Microelectronics Technology Program Review 2013-2017

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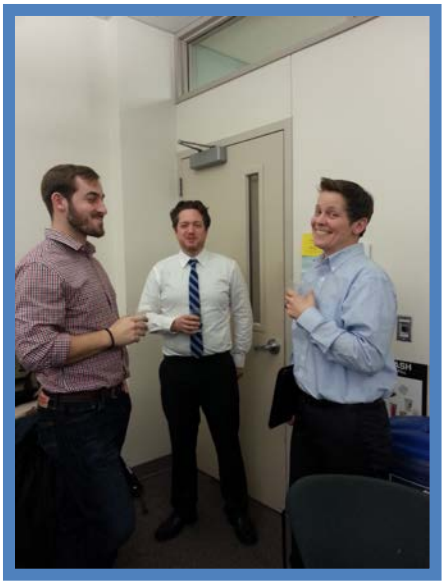
History of the Program

In 1990, at the request of Intel Corporation, PCC resurrected the MT program and updated the curriculum to fit Intel's wafer fab technician requirements. At this time, construction had begun on two new wafer fabs at Intel's Aloha, OR, campus. Intel's motivation in establishing an AAS program in Microelectronics Technology was to help approximately 300 operators in Fab4, their 4-inch wafer factory, transition to technician jobs in the new factories. The MT program was offered at Intel's Aloha, OR, campus from 1990 to 1995 under a contract administered by CWT. All courses were offered at Intel with the exception of science laboratories in chemistry and physics which were held at PCC. At this time, the MT program was only available to full-time Intel employees. In August of 1995, the MT program was moved from Intel to PCC's Washington County Workforce Training Center (CAPITAL Center) and was opened to the general public in addition to Intel employees. In 2005 the program was relocated to the Rock Creek Campus. In terms of college organization, the MT program is part of the Science and Technology Division at Rock Creek Campus. For the last five years, the administrative configuration of the department was:

SAC chair: Shelton Fu
Department chair: Eric Kirchner
Instructors: Dorina Cornea-Hasegan (FT), Jody House (PT), Paul Wohr (PT), Curtis Lipski (PT), Sidney Fernandez (PT)
Technical and Administrative and Student support: Robert Beadle (Technician), Niki Steele (Admin), Donna Drayer and Bill Manley (Student Employment), Jenny Kirchler (Recruitment-joined the program in January 2017)
Division Dean: Erica Heider, Besty Julian, Matthew Altman



1. Program/Discipline Overview:

A. Educational Goals of Microelectronics Technology Program

PCC's Microelectronics Technology serves a number of high technology companies that are pillars to Oregon's economic engine. We strive to endow our students with equipment maintenance and trouble-shooting skills and an understanding of the high technology manufacturing process to qualify them as technicians in the industry. The high technology industry presents a unique challenge to the Career and Technical education community as it requires a mix of traditional "wrench turning" mechanical skills and much more technology intense understanding of electronics and electro-mechanics in its technician workforce. It also requires understanding of sophisticated processing technologies which entails the grasp of the basic sciences such as physics and chemistry. Since its inception, Microelectronics Technology curriculum was designed to meet this challenge. The core of our program is the Microelectronics Technology AAS degree. Its learning outcomes state: MT graduates should be able to:

- *Operate, maintain and troubleshoot manufacturing and testing equipment;*
- *Troubleshoot circuits and systems;*
- *Monitor and maintain semiconductor manufacturing processes;*
- *Work effectively in teams;*
- *Communicate effectively with colleagues and vendors.*

This set of learning outcomes is mainly designed to target the needs of the semiconductor industry. Few specific national or professional discipline/program guidelines exist for two-year microelectronics technology programs due to its specialized nature. In 1995, SEMATECH's Technician Training Task Force published curriculum recommendations for two-year programs in semiconductor manufacturing technology. SEMATECH is the world's premiere semiconductor industry collaborative research consortium. These guidelines were based to a great extent on the two-year microelectronics technology curriculum jointly developed by Intel Corporation and Portland Community College in 1990. Maricopa Advanced Technology Center (MATEC) later inherited these guidelines and refined them in 2000 to be the MATEC Semiconductor Manufacturing Technician Skill Standards. PCC MT curriculum and program outcomes match closely to the above mentioned standards.

