Program Review

Automation, Robotics and Manufacturing

A combined effort of the Departments of:

Machine Tool Technology

Manufacturing Technology and

Engineering Technology

Conducted by: Eric Carlson

Fall, 2013

Overview of the Program

Provide a brief narrative description of the current program, including the program's mission statement and the students it serves. Describe the degrees and/or certificates offered by the program.

The Machine Tool Technology program was started in 1970 to support the Los Angeles South Bay area's machine shops and manufacturing base. At this time the Los Angeles area was still an epicenter of aerospace manufacturing. The Machine Tool Technology department has for ten years been evolving to better address the education of broader manufacturing beyond the traditional "machine shop" to higher technology. The Manufacturing Technology program was started 1989 to address the needs of local manufacturing and a diversified multi-discipline workforce. The Manufacturing Technology department was retooled in 2003 to attract younger students with the addition of robotics classes while maintaining its ability to offer a broad manufacturing and technology degree. Finally, the Engineering Technology was a recent addition in 2006 for a broad, collaborative effort to offer students a degree based on the national Project Lead the Way (PLTW) organization's curriculum.

Currently the program is in a consolidation phase of combining the departments of Machine Tool, Manufacturing and Engineering Technologies into a single entity-an Automation, Robotics and Manufacturing (ARM) program. In short, for some time these three departments have been by natural need and evolution of technology drawn together by crossover of disciples and joint use of resources. Students of these previously distinctly different disciples now are seen to need many of the same fundamentals and yet a broader set of skills and experiences as demanded by employers. This evolution of technology and technology education is a continuous process with the only constants being to adapt, incorporate, and train students for the latest technologies- imparting comprehension in both fundamentals and applied specifics for productivity.

The ARM designation to label this combined effort is appropriate. The term "automation" refers to "hard" or dedicated automation which has long history in manufacturing of mass production of consumer goods from tubes of toothpaste to the latest models of cars. "Robotics" although a subset of automation, is experiencing exponential growth in development and application- it refers to "flexible" or even "intelligent" automation that is capable of many tasks. Robotics is increasingly taking on obvious human-like characteristics. These disciplines are here to stay and will continue to displace human labor as employment costs increase and technology becomes ever more affordable. These developments change to needs of labor- from mundane low skill operators to the need of high-tech researchers, designers, engineers, programmers, troubleshooters, and field technicians. Finally, the term "manufacturing" refers to the technological underpinnings of the individual processes and the overreaching systems management and economic explanation of why all this technology even exists. In short- manufacturing is the technology of the creation of wealth. We are required to support the community in these technologies to maintain our societal quality of life.

Students may earn an Associate of Science (A.S.) degree and/or a Certificate of Achievement in the Machine Tool, Manufacturing and Engineering Technology 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 skills, knowledge and abilities. It is not uncommon for experienced machinists, engineers, and technicians to take these classes. The degrees and certificates are an integral part of the mission statements of these combined programs.

Machine Tool Technology Mission Statement:

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.

Students earning an A.S. degree in Machine Tool Technology may choose between (or earn both) Machinist or Numerical Control Programmer options. The Machinist option requires 28 major centered units and the Numerical Control Programmer option requires 33 major centered units. Students may instead choose a certificate of achievement in Machine Tool Technology. Options include CNC Machine Operator (16 units), Machinist (28 units) or Numerical Control Programmer which requires 33 units.

Manufacturing Technology Mission Statement:

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.

Manufacturing Technology students can earn an A.S. degree and/or a Certificate of Achievement- both of these require 37 units.

Engineering Technology Mission Statement:

The engineering technology program prepares students for transfer to university engineering technology programs and for employment in technical fields. By completing the degree or certificate requirements, students acquire a foundation in the principles of engineering, engineering design, digital electronics, automated manufacturing, and the application of math and science in technical fields. Careers in engineering technology involve high level technical work in the creation, production, utilization, and distribution of industrial materials, products, and processes. Competencies will be

assessed regularly in accordance with skill standards established by the National Alliance for Pre-Engineering Programs.

Engineering Technology students can earn an A.S. degree with an Engineering Technician option consisting of 26-28 major center units or an Engineering Technology option requiring 30-33 major centered units. Students may instead earn Certificates of Achievement. The Certificates of Achievement also have Technician and Technology options with the same 26-28 or 30-33 unit requirements respectively.

There is not a unified ARM program mission statement or unified degree and certificate program at this time. These are under consideration for future application.

Explain how the program fulfills the college's mission and aligns with the strategic initiatives.

The following explains how the ARM program will fulfill the college's mission and aligns with the strategic initiatives.

El Camino College Mission Statement: El Camino offers quality, comprehensive educational programs and services to ensure the educational success of students from our diverse community.

The ARM program focuses on the offering of quality technology education. This offering is continuously evaluated to be comprehensive and up-to-date to direct success of our students in the fields of automation, robotics and manufacturing. The program acknowledges that our students come from diverse backgrounds with a spectrum of goals- it is our goal to lead them to a technology driven future.

Strategic Initiative A- Enhance teaching to support student learning using a variety of instructional methods and services.

The ARM program consists of classes which teach theory and applied technology using a variety of instructional methods and services such as discussions, simulations, lab work, and student research projects to support student learning.

Strategic Initiative B- Strengthen quality educational and support services to promote student success.

The ARM program continuously evaluates and updates its performance in the delivery of technology education which is constantly changing to maintain quality. It refers and recommends the support services available to students through on campus and community organizations to promote student success.

Strategic Initiative C- Foster a positive learning environment and sense of community and cooperation through an effective process of collaboration and collegial consultation.

The Automation Robotics and Manufacturing program foster a positive learning environment through empowering students with skill building. Few other programs show students their potential of

physically changing their environment for the better. Problem solving, and application of science and math principles are core to the technological approach of ARM courses.

The ARM program displays its sense of community by participating in events such as Career Day, Majors Fair, and Space Day. Furthermore faculty actively participate and sponsor student driven organizations such as the Robot club, SME club, and Women in Industry and Technology (WIT).

The faculty of the ARM program are diverse and teach in multiple departments. By this very nature it encourages cooperation and collaboration. With faculty drawing from Machine Tool Technology, Manufacturing Technology, Engineering Technology, Electronics and Computer Hardware Technology, and Computer Aided Design and Drafting, students are exposed to the various perspectives and interconnectivity of these disciplines. Additionally, long term collaborations between other departments such as Welding, Construction Technology, Architecture, and Automotive Technology departments are progressing with shared resources and technology.

Strategic Initiative D- Develop and enhance partnerships with schools, colleges, universities, businesses and community-based organizations to respond to the workforce training and economic development needs of the community.

The ARM program has had an excellent history in partnerships with local high schools. This is evident in the articulation agreements including those leveraging the very popular national PLTW curriculum. Furthermore, due to the PLTW organization implementing Gateway to Technology classes in the middle schools – students are shown a clear educational pathway up to college. Grant funded (Workforce Investment Board) classes specifically recruit high school students have been offered summers for four years straight and Career Advancement Academy (CAA) grant funded classes have been offered for over two years of regular semesters.

In light of the more recent years budget constraints and limited seat numbers for students, partnerships with colleges and universities have been investigated. Neighboring states like Arizona and Oregon with notable programs have been approached by the STEM liaison for matriculation agreements with progress.

Partnerships with businesses are an integral part of the ARM program. The industry advisory committee meets at least one a year to review current fundamental skill requirements, specific skill needs, and current salary data. This committee is well attended by representatives of Northrop Grumman, Boeing, SpaceX, Motoman Robotics, Haas Automation, as well as smaller local manufacturers and job shops that bring with them their passion for their business and emphasis in education for technology.

Strategic Initiative E- Improve processes, programs, and services through the effective use of assessment, program review, planning, and resource allocation.

The ARM program seeks to educate in technology. Much of this is broad technology fundamentals. The specifics and applications are changing and evolving daily. Therefore the program is

in a continuous state of technology assessment and update. Part of this process is program review and general planning and pursuit of grants and other funding sources to enable this evolution.

Strategic Initiative F- Support facility and technology improvements to meet the needs of students, employees, and the community.

