12,270	65,353	63%	77%
	25%	18%	13%	7%	4%	8%	1%	2%	4%	19%			

Machine Tool Technology
Fall 2008

Course	A	B	C	P	D	F	I	NP	DR	W	Total Grades	Success Rate	Retention Rate
MTT-101ABCD	7	5	2	0	0	0	0	0	5	7	26	54%	54%
	27%	19%	8%	0%	0%	0%	0%	0%	19%	27%			
MTT-103ABCD	5	3	1	0	0	1	0	0	2	1	13	69%	77%
	39%	23%	8%	0%	0%	8%	0%	0%	15%	8%			
MTT-107ABCD	5	5	1	0	0	0	0	0	1	1	13	85%	85%
	39%	39%	8%	0%	0%	0%	0%	0%	8%	8%			
MTT-10B	5	9	3	0	0	3	0	0	0	0	20	85%	100%
	25%	45%	15%	0%	0%	15%	0%	0%	0%	0%			
MTT-10J	6	5	3	0	0	8	0	0	0	2	24	58%	92%
	25%	21%	13%	0%	0%	33%	0%	0%	0%	8%			
MTT-11ABCD	4	3	0	0	0	0	0	0	0	0	7	100%	100%
	57%	43%	0%	0%	0%	0%	0%	0%	0%	0%			
MTT-40	11	3	2	0	0	2	0	0	0	1	19	84%	95%
	58%	16%	11%	0%	0%	11%	0%	0%	0%	5%			
MTT-46	15	8	0	0	0	1	0	0	0	7	31	74%	77%
	48%	26%	0%	0%	0%	3%	0%	0%	0%	23%			
MTT-47ABCD	0	0	0	2	0	0	0	0	0	0	2	100%	100%
	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%			
MTT-48ABCD	0	0	0	1	0	0	0	0	0	0	1	100%	100%
	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%			
Course Totals	58	41	12	3	0	15	0	0	8	19	156	73%	83%
	37%	26%	8%	2%	0%	10%	0%	0%	5%	12%			
Division Total/Avg	1,616	1,306	675	1,252	161	561	43	84	170	680	6,548	74%	87%
	25%	20%	10%	19%	3%	9%	1%	1%	3%	10%			
College Total/Avg	18,319	12,726	9,310	5,700	3,176	6,871	461	1,814	3,085	10,741	72,203	64%	81%
	25%	18%	13%	8%	4%	10%	1%	3%	4%	15%			

Machine Tool & Manufacturing Technology Programs

Machine Tool Technology
Fall 2009

Course	A	B	C	P	D	F	I	NP	DR	W	Total Grades	Success Rate	Retention Rate
MTT-101ABCD	7	22	6	0	0	6	0	0	2	8	51	69%	80%
	14%	43%	12%	0%	0%	12%	0%	0%	4%	16%			
MTT-105ABCD	11	5	2	0	0	3	0	0	0	2	23	78%	91%
	48%	22%	9%	0%	0%	13%	0%	0%	0%	9%			
MTT-107ABCD	3	3	0	0	0	0	0	0	0	4	10	60%	60%
	30%	30%	0%	0%	0%	0%	0%	0%	0%	40%			
MTT-10A	3	2	6	0	0	4	0	0	2	5	22	50%	68%
	14%	9%	27%	0%	0%	18%	0%	0%	9%	23%			
MTT-10J	2	12	9	0	0	1	0	0	0	4	28	82%	86%
	7%	43%	32%	0%	0%	4%	0%	0%	0%	14%			
MTT-46	11	4	0	0	0	4	0	0	0	3	22	68%	86%
	50%	18%	0%	0%	0%	18%	0%	0%	0%	14%			
MTT-47ABCD	0	0	0	1	0	0	0	0	0	0	1	100%	100%
	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%			
Course Totals	37	48	23	1	0	18	0	0	4	26	157	69%	81%
	24%	31%	15%	1%	0%	12%	0%	0%	3%	17%			
Division Total/Avg	1,761	1,199	634	814	168	508	28	48	148	598	5,906	75%	87%
	30%	20%	11%	14%	3%	9%	1%	1%	3%	10%			
College Total/Avg	18,808	13,245	9,880	5,269	3,201	5,941	388	1,538	3,042	9,914	71,226	66%	82%
	26%	19%	14%	7%	5%	8%	1%	2%	4%	14%			

APPENDIX 2

Demographic and Enrollment Characteristics
Machine Tool Technology
Fall 2006 to Fall 2009