In 2007, we were excited to welcome the solar voltaic manufacturing industry to Oregon. We reached out to and were warmly received by companies in this sector. Since then, we have worked closely with their representatives to develop our Solar Voltaic Manufacturing Technology AAS and COC. The Solar Voltaic Manufacturing Technology AAS learning outcome states: SVMT graduates should be able to:

- *Monitor and evaluate solar cells manufacturing process.*
- *Operate, perform maintenance and trouble-shooting on selected solar cells process equipment.*
- *Be able to troubleshoot electrical, mechanical and automated systems.*
- *Work effectively in teams.*
- *Communicate effectively with colleagues and vendors.*

And the Solar Voltaic Manufacturing Technology COC learning outcome states: COC graduates should be able to:

- *operate manufacturing and testing equipment after specific training.*
- *monitor semiconductor manufacturing processes.*
- *communicate effectively with colleagues, supervisors and vendors.*

The semiconductor and solar voltaic manufacturing process has become highly automated. It involves automation within process equipment as well as a highly automated complex system used to shuttle materials in between process equipment. To meet this new trend in the industry, in consultation with our industrial partners, the MT program developed the Automated Manufacturing Technology AAS. Its learning outcomes state AMT graduates should be able to:

- *operate, maintain and troubleshoot automated equipment used in the high volume manufacturing environment.*
- *maintain automated systems used in work flows and for material and supply handling.*
- *work effectively in teams.*
- *communicate effectively with colleagues and vendors.*

These degree options in our program are consistent with national trends in high technology sector technician education. With the advancing technology of manufacturing, many of our counter parts around the nation have to adapt to serve a diverse field of industries: such as nano-technology, Micro Electro-mechanics, renewable energy, medical equipment, transportation equipment, etc. We see a continuing trend of program migration to these diverse fields but most of them share the commonality of electro-mechanical equipment or devices. Because of the nascent nature and diversity of the fields, there has been no national standard in these fields. The goals have not changed since the last review. However, as the industry we serve constantly changes, it is almost certain that our program will need to evolve as well. . We continue to monitor emerging industries that utilize similar skills we train our students to have. See section 7D for a discussion on the convergence of many industries in the future.

B. Briefly describe curricular, instructional, or other changes that were made as a result of SAC recommendations and/or administrative responses from the last program review?

In the 2012 program review cycle, the MT SAC discovered some weakness in circuit trouble-shooting skills of our students both at a system level and component level based on our equipment trouble-shooting skill assessment. Component level circuits demonstrate how various circuit components work. They typically contain fewer components (up to 20~30). Component level circuits serve as building blocks of system level circuits. System level circuits are typically made of 10 individual component level circuit blocks.
We will address improvements at these two levels separately.

1. System level circuit trouble-shooting skill:
In 2012 review, we recommended more rounds of instructor demonstrations in class and more student exercises in the area of signal tracing and probing.
A major challenge of system level circuit troubleshooting is its complexity. It starts from the understanding of complicated schematics. A signal can wind through 10 junctions through its

entire path. At each junction the signal takes on one out of many possible routes. A student has to judge intelligently which route the signal is likely to take based on his understanding and clues given by the schematic. This task is called signal tracing. It is akin to navigating trail heads without a map but managing not to get lost. To improve the learning of it, we added a discussion of the challenges and the pitfalls of signal tracing before the actual lecture on the details of how to do it. This tends to help students to get a better sense of what this task is about and thus learn it more efficiently.
We also added a new round of homework signal tracing on a sensor subsystem. Previous homework problems only focused on actuator systems. More importantly, we introduced the discussion of the meta-thinking behind how the instructor would make the right decision when judgement is required at various junctions of the signal path both in the lecture and in homework solutions. The meta-thinking discussion, in our opinion, helped students to improve their performance in this area significantly.

Once a student can trace a signal in the schematics, she then needs to probe the signal on the actual system following the schematics. Previously most of the probing procedures were described verbally in lectures, then demonstrated in class. But we found that many students who are struggling to understand a procedure may not be able to take detailed notes on how it should be done exactly while it is being discussed in a lecture. So we are beginning to document down these procedures in a worksheet format. In the future, we recommend more procedures, especially block diagnostic tests, should be documented down in a work-sheet format to help students to retain this knowledge better.