The staff and faculty of the ARM program are continuously surveying the fields of automation and manufacturing technology and education for the future trends to support the needs of the students, employees, and the community. These needs are met through research, discussion, proposals and grant activities.

Strategic Initiative G- Promote processes and policies that move the College toward sustainable, environmentally sensitive practices.

Manufacturing has not had good history with sustainable environmental practices but this is rapidly changing. The ARM program has kept abreast of the newest developments in such practices as 3D printing, rapid prototyping and rapid manufacturing, powder metallurgy manufacturing and alternative energy generation and use. With these technologies and others students are shown that manufacturing does not require heavy environmental impact.

Discuss the status of recommendations from your previous program review.

Previous Machine Tool and Manufacturing Technology program review recommendations:

The previous Machine Tool Technology program review included only equipment in the prioritized recommendation section. This equipment totaled over $3,940,000 in cost. Given the transitional nature of available facilities and realistic funding opportunities, it is suggested that almost all of these recommendations be deleted or put on indefinite hold. The reader is referred to the 2011 MTT program review for further reference of this list. A much reduced current recommended equipment list is included in the prioritized recommendations of this program review.

From the 2011 MTT program review (under the Analysis of Institutional Research Data section, List Related Recommendations):

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.

This program integration is in play. This combined program review is a testament to the shared resources, planning, curriculum, facility, equipment, instructors and students that make the cross-pollination and collaboration a natural process for these increasing less-distinct and less-separable disciplines. This integration will continue and be aided by the remodeled Industry and Technology building (formerly MCS) with proximity. Furthermore related departments such as

CADD, Electronics and Computer Hardware Technology and Architecture housed in a common building will encourage further collaboration with other departments.

Also from the 2011 MTT program review:

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.

The 2011 MTT recommendation is not clear. It is currently suggested that students seek gainful employment or start a venture of their own. It is not practical for students to do contract on their own without starting a dedicated job shop requiring tens of thousands to hundreds of thousands of dollars capital investment. Conversations with Society of Manufacturing Engineers (SME) professional organization leadership have confirmed the consensus is that entrepreneurship is a great subject of growth for business and employment. This subject deserves careful consideration with issues of liability, proprietary technology nondisclosure agreements, partnerships with business entities, and the union- or at least common ground found between for profit and non-profit institutions. It is true that almost every giant company started as a very small company and innovation supports progress.

This summer El Camino College was contacted by Honda Motor Company's small business jet initiative. Honda was interested in partnering with El Camino to have students design and prototype protective transportation packaging of the jet interior components which must travel from Santa Barbara California to North Carolina for final assembly and installation. Although this specific opportunity was not possible due to scheduling, this is exactly the type of synergy between students, the ARM program, El Camino College, and business in presenting real world challenges to be solved and benefit all parties involved. This design challenge is the kind of tackled by the Engineering Technology 18 capstone course where teams of students identify opportunities, design products, prototype solutions, and present their proposals for peer review. Funding and resource plans are being made that this course can be soon offered to students at El Camino.

Previous Engineering Technology 2009 program review recommendations:

Improved marketing of the program with an annual estimated cost of $5K.

The ARM faculty markets the program in an ongoing effort utilizing a variety of methods. Classes are advertised on Craigslist as well as internet hyperlinks on manufacturing related sites. Faculty are active presenters at events such as Career Day, Majors Fairs, and Space Day. Faculty sponsors guide clubs like the Robotics and SME which introduce students to the program's offerings. For the fall semester of 2013 all sections were full. Additional sections are in

consideration and an added summer section of the MTT 101 "Introduction to Conventional and CNC Machining" has been requested.

Offer the full program of courses on a regular basis.

Since the recent budget crisis condition has improved, all courses are currently offered except MTT 16 and ETEC 18. MTT 16 cannot be offered due to the temporary lack of resources in the current "swing space"- as this course requires sheet metal, casting, and welding equipment that is stored in the MCS building undergoing a remodel. ETEC 18 is not a required course for completion of a degree or certification- but as a capstone course it offers the opportunity to show students the fruits of their labor and allows unique opportunities of collaboration with industry such as the previously mentioned dialogue with Honda. ETEC 18 may possibly be offered in the spring of 2014 depending on funding and resources.

Strengthen relationships with local feeder schools.

The ARM program continuously strives to build and strengthen relationships with local feeder schools. This effort has made great strides with shared PLTW curriculum adaptation at the high schools and the El Camino Engineering Tech PLTW based courses. With the networking of El Camino representatives- high school students are shown an educational career pathway where they can fill gaps in their knowledge, build on their accomplishments, and even earn dual credit. In addition it is made clear to students that Machine Tool Tech and Manufacturing Tech as well as other related programs offer career education opportunities that are not offered anywhere else.

Strengthen relationships with local industry.

The ARM program's work to strengthen relationships with local industry is another continuous effort. This is a natural process with advisory committee meetings, contacts about job offerings, needed skills and involvement with industry trade shows. Through all of it faculty stress to employers the need to support continuous education for their employees. One particular accomplishment of the program was the presentation at WESTEC trade show of the El Camino mini mill manufacturing project. This small automated device built by CAA grant class students was presented in the show's manufacturing challenge competition. This offered marketing visibility of the program and ultimately led to dialogue with senior leadership of Haas Automation. Haas Automation is the largest builder of American CNC machines and expressed interest in partnering with El Camino College in using the mini mill concept for national competitions.

Update facilities to include automation, robotics, and technology.

The ARM program is continuously updating its facilities with the latest equipment to offer the current training for students. With one relocation completed and another due in a year, the program has made the most of the situation in this state of flux. Small, tabletop CNC mills and lathe workstations were purchased and integrated in anticipation of the current "swing space" and this equipment will be an important stepping stone educational tool for students after the second move to permanent facilities. Even through this transitional state the program is currently working on the acquisition of a CNC plasma cutter station and robotic welding station in conjunction with the

Welding department. Faculty is always surveying the latest technology through trade publications, shows, and industry contacts. It is realized that with the fast pace of technology, we must look ahead- not teach yesterday's skills.

Analysis of Research Data

Provide and analyze the following statistics/data. Head count of students in the program.

The head counts of the individual departments are presented; followed by the results of the combined numbers of all three together. All the data is taken from fall semesters.

Machine Tool Technology 2009	157
Machine Tool Technology 2010	134
Machine Tool Technology 2011	174
Machine Tool Technology 2012	174

The Machine Tool Technology department's fluctuations show a dip during 2010 when combined classes were utilized during fiscal constraints. These combined classes required fewer available seats which reduced the headcount. Since then, the trend shows to be a modest increase in head count with a leveling off.

Engineering Technology 2009	83
Engineering Technology 2010	52
Engineering Technology 2011	49
Engineering Technology 2012	214

The Engineering Technology department's head count numbers also show a dip which resulted from fiscal constraints and subsequent section cuts. This data also includes off campus sections sponsored at local high schools- which were not offered in 2011 resulting the lowest number. These off campus sections are subject to independent agreements and demand. On campus sections remained steady with 1 section in 2009 and 2010 with growth to two sections in 2011 and 2012.

Manufacturing Technology 2009	73
Manufacturing Technology 2010	32
Manufacturing Technology 2011	24
Manufacturing Technology 2012	0

The Manufacturing Technology department showed a steady reduction in head count with reduced sections from 4, 2, 1, and 0 from 2009 to 2012 respectively. This reduction is explained by fiscal constraints, personnel changes and the scheduling of off campus sections. Because of the few number of core classes in the department, it is more sensitive to change.

Total of all three departments 2009	313
Total of all three departments 2010	218

Total of all three departments 2011 247
Total of all three departments 2012 388

The combined head count numbers of all three departments show an initial sizeable reduction, best summed up by section number decreases and then a considerable growth. Preliminary numbers from the fall 2013 semester head count numbers support this continued growth trend.

Course grade distribution.