Characteristic	Category	Fall 2006		Fall 2007		Fall 2008		Fall 2009		ECC		ECC District	
		n	%	n	%	n	%	n	%	n	%	n	%
All Enrolled	Total	106	100%	112	100%	121	100%	128	100%	*27,271*	100%	520,376	100%
Gender	Female	9	9%	9	8%	4	3%	6	5%	14,312	53%	264,871	51%
	Male	97	92%	103	92%	117	97%	122	95%	12,953	48%	255,505	49%
	Unknown	0	0%	0	0%	0	0%	0	0%	6	0%	0	0%
Ethnicity	African-American	7	7%	10	9%	8	7%	6	5%	4,577	17%	88,701	17%
	Amer. Ind. or Alaskan	1	1%	2	2%	1	1%	1	1%	100	0%	1,219	0%
	Asian	7	7%	12	11%	18	15%	19	15%	4,539	17%	58,779	11%
	Latino	50	47%	41	37%	43	36%	47	37%	9,466	35%	157,138	30%
	Pacific Islander	0	0%	0	0%	0	0%	2	2%	257	1%	2,061	0%
	White	34	32%	34	30%	32	26%	38	30%	5,236	19%	197,570	38%
	Unknown or Decline	7	7%	13	12%	19	16%	15	12%	3,096	11%	0	0%
Age/Age Group	Under 17	11	10%	10	9%	5	4%	0	0%	572	2%	139,140	27%
	17	6	6%	4	4%	7	6%	1	1%	758	3%		
	18	6	6%	5	5%	4	3%	3	2%	3,326	12%	11,840	2%
	19	5	5%	8	7%	6	5%	8	6%	3,678	14%		
	20	4	4%	2	2%	8	7%	9	7%	2,977	11%	5,996	1%
	21	6	6%	2	2%	8	7%	9	7%	2,305	9%	5,720	1%
	22	0	0%	3	3%	2	2%	8	6%	1,677	6%	20,233	4%
	23	3	3%	1	1%	3	3%	7	6%	1,347	5%		
	24	3	3%	7	6%	2	2%	4	3%	1,121	4%		
	25-29	11	10%	11	10%	22	18%	19	15%	3,398	13%	43,779	8%

Machine Tool & Manufacturing Technology Programs

Characteristic	Category	Fall 2006		Fall 2007		Fall 2008		Fall 2009		ECC		ECC District	
		n	%	n	%	n	%	n	%	n	%	n	%
Age/Age Group	30-39	12	11%	18	16%	18	15%	15	12%	2,896	11%	97,447	19%
	40-49	18	17%	22	20%	16	13%	18	14%	1,770	7%	80,126	15%
	50-64	19	18%	18	16%	18	15%	24	19%	1,195	4%	69,852	13%
	65+	2	2%	1	1%	2	2%	3	2%	251	1%	46,878	9%
Class Load	Full-time	9	9%	7	6%	8	7%	11	9%	8,560	31%		
	Part-time	91	86%	98	88%	111	92%	117	91%	18,675	69%		
	Not enrolled or N/A	6	6%	7	6%	2	2%	0	0%	36	0%		
Time of Classes*	Daytime	29	27%	23	21%	32	26%	45	35%	19,337	71%		
	Evening	71	67%	82	73%	87	72%	82	64%	5,084	19%		
	Unknown	0	0%	0	0%	0	0%	1	1%	2,850	11%		
Academic Level	College degree	23	22%	22	20%	27	22%	27	21%	3,680	14%		
	HS Graduate	55	52%	60	54%	63	52%	83	65%	21,533	79%		
	Not a HS Grad	4	4%	7	6%	8	7%	11	9%	582	2%		
	K-12 Special Admit	16	15%	13	12%	12	10%	1	1%	916	3%		
	Unknown	8	8%	10	9%	11	9%	6	5%	560	2%		
Educational Goal	Intend to Transfer	16	15%	19	17%	19	16%	16	13%	8,408	31%		
	Degree/Certif. Only	12	11%	12	11%	8	7%	10	8%	1,115	4%		
	Retrain/recertif.	12	11%	21	19%	24	20%	25	20%	1,719	6%		
	Basic Skills/GED	4	4%	7	6%	6	5%	3	2%	1,262	5%		
	Enrichment	9	9%	10	9%	10	8%	8	6%	985	4%		
	Undecided	36	34%	26	23%	30	25%	19	15%	6,136	23%		
	Unknown	17	16%	17	15%	24	20%	47	37%	7,646	28%		

Demographic and Enrollment Characteristics
Manufacturing Technology
Fall 2006 to Fall 2009