We were not able to follow up the recommendation of inserting more rounds of signal probing because our curriculum is already so packed. Future recommendation: we realize that work load in our curriculum tends to ebb and flow. While the signal probing period of the curriculum has no more room for additional exercises, there is space in other weeks, either before or after this part of the curriculum. We can isolate out parts of the signal probing task to teach and ask students to practice during lighter load weeks. This may prove to be critical as currently students do not have enough practice to be familiar with these procedures. One complication instructors have to pay extra attention to in order to implement these changes is to stage the safety setup of the equipment carefully so that both the new signal probing exercises and the existing exercises in those weeks can proceed simultaneously safely, for different exercises require different safety setups.

2. Component level circuit trouble-shooting:

All the ideas and plans formulated in the previous review were implemented in the circuit classes (MT 111, 112, 113, 121, 122) in new and creative ways, through lectures, lab activities and also assessments.

Lecture level: every lecture in these classes now has a portion dedicated to the specifics of troubleshooting either a particular component, or a particular circuit. For example in the lecture

about "series circuits" after presenting the characteristics of such a circuit, a detailed discussion will take place about what will happen in the series circuit if there were a "short" or "an open". When a topic like "transformers" is presented the students are shown a burned transformer and the poor practices that may bring the device in such a state are discussed in class.

Lab level: The lab time is indeed the best time to teach troubleshooting techniques. The instructors use practical teaching strategies, making the most of the lab time. For example when an unintentional mistake is made by a team of students an unexpected circuit output is revealed. The case is assessed , discussed by the student-instructor team, and before fixing the fault, the entire class is invited over to that station to learn about the troubleshooting methodology used for the particular, unexpected scenario that occurred.

Most of the lab exercises have at least a troubleshooting scenario to be performed. The practical exam of MT 113 is mostly dedicated to circuit troubleshooting techniques and it became in time a measuring tool for one of the program outcomes.

Assessment level: All the exams (midterms and finals) have a significant section dedicated to troubleshooting scenarios. The questions are usually formulated like this: "The output of this circuit is expected to look like this. However something happened and the measured output looks like this …instead. What could be the problem? Justify your assumption." The final exam in MT 112 became a 100% practical exam, replacing the "paper final exam". This final is focused on troubleshooting ac circuits consisting of R, L, C obscued in a blackbox, that has a measurable output. Based on the differences between the expected and measured output, the student is expected to diagnose and then fix the circuit." See also next section 2.A.i.

2. **Outcomes and Assessment: Reflect on learning outcomes and assessment, teaching methodologies, and content in order to improve the quality of teaching, learning and student success.**

A. **Course-Level Outcomes: The college has an expectation that course outcomes, as listed in the CCOG, are both assessable and assessed, with the intent that SACs will collaborate to develop a shared vision for course-level learning outcomes**

i. **What is the SAC process for review of course outcomes in your CCOGs to ensure that they are assessable?** *MT SAC counts on each instructor who teaches an MT course to assess the outcomes that are established through the CCOG. We are presenting here an example of how "circuit troubleshooting" course outcome is assessed in one MT course.*

Student Name:……

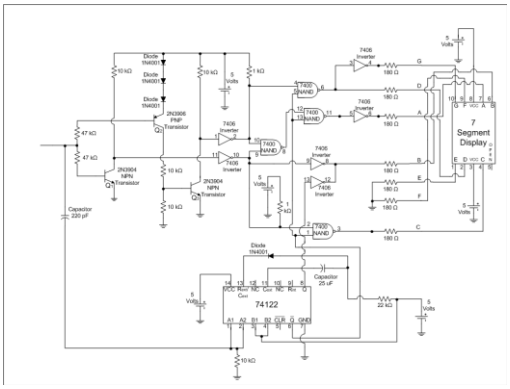
Score:… /5

MT 113 Practical Examination (60 minutes)

SAMPLE—Course Outcome ASSESSMENT

June 2015

The given circuit is supposed to be a reflection of the schematic below. However a problem was purposely created when the circuit was built on the breadboard. Your task now is to find the problem, to fix it and to test the circuit proving its expected function (according to the schematic). Follow the steps from below, and show your work to your instructor one step at a time.