Grade Distribution, Success, and Retention																		
Engineering Technology																		
Fall																		
Program	Engineering Technology					Preliminary Success Standard					75.70%							
Term	Fall					5 year Success Average					88.30%							
Do Not select more than one term or Program.						5 year Success Minimum					63.00%							
				Grade Distribution													Succ.	Reten.
Year	COURSE	Method	Weeks	'A'	'B'	'C'	'P'	'D'	'F'	'NP'	Inc P	Inc NP	'DR'	'W'	Total			
2009	ETEC-10	Lecture	16	2	11	-	-	-	-	-	-	-	2	9	24	54.20%	54.20%	
	ETEC-10A	Lecture	16	11	8	2	-	-	-	-	-	-	-	-	21	100.00%	100.00%	
	ETEC-12A	Lecture	14	9	2	4	-	-	1	-	-	-	-	2	18	83.30%	88.90%	
			16	-	-	-	-	-	-	-	-	-	-	-	-			
	ETEC-14A	Lecture	14	-	-	-	-	-	-	-	-	-	-	-	-			
			16	9	11	-	-	-	-	-	-	-	-	-	20	100.00%	100.00%	
2009 Total				31	32	6	-	-	1	-	-	-	2	11	83	83.10%	84.30%	
2010	ETEC-10	Lecture	16	3	4	-	-	-	1	-	-	-	2	7	17	41.20%	47.10%	
	ETEC-10A	Lecture	16	9	10	1	-	-	1	-	-	-	-	-	21	95.20%	100.00%	
	ETEC-14A	Lecture	14	4	3	2	-	-	2	-	-	-	-	3	14	64.30%	78.60%	
2010 Total				16	17	3	-	-	4	-	-	-	2	10	52	69.20%	76.90%	
2011	ETEC-10	Lecture	16	4	5	5	-	-	3	-	-	-	1	6	24	58.30%	70.80%	
	ETEC-12	Lecture	16	11	1	3	-	-	8	-	-	-	2	-	25	60.00%	92.00%	
2011 Total				15	6	8	-	-	11	-	-	-	3	6	49	59.20%	81.60%	
2012	ETEC-10	Lecture	16	3	4	6	-	-	2	-	-	-	-	5	20	65.00%	75.00%	
	ETEC-10A	Lecture	16	33	30	10	-	-	1	-	-	-	-	-	74	98.60%	100.00%	
	ETEC-12	Lecture	16	5	6	5	-	-	5	-	-	-	-	5	26	61.50%	80.80%	
	ETEC-12A	Lecture	16	45	10	1	-	1	1	-	-	-	-	-	58	96.60%	100.00%	
	ETEC-14A	Lecture	16	16	2	-	-	-	-	-	-	-	-	-	18	100.00%	100.00%	
	ETEC-18A	Lecture	16	18	-	-	-	-	-	-	-	-	-	-	18	100.00%	100.00%	
2012 Total				120	52	22	-	1	9	-	-	-	-	10	214	90.70%	95.30%	

Grade Distribution, Success, and Retention																		
Manufacturing Technology																		
Fall																		
Program	Manufacturing Technology					Preliminary Success Standard					77.00%							
Term	Fall					5 year Success Average					83.30%							
Do Not select more than one term or Program.						5 year Success Minimum					70.70%							
				Grade Distribution													Succ.	Reten.
Year	COURSE	Method	Weeks	'A'	'B'	'C'	'P'	'D'	'F'	'NP'	Inc P	Inc NP	'DR'	'W'	Total			
2009	MTEC-70	Lecture	12	11	4	2	-	-	3	-	-	-	4	11	35	48.60%	57.10%	
			14	9	7	-	-	-	-	-	-	-	3	-	19	84.20%	84.20%	
	MTEC-75A	Lecture	14	5	5	1	-	-	-	-	-	-	2	6	19	57.90%	57.90%	
			16	-	-	-	-	-	-	-	-	-	-	-	-			
2009 Total				25	16	3	-	-	3	-	-	-	9	17	73	60.30%	64.40%	
2010	MTEC-70	Lecture	12	6	5	-	-	1	1	-	-	-	2	2	17	64.70%	76.50%	
	MTEC-75A	Lecture	16	8	7	-	-	-	-	-	-	-	-	-	15	100.00%	100.00%	
2010 Total				14	12	-	-	1	1	-	-	-	2	2	32	81.30%	87.50%	
2011	MTEC-70	Lecture	14	11	2	3	-	1	2	-	-	-	1	4	24	66.70%	79.20%	
2011 Total				11	2	3	-	1	2	-	-	-	1	4	24	66.70%	79.20%	

Grade Distribution, Success, and Retention																		
Machine Tool Technology																		
Fall																		
Program	Machine Tool Technology					Preliminary Success Standard					74.10%							
Term	Fall					5 year Success Average					74.90%							
Do Not select more than one term or Program.						5 year Success Minimum					73.40%							
				Grade Distribution													Succ.	Reten.
Year	COURSE	Method	Weeks	'A'	'B'	'C'	'P'	'D'	'F'	'NP'	Inc P	Inc NP	'DR'	'W'	Total			
2009	MTT-101A	Lecture	16	7	22	6	-	-	6	-	-	-	2	8	51	68.60%	80.40%	
	MTT-105A	Lecture	16	11	5	2	-	-	3	-	-	-	-	2	23	78.30%	91.30%	
	MTT-107A	Lecture	16	3	3	-	-	-	-	-	-	-	-	4	10	60.00%	60.00%	
	MTT-10A	Lecture	16	3	2	6	-	-	4	-	-	-	2	5	22	50.00%	68.20%	
	MTT-10J	Lecture	16	2	12	9	-	-	1	-	-	-	-	4	28	82.10%	85.70%	
	MTT-46	Lecture	16	11	4	-	-	-	4	-	-	-	-	3	22	68.20%	86.40%	
	MTT-47AB	Laborator	16	-	-	-	1	-	-	-	-	-	-	-	1	100.00%	100.00%	
2009 Total				37	48	23	1	-	18	-	-	-	4	26	157	69.40%	80.90%	
2010	MTT-101A	Lecture	16	8	7	5	-	-	2	-	-	-	1	9	32	62.50%	68.80%	
	MTT-105A	Lecture	16	2	4	2	-	-	-	-	-	-	-	2	10	80.00%	80.00%	
	MTT-107A	Lecture	16	4	6	4	-	-	-	-	-	-	2	3	19	73.70%	73.70%	
	MTT-10A	Lecture	16	6	7	3	-	-	6	-	-	-	1	2	25	64.00%	88.00%	
	MTT-10J	Lecture	16	1	8	3	-	-	6	-	-	-	3	-	21	57.10%	85.70%	
	MTT-46	Lecture	16	13	4	2	-	-	1	-	-	-	3	2	25	76.00%	80.00%	
	MTT-47AB	Laborator	16	-	-	-	1	-	-	-	-	-	-	1	2	50.00%	50.00%	
2010 Total				34	36	19	1	-	15	-	-	-	10	19	134	67.20%	78.40%	
2011	MTT-101A	Lecture	16	7	1	5	-	1	8	-	-	-	2	7	31	41.90%	71.00%	
	MTT-103A	Lecture	16	6	4	3	-	-	-	-	-	-	-	2	15	86.70%	86.70%	
	MTT-105A	Lecture	16	14	7	2	-	-	1	-	-	-	-	2	26	88.50%	92.30%	
	MTT-10A	Lecture	16	4	6	8	-	-	1	-	-	-	1	1	21	85.70%	90.50%	
	MTT-10K	Lecture	16	8	13	9	-	-	2	-	-	-	-	1	33	90.90%	97.00%	
	MTT-2	Lecture	16	13	2	2	-	1	7	-	-	1	2	-	28	60.70%	92.90%	
	MTT-46	Lecture	16	7	1	1	-	-	4	-	-	-	1	3	17	52.90%	76.50%	
	MTT-47AB	Laborator	16	-	-	-	3	-	-	-	-	-	-	-	3	100.00%	100.00%	
2011 Total				59	34	30	3	2	23	-	-	1	6	16	174	72.40%	87.40%	
2012	MTT-101A	Lecture	16	8	5	9	-	3	2	-	-	-	-	6	33	66.70%	81.80%	
	MTT-103A	Lecture	16	7	7	6	-	2	-	-	-	-	-	2	24	83.30%	91.70%	
	MTT-107A	Lecture	16	4	7	2	-	-	-	-	-	-	-	-	13	100.00%	100.00%	
	MTT-10A	Lecture	16	4	4	13	-	-	3	-	-	-	-	4	28	75.00%	85.70%	
	MTT-10J	Lecture	16	8	3	6	-	-	-	-	-	-	-	1	18	94.40%	94.40%	
	MTT-16AB	Lecture	16	10	7	3	-	-	-	-	-	-	-	2	22	90.90%	90.90%	
	MTT-2	Lecture	16	8	9	7	-	2	-	-	-	-	-	7	33	72.70%	78.80%	
	MTT-47AB	Laborator	16	-	-	-	1	-	-	-	-	-	-	2	3	33.30%	33.30%	
2012 Total				49	42	46	1	7	5	-	-	-	-	24	174	79.30%	86.20%	

None of the program's courses appear irregular in grade distribution. It is noted that class grade performance can vary from semester to semester and class size has influence. It is seen that smaller classes tend to have less spread.