Characteristic	Category	Fall 2006		Fall 2007		Fall 2008		Fall 2009		Fall 2009 ECC		2000 Census ECC District	
		n	%	n	%	n	%	n	%	n	%	n	%
All Enrolled	Total	32	100%	80	100%	48	100%	113	100%	*27,271*	100%	520,376	100%
Gender	Female	8	25%	28	35%	15	31%	37	33%	14,312	53%	264,871	51%
	Male	24	75%	52	65%	33	69%	76	67%	12,953	48%	255,505	49%
	Unknown	0	0%	0	0%	0	0%	0	0%	6	0%	0	0%
Ethnicity	African-American	1	3%	21	26%	7	15%	23	20%	4,577	17%	88,701	17%
	Amer. Ind. or Alaskan	0	0%	0	0%	0	0%	0	0%	100	0%	1,219	0%
	Asian	9	28%	11	14%	16	33%	13	12%	4,539	17%	58,779	11%
	Latino	15	47%	16	20%	13	27%	62	55%	9,466	35%	157,138	30%
	Pacific Islander	0	0%	1	1%	0	0%	1	1%	257	1%	2,061	0%
	White	4	13%	16	20%	12	25%	6	5%	5,236	19%	197,570	38%
	Unknown or Decline	3	9%	15	19%	0	0%	3	3%	3,096	11%	0	0%
Age/Age Group	Under 17	23	72%	48	60%	33	69%	54	48%	572	2%	139,140	27%
	17	1	3%	21	26%	1	2%	21	19%	758	3%		
	18	1	3%	2	3%	0	0%	8	7%	3,326	12%	11,840	2%
	19	1	3%	3	4%	2	4%	5	4%	3,678	14%		
	20	0	0%	1	1%	2	4%	1	1%	2,977	11%	5,996	1%
	21	1	3%	0	0%	1	2%	3	3%	2,305	9%	5,720	1%
	22	1	3%	0	0%	0	0%	1	1%	1,677	6%	20,233	4%
	23	1	3%	0	0%	0	0%	3	3%	1,347	5%		
	24	0	0%	1	1%	1	2%	1	1%	1,121	4%		
	25-29	0	0%	0	0%	2	4%	4	4%	3,398	13%	43,779	8%

Machine Tool & Manufacturing Technology Programs

Characteristic	Category	Fall 2006		Fall 2007		Fall 2008		Fall 2009		ECC		ECC District	
		n	%	n	%	n	%	n	%	n	%	n	%
Age/Age Group	30-39	2	6%	1	1%	3	6%	3	3%	2,896	11%	97,447	19%
	40-49	1	3%	2	3%	2	4%	6	5%	1,770	7%	80,126	15%
	50-64	0	0%	1	1%	1	2%	3	3%	1,195	4%	69,852	13%
	65+	0	0%	0	0%	0	0%	0	0%	251	1%	46,878	9%
Class Load	Full-time	2	6%	1	1%	0	0%	1	1%	8,560	31%		
	Part-time	5	16%	3	4%	42	88%	64	57%	18,675	69%		
	Not enrolled or N/A	25	78%	76	95%	6	13%	48	43%	36	0%		
Time of Classes*	Daytime	5	16%	55	69%	41	85%	97	86%	19,337	71%		
	Evening	27	84%	25	31%	7	15%	16	14%	5,084	19%		
	Unknown	0	0%	0	0%	0	0%	0	0%	2,850	11%		
Academic Level	College degree	3	9%	3	4%	2	4%	9	8%	3,680	14%		
	HS Graduate	5	16%	5	6%	12	25%	26	23%	21,533	79%		
	Not a HS Grad	0	0%	0	0%	0	0%	0	0%	582	2%		
	K-12 Special Admit	23	72%	71	89%	34	71%	73	65%	916	3%		
	Unknown	1	3%	1	1%	0	0%	5	4%	560	2%		
Educational Goal	Intend to Transfer	4	13%	11	14%	5	10%	17	15%	8,408	31%		
	Degree/Certif. Only	0	0%	1	1%	1	2%	2	2%	1,115	4%		
	Retrain/recertif.	0	0%	2	3%	2	4%	5	4%	1,719	6%		
	Basic Skills/GED	3	9%	10	13%	10	21%	9	8%	1,262	5%		
	Enrichment	7	22%	9	11%	9	19%	6	5%	985	4%		
	Undecided	17	53%	46	58%	46	96%	58	51%	6,136	23%		
	Unknown	1	3%	1	1%	1	2%	16	14%	7,646	28%		

APPENDIX 3

Units	Equipment
10	Conventional engine lathes
6	Conventional vertical milling machines
1	Conventional horizontal milling machine
8	CNC hybrid Kent vertical milling machines
3	CNC FADAL vertical milling machines
1	Water Jet
2	CNC HAAS lathes
2	CNC HAAS vertical milling centers
3	Robotic arms, industrial size
1	Vertical bandsaw
1	Power hack saw
5	Surface grinders
1	OD-ID grinder
1	Tool and cutter grinder
3	Pedestal grinders
1	Sandblaster
1	Powder coating capability
3	Heat treat ovens and furnaces
3	Welding stations
4	Rapid prototyping machines
1	Wire EDM machine
1	Sinker EDM machine
1	CMM inspection machine
1	Inspection equipment
7	Simulators
8	Computers
1	Sheet router
1	25 watt laser printer
1	400 watt laser