1. *Describe in writing what the function of the circuit from the schematic should be. Describe separately all three cases A, B, and C defined below.*

Case A: Vin=0V 7 Segm Display shows: …….. (0.5p….0p)

Case B: Vin=5V 7 Segm Display shows: …….. (0.5p….0p)

Case C: Input is floating 7 Segm Display shows: ……. (0.5p…0p)

2. *Test the circuit and fill out the table below: (1p….0.5p….0p)*

Describe in writing the tests you decided to run:	*Expected (theoretical) OUTPUT for each case:*	*Real (tested) OUTPUT for each case:*
A. *B.* *C.*	*A.* *B.* *C.*	*A.* *B.* *C.*

3. *Based on the test results from step #2, 'diagnose the circuit': identify the problem using a systematic approach that involves the test equipment available (the DMM or the oscilloscope). Describe in writing the troubleshooting strategy adopted. Once the problem is identified and eliminated, demonstrate the functioning circuit to your instructor.*
   (2.5p….1.25p….0p)
   (Note: The expected troubleshooting method is 'signal tracing'.)

*Interpretation of the results: The course outcome assessed here is *CIRCUIT TROUBLESHOOTING* According to the previous assessment results, of a population of 33-- 20 students (60%) met the benchmark, and 13 (40%) did not. The benchmark adopted by the SAC was to earn a score of minimum 2.5 out of 5 on the practical examination taken in MT 113 class. The same assessment method and the same benchmark will be used in the current assessment (2014-2015).*

*Based on the 2014 analysis of student performance, the MT SAC decided to further infuse *circuit troubleshooting* concepts into the first year curriculum. The majority of the topics in MT 113 have now a stronger emphasis on "circuit troubleshooting". From the total population of 25, 88% achieved the benchmark level of 2. 5 (out of a maximum of 5 points) the measured outcome, which is CIRCUIT TROUBLESHOOTING. For this 88% of benchmark attainers, the average score was 3.2. For the 12% of the population that did not achieve the benchmark level of 2.5, the average was 1.75 (out of a maximum score of 5).*

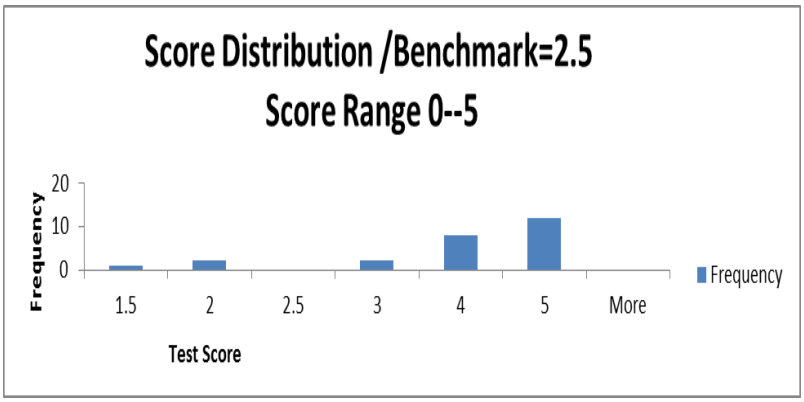
In the previous assessment, when both the benchmark (2.5 out of 5 on the practical exam) and the assessment tool were the same as now, 60% of a population of 33 participants achieved the benchmark level for circuit troubleshooting.

In summary:

2014---60% (population of 33) attained the benchmark

2015—88% (population of 25) attained the benchmark

*The new assessment indicates a better student preparation for *circuit troubleshooting* in 2015 than in 2014.*



ii. Identify and give examples of changes made in instruction (on-campus and online as appropriate), to improve students' attainment of course outcomes, or outcomes of requisite course sequences (such as are found in in MTH, WR, ESOL, BI, etc.) that were made as a result of assessment of student learning.