Success rates

(Discuss your program's rates in light of the college's success rate standard. Set a standard for you program.)

Total of all three departments 2009	70.9%
Total of all three departments 2010	69.7%
Total of all three departments 2011	69.2%
Total of all three departments 2012	85.6%

Success rates show an upward spike in 2012 after continuous levels for the previous three years. One explanation would be the inherent synergy of these three departments- as the interconnectivity between these disciplines has been more recently stressed- it has been seen that students are shared

between the programs. It becomes clear to the students how the knowledge fits together and how they can use it for their career and lives. With this the students have been more engaged in the material and more successful.

Retention rates.

Total of all three departments 2009	78.0%
Total of all three departments 2010	79.4%
Total of all three departments 2011	85.4%
Total of all three departments 2012	91.2%

The program's retention rates show a steady increase. This is a very encouraging statistic- and coupled with the previous success data suggests that the program is extremely effective. With continued future success- SLOs will show how these students succeed and how these statistics can be maintained.

A comparison of success and retention rates in face-to-face classes with distance education classes.

Not applicable- no distance education classes offered. The ARM program's courses are 66%-75% hands-on skill building with lab activities. These courses with critical lab activities requiring resources and equipment not available to individuals do not lend themselves to distance education formats.

Enrollment statistics with section and seat counts and fill rates.

Fall Section Fill Rates for Machine Tool Technology

2009	88.2%
2010	75.3%
2011	85.3%
2012	95.1%

The fill rates for MTT show to be relatively stable for the longest running program of the three.

Fall Section Fill Rates for Engineering Technology

2009	30.3%
2010	37.1%
2011	94.2%
2012	58.8%

Engineering Technology is the newest of the three programs which has seen growth since its introduction in 2006. This program has also been affected by the use of off-site sections at local high schools which would influence the fill rates. This program is in a stabilizing mode.

Fall Section Fill Rates for Manufacturing Technology

2009	66.9%
2010	64.0%
2011	100.0%
2012	0%

Manufacturing Technology is the smallest of the three programs with only two core classes. Due to small number of classes and personnel changes, no classes were offered in the fall semester of 2012.

Fill rates of the program are appropriate. Ideally lab oriented classes cannot be as large as lecture only classes and for many a limit of 15 student would best serve their needs. Realistically, attrition and focused students rule. As the trend to increase sections continues, an eye on these fill rates will dictate whether these sections are needed.

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

Current classes are offered as morning classes, early afternoon, night and a few are offered on Saturdays. Students are not able to complete degrees or certificates without some combination of these with most drawing from night and day classes. It is not practical to alter or increase sections at this time such that students could complete from a sole time slot. The most recent two semesters have seen a marked increase in the attendance of early afternoon sections during the traditional "dead hours" of campus. No changes are proposed at this time.

Improvement rates (if applicable).

Improvement rates are not applicable to the program.

Additional data compiled by faculty.

It was noted that there was a sharp decline in women student of the Manufacturing Technology program when looking at the fall semester:

2009	32.7%	11 sections total for the year
2010	18.8%	4 sections
2011	8.3%	2 sections
2012	0	0 (no courses offered)

This is not an alarming statistic given the small size of this program and declining number of sections offered. The number of sections offered has varied due to offsite sections and personnel changes- hence no concerns are raised with this data, and no recommendations are necessary. The Manufacturing Technology courses consists of robotics curriculum which continues to be in demand.

List any related recommendations.

No further recommendations.

Curriculum

Review and discuss the curriculum work done in the program during the past four years, including the following:

All of the courses have been reviewed and updated within the last four years according to schedule. Faculty are active in the Division Curriculum Committee to assure that all courses meet requirements.

Provide the curriculum course review timeline to ensure all courses are reviewed at least once every 6 years.

Courses are scheduled for curriculum review as follows:

ETEC 10	3/2016
ETEC 10A	3/2016
ETEC 10B	3/2016
ETEC 12	11/2017
ETEC 12A	11/2017
ETEC 12B	11/2017
ETEC 14	11/2017
ETEC 14A	11/2017
ETEC 14B	11/2017
ETEC 16	11/2017
ETEC 16A	11/2017
ETEC 16B	11/2017
ETEC 18	11/2017
ETEC 18A	11/2017
ETEC 18B	11/2017
MTT 101	5/2015
MTT 103	5/2015
MTT 105	5/2015
MTT 107	5/2015
MT 70	10/2016
MT 70A	10/2016

MT 70B	10/2016
MT 75	10/2016
MT 75A	10/2016
MT 75B	10/2016

Explain any course additions to current course offerings.

There have been no new course offerings since the last program review. Because the curriculum was extensively revised within the last 10 years, no major changes have been necessary.

Explain any course deletions and inactivations from current course offerings.

There have been no deletions or inactivations since the last program review.

Describe the courses and number of sections offered in distance education.

No courses in the ARM program are offered in the distance education format. Courses in this program are applied technology that depends on skill building and hands on learning to contextualize the theory- separating the theory and application hinder the associative process.

Discuss how well the courses, degrees, or certificates are meeting students' transfer or career training needs:

Traditionally students of the program were trained to enter employment directly after completion. With this in consideration, transfer has not been a factor. This has evolved with the addition of the Manufacturing Technology and Engineering Technology programs- both more oriented to offering the student a path option to continued education at a four year institution. Regardless, all three programs offer solid hands-on technology training for immediate technician employment or foundational study for an engineering degree. Students are lead to appreciate that the El Camino ARM program offers educational opportunities that are unparalleled. Traditional on the job training cannot match the breadth of knowledge offered and four year engineering programs lack any significant hands on contextual training.

Have all courses that are required for your program's degrees and certificates been offered during the last two years? If not, has the program established a course offering cycle?

All of the required courses for the program's degrees and certificates have been offered during the last two years- although MTT 16 general metals will not be offered for another possible 3 semesters due to temporary relocation of the program and lack of support equipment. It is suggested that a temporary substitution of an introduction welding class be used.

Are there any concerns regarding program courses and their articulation?

There are no present concerns regarding articulation. Solidifying articulation agreements is an ongoing effort and made more challenging for rapidly evolving technology courses. Due to the

continuing work of El Camino articulation officers and STEM liaisons this need is being met. The newfound visibility and attention of technology training makes articulation effort easier.

How many students earn degrees and/or certificates in your program? Do students take licensure exams? If so, what is the pass rate? If few students receive degrees or certificates or if few students pass the licensure exam, should the program's criteria or courses be re-examined? Set an attainable, measurable goal for future degrees, certificates, and/or licensure pass rates.

There is no licensure exam for the ARM program, but the National Institute for Metalworking Skills (NIMS) certificates are receiving increased attention. Because these certificates are recognized nationally and there are many other manufacturing industry clusters around the country, students stand to benefit with position opportunities and increased compensation. Local employers see the can assess student skill levels with the standards set by these certificates.

Because of the dynamic nature of these certificates demand by students and employers, definite goals of their use cannot be projected at this time. The cost of attaining these certificates in number can be considerable and current classes offering them are almost all grant funded- with no cost to the student. If a future consistent funding schedule or source can be determined, it is recommended that NIMS certificates be further integrated with the ARM program courses.

Other challenges to this integration are the adaptation of course curriculum to fit the certifications. Course outlines might require overhauling to properly prepare students for certificate testing preparation. In light of these obstacles, the current approach of special classes and "letting the market decide" and gradual adaptation to current curriculum is appropriate.

List any related recommendations.

No further recommendations.

Assessment and Student and Program Learning Outcomes (SLOs & PLOs)

It is noted that some courses share the same SLO. This is explained in that these courses are halves which contain the same content as the whole course. For example ETEC 10A and ETEC 10B are the two halves that make up ETEC 10. These half courses were created to offer them at off-site partner high schools and meet their schedule constraints.

The ARM program is finalizing the additional SLOs remaining to comply with the new three SLO minimum standard per course.

The program is scheduled to be reviewed on a two-year cycle. This document fulfills the review requirement for 2012-2013. Beginning in 2013, program reviews will begin in spring and be completed in fall to keep them consistent with the college planning and budgeting cycle.

Provide a copy of your alignment grid, which shows how course, program, and institutional learning outcomes are aligned.

Industry and Technology
Institutional (ILO), Program (PLO), and Course (SLO) Alignment

Program: Automation, Robotics, and Manufacturing **Engineering Technology (ETEC), Manufacturing Technology (MTEC), and Machine Tool Technology (MTT)**	**Number of Courses:** 36	**Semester Updated:** Fall 2013	**Submitted by:** Eric Carlson, Ed Hofmann

ILO Rating Rubric

4 - A major focus of the course. Direct instruction is provided. Students are evaluated multiple times (and possibly in various ways) throughout the course.
3 - An important part of the course. Some direct instruction is provided and students are evaluated on the concepts once or twice within the course.
2- Only a minor focus of the course. Some instruction is given in the area but students are not formally evaluated on the concepts.
1- May be tangentially part of the class, but is not directly taught or evaluated or is not part of the course at all.

Institutional Learning Outcomes (ILOs)	I. Content Knowledge	II. Critical, Creative, and Analytical Thinking	III. Communication and Comprehension	IV. Professional and Personal Growth	V. Community and Collaboration	VI. Information and Technology Literacy
Overall Rating	4	3	1	3	1	2

ETEC Technology Program Level SLOS	**ILOs to PLOs Alignment** (Rate 1-4)					
	I	**II**	**III**	**IV**	**V**	**VI**
ETEC PLO #1 Phases of Product Lifecycles Upon completion of the courses in this discipline, the student will be able to identify the phases of a product lifecycle.	4	4	2	1	1	2
ETEC PLO #2 New Product Tests Upon completion of the courses in this discipline, the student will be able create a list of tests that a new product should be subjected to.	3	4	2	1	1	1
ETEC PLO #3 Solving Engineering Problems Students will apply principles from mathematics, physics, and chemistry to solve applied problems in engineering.	3	4	2	1	1	1

ETEC Course Level SLOs	Course to PLO Alignment			ILOs to Course SLOs Alignment (Rate 1-4)					
	P1	P2	P3	I	II	III	IV	V	VI
ETEC 10 Principles of Engineering Technology: SLO #1 Careers Students will research engineering and engineering technology careers and create a report.				4	1	2	3	1	2
ETEC 10 Principles of Engineering Technology: SLO #2 Marble Sorter Students will build an automated marble sorter.									
ETEC 10 Principles of Engineering Technology: SLO #3 Six Simple Machines Student will build the SMET project demonstrating the six simple machines.									
ETEC 10A Principles of Engineering Technology I: SLO #1 Careers Students will research engineering and engineering technology careers and create a report.				4	1	2	3	1	2
ETEC 10A Principles of Engineering Technology I: SLO #2 Six Simple Machines Student will build the SMET project demonstrating the six simple machines.									
ETEC 10A Principles of Engineering Technology I: SLO #3 Mousetrap Car Student will build a mousetrap-powered car.									
ETEC 10B Principles of Engineering Technology II: SLO #1 Marble Sorter Students will build an automated marble sorter.				3	4	1	1	1	1
ETEC 10B Principles of Engineering Technology II: SLO #2 Optimized Bridge Students will build an optimized bridge using West Point Bridge simulation software.									
ETEC 10B Principles of Engineering Technology II: SLO #3 Bridge Construction & Testing Students will build a bridge from popsicle sticks and load test their design to failure.									
ETEC 12 Introduction to Engineering Design: SLO #1 Missing Orthographic Views Given an incomplete set of orthographic views of a simple machined part, the student shall be able to complete the given views and to construct the missing views.				3	4	1	1	1	1
ETEC 12 Introduction to Engineering Design: SLO #2 Two and Three-Dimensional Models Given a simple set of design constraints, the student shall be able utilize AutoCad Inventor software to produce a design package including two-dimensional drawings and three-dimensional models.									
ETEC 12 Introduction to Engineering Design: SLO #3 Design Project Upon completion of the course, the student shall be able to take a design project from problem statement to final production drawings.									

ETEC Course Level SLOs	Course to PLO Alignment			ILOs to Course SLOs Alignment (Rate 1-4)					
	P1	P2	P3	I	II	III	IV	V	VI
ETEC 12A Introduction to Engineering Design I: SLO #1 Two and Three-Dimensional Models Given a simple set of design constraints, the student shall be able utilize AutoCad Inventor software to produce a design package including two-dimensional drawings and three-dimensional models.				3	4	1	1	1	1
ETEC 12A Introduction to Engineering Design I: SLO #2 Missing Orthographic Views Given an incomplete set of orthographic views of a simple machined part, the student shall be able to complete the given views and to construct the missing views.									
ETEC 12A Introduction to Engineering Design I: SLO #3 Making Revisions Given an incorrect design package and a list of needed revisions, the student shall be able to correctly and effectively incorporate the revisions into the drawings and models.									
ETEC 12B Introduction to Engineering Design II: SLO #1 Two and Three-Dimensional Models Given a simple design problem statement and set of design constraints, the student shall be able utilize AutoCad Inventor software to produce a design package including two-dimensional drawings and three-dimensional models.				3	4	1	1	1	1
ETEC 12B Introduction to Engineering Design II: SLO #2 Design Project Upon completion of the course, the student shall be able to take a design project from problem statement to final production drawings.									
ETEC 12B Introduction to Engineering Design II: SLO #3 Design Process Upon completion of the course, the student shall be able to describe the steps of the design process and give examples of documents appropriate for each step.									
ETEC 14 Electronics for Engineering Technologists: SLO #1 Logic Equivalencies Students will be able to use NAND and NOR Gates to configure and test logic equivalencies of: NOT, AND, OR, Exculsive OR and Exclusive NOR logic functions.				3	4	1	1	1	1
ETEC 14 Electronics for Engineering Technologists: SLO #2 Logic Circuit Using discrete TTL or CMOS Logic Gates to design, construct, and demonstrate a logic circuit which displays the students Birth Date using three toggle switches, various logic gates, and a single seven segment common anode LED display.				3	4	1	1	1	1
ETEC 14 Electronics for Engineering Technologists: SLO #3 Karnaugh Map Given a 4 bit (16 items) binary truth table, generate a Karnaugh Map to find a simplified solution.									

ETEC Technology Course Level SLOS	Course to PLO Alignment			Core Competencies to Courses Alignment					
				I	II	III	IV	V	VI
	P1	P2	P3						
ETEC 14 Electronics for Engineering Technologists: SLO #4 Base 10 Conversion Given a negative two's complement binary number, convert this to a base 10 number.									
ETEC 14A Electronics for Engineering Technologists I: SLO #1 Logic Circuit Using discrete TTL or CMOS Logic Gates to design, construct, and demonstrate a logic circuit which displays the students Birth Date using three toggle switches, various logic gates, and a single seven segment common anode LED display.				3	4	1	1	1	1
ETEC 14A Electronics for Engineering Technologists I: SLO #2 Karnaugh Map Given a 4 bit (16 items) binary truth table, generate a Karnaugh Map to find a simplified solution.									
ETEC 14A Electronics for Engineering Technologists I: SLO #3 Unsigned Binary Conversion Given an unsigned binary number, convert this number to base 10.									
ETEC 14B Electronics for Engineering Technologists II: SLO #4 JK Flip Flop Given a JK Flip Flop, identify what the output will be for all possible states of J and K.									
ETEC 16 Computer Integrated Manufacturing: SLO #1 Solid Modeling Students will measure and solid model a provided assembly.				3	4	1	1	1	1
ETEC 16 Computer Integrated Manufacturing: SLO #2 Robotic Arm: Palletize Students will program a robot arm to palletize parts.									
ETEC 16 Computer Integrated Manufacturing: SLO #3 CNC Mill: Initials Students will program a CNC mill to engrave their initials in a block of wood.									
ETEC 16A Solid Modeling SLO #1 Solid Modeling Students will measure and solid model a provided assembly.				3	4	1	1	1	1
ETEC 16A Solid Modeling SLO #2 CNC Mill: Initials Students will program a CNC mill to engrave their initials in a block of wood.									
ETEC 16A Solid Modeling SLO #3 MasterCam Toolpath Student will create a toolpath using MasterCam from a given solid model.									
ETEC 16B Computer Integrated Manufacturing II: SLO #1 Robotic Arm: Palletize Students will program a robot arm to palletize parts.				3	4	1	1	1	1

ETEC Technology Course Level SLOS	Course to PLO Alignment			Core Competencies to Courses Alignment					
				I	II	III	IV	V	VI
	P1	P2	P3						
ETEC 16B Computer Integrated Manufacturing II: SLO #2 Robotic Arm: Tool Frame Students will program a tool frame (tool coordinates) for a robot arm.									
ETEC 18 Engineering Design and Development: SLO #1 Engineering Notebook Students will develop and maintain an engineering notebook. This legal document contains all the information that is relevant to its purpose of original design. It includes contact information, correspondence, telephone logs, sketches and drawings, reference citations, collected data, and a chronological listing of the events dates and time, connected to the journal's purpose.				2	2	3	3	3	2
ETEC 18 Engineering Design and Development: SLO #2 Research Methodology & Technology After carefully defining a technical problem, the student will use both research methodology and technology to choose, build, validate and justify an engineering solution to a design challenge.				3	4	2	3	3	3
ETEC 18 Engineering Design and Development: SLO #3 Tech Review Presentation The student will make a formal presentation to defend their research, design criteria, prototype, applications, and conclusions to a technical review panel.									
ETEC 18A Engineering Design and Development I: SLO #1 Engineering Notebook Students will develop and maintain an engineering notebook. This legal document contains all the information that is relevant to its purpose of original design. It includes contact information, correspondence, telephone logs, sketches and drawings, reference citations, collected data, and a chronological listing of the events dates and time, connected to the journal's purpose.				2	2	3	3	3	4
ETEC 18A Engineering Design and Development I: SLO #2 New Engineering Concept The student will work as part of an engineering group to develop an engineering concept that is new in nature, safe, cost effective, reliable, and could be mass produced.				3	4	3	3	3	3
ETEC 18A Engineering Design and Development I: SLO #3 Research Methodology & Technology After carefully defining a technical problem, the student will use both research methodology and technology to choose, build, validate and justify an engineering solution to a design challenge.									
ETEC 18B Engineering Design and Development II: SLO #1 New Engineering Concept The student will work as part of an engineering group to develop an engineering concept that is new in nature, safe, cost effective, reliable, and could be mass produced.				3	4	2	3	3	3

ETEC Technology Course Level SLOS	Course to PLO Alignment			Core Competencies to Courses Alignment					
				I	II	III	IV	V	VI
	P1	P2	P3						
ETEC 18B Engineering Design and Development II: SLO #2 Tech Review Presentation The student will make a formal presentation to defend their research, design criteria, prototype, applications, and conclusions to a technical review panel.									

MTEC Technology Program Level SLOs	ILOs to Course SLOs Alignment (Rate 1-4)					
	I	II	III	IV	V	VI
	4	2	1	2	2	2
MTEC PLO #1 Digital and Analog Sensor Technologies Upon completion of the courses in this discipline, the student will be able to identify different digital and analog sensor technologies.						

MTEC Technology Course Level SLOS	Course to PLO Alignment			Core Competencies to Courses Alignment					
				I	II	III	IV	V	VI
	P1	P2	P3						
MTEC 70 Basic Robotics: SLO #1 Four-Block Flow Chart Students correctly draw a 4 block flowchart of a computer/robot including: input, processor, memory, and output.	X			4	2	1	2	2	2
MTEC 75 Integrated Robotic and Automated Technologies: SLO #1 Programming a Robot Students will correctly program a robot to travel 5 feet turn 180 degrees and return to the start point.	X			4	2	1	2	2	2
MTEC 75A Integrated Robotic and Automated Technologies I: SLO #1 Programming a Robot Students will correctly program a robot to travel 5 feet turn 180 degrees and return to the start point.	X			4	2	1	2	2	2
MTEC 75B Integrated Robotic and Automated Technologies II: SLO #1 Programming a Robot Students will correctly program a robot to travel a total of 10 feet. Within the travel the robot will reach maximum velocity by smoothly accelerating and deaccelerating.	X			4	2	1	2	2	2

MTT Technology Program Level SLOs	ILOs to Course SLOs Alignment (Rate 1-4)					
	I	II	III	IV	V	VI
MTT PLOI #1 Prints and Shop Calculations Upon completion of a course of study in Machine Tool Technology, a student will demonstrate an ability to read prints and be proficient at shop calculations.	4	3	1	2	2	2
MTT PLO #2 Trouble Shooting Upon completion of a course of study, a Machine Tool Technology student will be able to trouble shoot machine tool problems using proper set up technique, RPMs and feed calculations.	4	3	1	2	2	2
MTT PLO #3 Basic Safety Upon a completion of a course of study in Machine Tool Technology, a student will practice safety in basic machine tool operations including lathe, milling, grinding machines and hand tools.	4	3	1	2	2	2
MTT PLO #4 Preparing for the Job Market Upon a completion of a course of study, Machine Tool Technology will successfully compete for jobs in the machine tool technology job market	4	2	1	2	2	2

MTT Course Level SLOs	Course to PLO Alignment				ILOs to Course SLOs Alignment (Rate 1-4)					
	P1	P2	P3	P4	I	II	III	IV	V	VI
MTT 2 Manufacturing Print Reading SLO #1: Orthographic Orientation. Student will correctly sketch a part in orthographic orientation.	X				4	3	1	2	2	2
MTT 2 Manufacturing Print Reading SLO #2 : Demonstrate basic understanding or Multi-View Orthographic drawings, including part visualization and interpretation and the mechanics of: dimensioning, tolerancing and drawing.	X				4	3	1	2	2	2
MTT 2 Manufacturing Print Reading SLO #3 Total Position Tolerance Gain a basic understanding of GD&T (Geometric Dimensioning and Tolerancing) practices. Presented with a Feature Control Frame, students will calculate total positional tolerance of a hole utilizing Maximum Material Condition, Least Material Condition and Regardless of Feature Size Modifiers.	X				4	2	1	2	2	4

MTT Course Level SLOs	Course to PLO Alignment				ILOs to Course SLOs Alignment (Rate 1-4)					
	P1	P2	P3	P4	I	II	III	IV	V	VI
MTT 10A Introduction to CAD/CAM: SLO #1 High Speed Steel End Mill Student will calculate the correct rotations per minute (RPM) for a high speed steel end mill using the correct cutting speed and end mill diameter.		X			4	4	4	2	2	4
MTT 10B Computer Numerical Control Programming: SLO #1 Inputting a Program Student will input a program in to a Computer Numerical Control (CNC) machine.				X	4	4	4	2	2	4
MTT 10J Numerical Control Graphics Programming: SLO #1 Geometric Elements Student will create geometric elements such as points, lines, and circles.				X	4	4	4	2	2	4
MTT 10K 3D Numerical Control Graphics Programming: SLO #1 Creating a 3D Solid Model Student will correctly create a 3D solid model in CAD software and practice roughing the 3D surface using CAM software.	X	X		X	4	2	1	2	2	2
MTT 16 General Metals: SLO #1 HSS Cutting Speed and Mill Diameter Student will calculate the correct rotations per minute (rpm) for a high speed steel end mill using the correct cutting speed and end mill diameter.	X	X	X		4	2	1	2	2	2
MTT 40 Machine Shop Calculations: SLO #1 HSS Setting the Speed Student will 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.	X	X			4	2	1	2	2	2
MTT 46 Basic Machine Tool Operation: SLO #1 HSS Setting the Milling Machine Student will 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.	X	X			4	2	1	2	2	2
MTT 47 NIMS Level I Credential Preparation SLO #1 HSS Setting the Milling Machine Student will 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.	X				4	2	1	2	2	2
MTT 101 Introduction to Conventional and CNC Machining: SLO #1 Measuring and Recording Dimensions Given a ground steel block of known and verified dimensions, measure and record the three dimensions of the block using a micrometer to a precision of .001 inches.	X	X			4	2	1	2	2	2

MTT Course Level SLOs	Course to PLO Alignment				ILOs to Course SLOs Alignment (Rate 1-4)					
	P1	P2	P3	P4	I	II	III	IV	V	VI
MTT 101 Introduction to Conventional and CNC Machining: SLO #2 Blue Prints Given a Blue Print student will use all manufacturing equipment available to manufacture the project on the Blue Print to noted specifications.	X				4	2	1	2	2	2
MTT 103 Conventional and CNC Turning: SLO #1 Lathe Dimension Students will turn a part on the lathe to a given drawing dimension to an accuracy of +/- .001 inches.	X	X	X		4	2	1	2	2	2
MTT 105 Conventional and CNC Milling: SLO #1 Squaring the Block Given a rough-cut aluminum block, square the block using a milling machine, cutters and measurement tools.	X	X	X		4	2	1	2	2	2
MTT 107 Advanced Manufacturing Processes: SLO #1 Pros and Cons of Cuttings Record the benefits and downsides of the following processes: Waterjet cutting, EDM wire cutting, Plasma cutting and Laser cutting.				X	4	2	1	2	2	2

Provide a timeline for course and program level SLO assessments.

Fall 2013: ETEC 16B, ETEC PLO, MTEC 70

Spring 2014: MTT 10K, MTT 16 (MTT 16 assessment will not be possible, course not offered due to temporary relocation of program and lack of required equipment. This class may be offered again on or after the spring 2015 semester- the course SLOs will be assessed at this time.)

Fall 2014:

Spring 2015: MTT 40

Fall 2015: MTT47

2016: Next Program Review due

State the percent of course and program SLO statements that have been assessed.

All scheduled assessments have been made.

Summarize the SLO and PLO assessment results over the past four years and describe how those results led to improved student learning. Analyze and describe those changes. Provide specific examples.

As course SLOs and PLOs have been assessed improvements have been found. Key lessons have been learned in making these statements natural, effective, and measurable. Also, assessment methods have undergone adjustment. From the ETEC 16 SLO last assessed, it was determined that the task or assessment method required alteration to provide levels of success due to the 100% completion rate of the class. It was shown that solely pass/fail assessments do not provide good indications for improvement of the process. The next assessment will be conducted using a gradient grading scale to indicate how students and the teaching method can both be made better.

Determine and discuss the level your program has attained in the SLO rubric in Appendix B.

The ARM Program is currently in the Developmental stage of the ACCJC SLO Rubric. The program has established a framework for definition of SLOs, established assessment strategies, and faculty members have accepted responsibility for SLO outcomes implementation. Faculty and staff are fully engaged in SLO development- with the completion of the recently added SLOs to meet the new three statement minimum, the program will be ready to meet proficiency.

Describe how you have improved your SLO process and engaged in dialogue about assessment results.

Faculty has been discussing contributions, appropriate SLO statements and assessments. The goals and deadlines are regularly updated and supported. Because of the number of involved departments and faculty- coordination and communication are important.

List any recommendations.

No further recommendations.

Facilities and Equipment

The ARM Center directly supports classes for Machine Tool Technology, Engineering Technology and Manufacturing Technology. It hosts tours and demonstrations for industry representatives, related classes, workshops and open house events open to the community.

Describe and assess the existing program facilities and equipment.

The ARM program currently resides in a temporary "swing space" in the basement of the Communications Building. This move from the Math and Computer Science (MCS) building occurred over the winter break of 2012-2013. The MCS building is undergoing a complete remodel and due to re-inhabited the spring semester of 2015. Two relocations in two years is proving to be a considerable challenge due to the size and number of equipment involved. The current space is less than half of the previous and future spaces so many pieces are in storage. This has limited available equipment and technologies available for student learning. Due to this temporary relocation was known far in advance, small table top CNC equipment was purchased with grant funds. This equipment has necessitated adjustment of the curriculum and teaching methods used. Given the provided resources, the program has succeeded in supporting student learning and made opportunities to improve out of the struggle.

Future challenges are new Department of State Architects (DSA) requirements for egress, disabled student equipment access, and seismic equipment restraints. These issues are scheduled to be resolved by the time the MCS building remodel is complete.

Explain the immediate (1-2 years) needs related to facilities and equipment. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

The immediate equipment and facilities needs are limited. This is due to the limited temporary space available, and limited facilities related to air, electrical power and water services. The following list is comparatively short but the equipment represents high technology value with is not presently available to students. These machines are compact but represent technology that students would find in industry.

Haas CNC office mill	$100K
Haas CNC office lathe	$40K

Explain the long range (2-4+ years) needs related to facilities and equipment. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

CNC waterjet $45K- This technology has seen increased use due to its low environmental impact compared to traditional methods. Many local businesses use this equipment to cut products from metal parts for aircraft to slicing bread and cakes.

CNC wire EDM machine $60K- This is a technology which the program has outdated equipment from 1989. Many advances have been made with this technology which demonstrates cutting of any conductive material to extremely high tolerances.

Motoman HP50 robot arm $60K- It is suggested the program continue the acquisition of equipment for student learning which demonstrates flexible automation. This equipment is sized to be capable of 5-axis material removal to create geometries not possible with traditional CNC equipment.

3 hybrid CNC lathes (2-4 year) $120K- A number of conventional lathes are in storage and due for replacement. The trend in industry is toward hybrid machines which can be used manually or CNC programmed. These types of machines have great value in the educational environment because of their compact size for offering manual and CNC use.

List any related recommendations.

No further recommendations.

Technology and Software

Describe and assess the adequacy and currency of the technology and software used by the program.

Although the program uses a number of software applications, many of these are one time purchase, shared such as CATIA and Inventor (purchased by CADD), or free software. Powerful applications that represent industry have been developed that are free to the program and students for installation at home. Software suppliers are also learning to offer once expensive applications free to students to increase market share in industry with commercial versions. The faculty regularly assesses software and technology developments, attends training, and makes recommendations based on industry needs.

Explain the immediate (1-2 years) needs related to technology and software. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

Mastercam is an application that demonstrates graphical programming of CNC machines. This is a critical need for students to teach how most parts are programmed in industry. The yearly cost for updating this application is $3000.

Robotmaster is an extension application for Mastercam which allows students to program robots to do machining which has traditionally been restricted to machine tools like mills. This is a

recent development and this technology is experiencing increased use with the growth of applied automation. The cost for Robotmaster is $1000 per year.

Explain the long range (2-4+ years) needs related to technology and software. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

The long range software and technology needs of the program are not different than the short term needs. No other needs are seen nor can be predicted at this time. The program has successfully covered current and future needs but will stay alert to new developments.

List any related recommendations.

No further recommendations.

Staffing

Describe the program's current staffing, including faculty, administration, and classified staff.

Faculty:

Eric Carlson	MTT/MT/ETEC full time instructor
Robert Diaz	ETEC and ECHT part time instructor
Harold "Ed" Hofmann	MTT/MT/ETEC full time instructor
Victor De La Torre	MTT part time instructor
Matt Griffin	MTT part time instructor
Richard Hughes	ETEC and CADD full time instructor (retiring fall 2013)
Steve Shibuya	MTT part time instructor

Staff:

Seth Banard	MTT Grant class part time coverage tool crib attendant
Rosa Novak	MTT Grant class part time coverage tool crib attendant
Mike Pahls	MTT/MT/ETEC Technician with tool crib attendant duties
Doroteo "Nick" Quero	MTT Part time coverage tool crib attendant

Explain and justify the program's staffing needs in the immediate (1-2 years) and long term (2-4+ years). Provide cost estimates and explain how the position/s will help the program better meets its goals.

The most immediate need of the program is a dedicated full time tool room attendant. Progressing through the late 1990's the program's technician has increase tool room duties shared with regular technician tasks as a budget constraint compromise. With the growth and addition of multiple departments this is no longer viable. Dedicated technician support is need to setup maintain and troubleshoot equipment. Estimated cost for dedicated full time tool room support is projected to be $50K per year.

The program may require a replacement for Richard Hughes who has taught ETEC 12, although at least one instructor is trained to teach this class. Depending on the class load of full time and part time instructors, and the drive to increase section numbers and FTES, another lab class instructor for Machine Tool Technology classes may be required. This level of support is not known for certain but could range from $30K - $80K depending on section number.

List any related recommendations.

No further recommendations.

Future Direction and Vision

Describe relevant changes within the academic field/industry. How will these changes impact the program in the next four years?

The changes in manufacturing technology and related fields in the next four years will be numerous. Due to the nature of technology and its rapid development- some of these changes cannot be predicted. There are some trends of change however. There will be an assured increase of automation across industries with an appropriate increase in the need for trained personnel to design, build, troubleshoot and maintain this equipment. There will also be a reciprocal decrease in the need for less skilled labor replaced by automation. Automation technologies traditionally reserved for manufacturing and heavy industry will continue filtering into other businesses like food preparation and services as automation becomes more affordable and easier to use. Although not considered manufacturing- these businesses will evolve and more closely resemble the industries they will borrow from in technology and trained personnel.

These changes will drive demand for increased training in automation and robotics. A heavier emphasis of fundamental principles, programming and troubleshooting will be required. This evolution will also drive the need for equipment to train for these technologies.

Explain the direction and vision of the program and how you plan to achieve it.

The direction and vision of the program is to best prepare students for employment in automation and manufacturing technologies for today and the future. Due to the sometimes lumbering execution pace of institutions, a forwarding looking perspective is required. Automation technologies are evolving at an increasing pace and without aggressive action it becomes easy to fall behind. By stressing fundamentals and building skills on top of them in addition to creative problem solving skills, curriculum can be kept current and relevant into the future. By continuously scanning the horizon for

new technologies and an unbiased view- trends can be found that employers cannot yet afford. Through aggressive grant proposals and forging relationships with local industries to listen to their needs, the equipment and training curriculum is updated regularly.

List any related recommendations.

No further recommendations.

Prioritized Recommendations

Provide a single, prioritized list of recommendations and needs for your program/department (drawn from your recommendations in sections 2-8). Include cost estimates and list the college strategic initiative that supports each recommendation.

The following are recommendations in a prioritized list of order.

Full-time tool room attendant	$50K	Strategic initiative E
Part-time MTT lab instructor	$30K -$80K	Strategic initiative E
Haas CNC office mill	$100K	Strategic Initiative F

This equipment is currently being pursued with STEM grant funds.

Haas CNC office lathe	$40K	Strategic Initiative F
CNC waterjet	$45K	Strategic Initiative F
CNC wire EDM machine	$60K	Strategic Initiative F
Motoman HP50 robot arm	$60K	Strategic Initiative F
3 hybrid CNC lathes	$120K	Strategic Initiative F

Explain why the list is prioritized in this way.

The list of recommendations is prioritized such that the personnel needs should be addressed first- this is would help to enable assigned staff to accomplish tasks to further the program and meet student needs. After this, the compact equipment of a Haas CNC office mill and lathe can be utilized immediately in the temporary swing space. The remained equipment needs are then listed in order of effectiveness in demonstrating technology to students balanced with current unmet capabilities. Depending on the timing and availability of funds, the larger equipment starting with becomes a higher priority over the compact Haas machines when the program returns to its permanent location with more space leeway.

CTE Program Review Supplementary Questions & Answers

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?

Occupational demand for the program is strong. Even in this time of marginal economic recovery, the Los Angeles Basin remains the largest manufacturing region in the United States. Employers regularly contact the program looking for trained students to hire. Faculty receive request from local employers but also from as far away as northern California, Texas and even the Mid-West states. The ongoing trend is that experienced, older employees with skills are retiring and an insufficient number of students are taking up the technology field. This condition has continued for the last 5 year and is anticipated to worsen for the next 5 years as the current average for working employees in the field for some disciples is in the 50+ years of age.

What is the district's need for the program?

The district's need for the program is critical with respect to support of local industry. As the industrial focus has moved away from aircraft manufacturing, avionics, electronics, automotive, consumer and industrial manufacturing remain strong presences in the local area. As an example, as much as 80%+ of all aerospace fasteners manufacturing for the entire world remains within several miles of the south bay region of Los Angeles.

What is the state's need for the program?

As the Los Angeles region is the largest manufacturing base in the entire country, this renders this area critical the welfare of the state's economic health. The California economy is the eighth largest in the world, manufacturing in Los Angeles is the foundation of this reality.

How does the program address needs that are not met by other similar programs in the area?

The El Camino College programs of Machine Tool, Manufacturing, and Engineering have worked to provide unparalleled educational opportunities for students. As a unified Automation, Robotics and Manufacturing (ARM) program it will be even stronger in the collaboration and utilization of resources and demonstration of integration of concepts to students. The contextual, a hand on learning experience available is not found at the university level. Likewise, no local community college program has been as aggressive in staying current with modern technology education and the equipment and facility resources available to students.

Are the students satisfied with their preparation for employment? Are the employers in the field satisfied with the level of preparation of our graduates?

Students often comment on their surprise and appreciation of the support they receive in their education. The industrial advisory board repeatedly states that the program meets the needs for educating their employees and potential hires.

What are the completion success and employment rates for the students?

While the education branches of government have decreed that institutions must provide data showing the employment data for graduates, federal law protects individual privacy and limits access to this data. These contradictions make the collection of this data nearly impossible. It is suggested that the only viable solution is to appeal to the students to provide this data willingly. The creation of a database which graduating students could opt into and provide their current employment data could suit this need. Students would provide this data because their information would be shared with industry partners looking for employees. If the requirements for students are completion of the program and industry partners follow set data use guidelines, the system could benefit all parties.

Considering students of the program are trained for careers, and the attention paid to the program by local industry, graduates have great success in finding employment. Numerous shared stories and visiting graduates offer continuous proof of the program's success. During stable and up swinging economic times, the program has problems with retention due to the premature hiring of students. Faculty stresses the importance of completion to combat this.

What impact does the advisory board have on the program?

The industrial advisory board meets at least one every year. This board is comprised of representatives of companies such as Boeing, Northrop Grumman, SpaceX, as well as the many smaller manufacturers. The board comments on the state of industry, trends, and current pay for employees, and gives suggestions for the program. This board has regularly stated that the program meets their needs.

Qty.	Equipment
10	Conventional engine lathes
1	Conventional vertical milling machine
1	Conventional horizontal milling machine
9	CNC hybrid Kent vertical milling machines
1	Water Jet cutting head
2	CNC HAAS lathes
2	CNC HAAS vertical milling machines
4	Industrial robotic arms

26	Training robotic arms
2	Vertical bandsaws
2	Horizontal bandsaws
1	Power hack saw
3	Surface grinders
1	OD-ID grinder
1	Tool and cutter grinder
5	Pedestal grinders
1	Sandblaster
1	Powder coating station
4	Heat treat ovens and furnaces
3	Welding stations
8	Rapid prototyping machines
1	Wire EDM machine
1	Sinker EDM machine
1	CMM inspection machine
7	Haas and Fadal CNC Simulators
24	Desktop computers
24	Sherline hybrid desktop CNC mills
24	Sherline hybrid desktop CNC lathes
1	Emco CNC lathe
1	Haas CNC Sheet router
1	Epilog 25 watt laser engraver
1	Vacuum former
1	CNC foamcutter

1	3D laser scanner with computer
1	400 watt laser head