1. *According to the program outcome assessment finished in June 2011, "troubleshooting" revealed poor student performance, both at the system and the component level. As a result, the following changes were adopted in the first year -electronics classes, during 2011-2012 school year 1) Labs in Digital II-troubleshooting section required and graded. 2) Re-writing some lab experiments in MT 113. 3) Re designing the practical examination in MT 113.*
2. *The 2011 assessment report emphasized weaknesses in troubleshooting in second year students, and recommended several changes to the second year process equipment sequence. Based on that analysis, the MT SAC decided to put forth efforts to further infuse troubleshooting concepts into the rest of the curriculum. As a result of this, a few changes in teaching the subject of electronics took place, more this academic year (2012-13) than ever before: The majority of the topics taught have now a new and stronger emphasis on troubleshooting.* ***For example*** *before, if the topic was "transistors", students were studying the type of, the characteristics of, and some applications of these devices, while the troubleshooting methodology of them was only occasionally touched. This year, a clear and consistent shift from the above mentioned content was implemented: for each type of transistor or transistor circuit, a table with "potential problem-possible cause-solution" is presented, and becomes the focus of the lecture about "transistors". Two new lab experiments were designed and*

implemented in MT 112, both with a strong emphasis in troubleshooting. In one of them, students have to test and recognize specific "faults" in transformers, and in the other they have to go through the same process of identifying "the problem-the cause-the solution"-all related to a solar-system-inverter circuit. Replacement of the on-paper-final-exam in MT 112 with a practical-in-lab final exam. The new practical final exam is dedicated mainly to circuit troubleshooting skill assessment.

3. *The 2012 report indicated the department should evaluate how report organization and data presentation are integrated into classes, and to consider requiring COMM111 Public Speaking. A new course was developed on statistics for process control, which emphasizes handling and presentation of data. The report template utilized by the department was reevaluated and circulated among the teaching faculty.*

B. Addressing College Core Outcomes

i. Updated Core Outcomes Mapping Matrix.

Microelectronics Core Outcomes Mapping

Mapping Level Indicators:	***Core Outcomes:***
0 Not Applicable *1 Limited demonstration or application of knowledge and skills.* *2 Basic demonstration and application of knowledge and skills.* *3 Demonstrated comprehension and is able to apply essential knowledge and skills* *4 Demonstrates thorough, effective and/or sophisticated application of knowledge and skills.*	*CO1- Communication* *CO2- Community and Environmental Responsibility* *CO3- Critical Thinking and Problem Solving* *CO4- Cultural Awareness* *CO5- Professional Competence* *CO6- Self-Reflection*

Course #	***Course Name***	***CO1***	***CO2***	***CO3***	***CO4***	***CO5***	***CO6***
MT 101	***Intro to Semiconductor Manufacturing***	***2***	***1***	***1***	***1***		***1***
MT 102	***Intro to Semiconductor***	***2***	***0***	***1***	***0***		***1***

	Devices						
MT 103	*Intro to Micro and Nano Processing*	*2*	*0*	*1*	*0*		*1*
MT 104	*Intro to Solar Voltaic Processing*	*2*	*0*	*1*	*0*		*1*
*MT 108**	*Statistics for Process Control*	*2*	*0*	*2*	*1*		*1*
MT 109	*Basic Electronics and Instrumentation*	*2*	*1*	*1*	*0*		*1*
MT 111	*Electronic Circuits & Devices I*	*2*	*0*	*1*	*0*		*0*
MT 112	*Electronic Circuits & Devices II*	*2*	*0*	*1*	*0*		*0*
MT 113	*Electronic Circuits & Devices III*	*2*	*0*	*1*	*0*		*0*
MT 121	*Digital Systems I*	*2*	*0*	*2*	*0*		*0*
MT 122	*Digital Systems II*	*3*	*3*	*4*	*0*		*0*
*MT 131**	*Intro to Programmable Logic Controllers*	*2*	*0*	*3*	*0*		*0*
MT 180	*High Tech Employment Strategies*	*4*	*0*	*3*	*3*		*4*
MT 200	*Semiconductor Processing*	*3*	*2*	*4*	*1*		*3*
MT 222	*Quality Control Methods in Manufacturing*	*3*	*2*	*3*	*1*		*2*
MT 223	*Vacuum Technology*	*2*	*0*	*3*	*0*		*0*
MT 224	*Process Equipment I*	*2*	*0*	*3*	*0*		*0*
MT 227	*Process Equipment II*	*2*	*0*	*3*	*0*		*0*
MT 228	*Process Equipment III*	*2*	*0*	*3*	*0*		*0*
MT 240	*RF Plasma Systems*	*3*	*1*	*3*	*0*		*1*

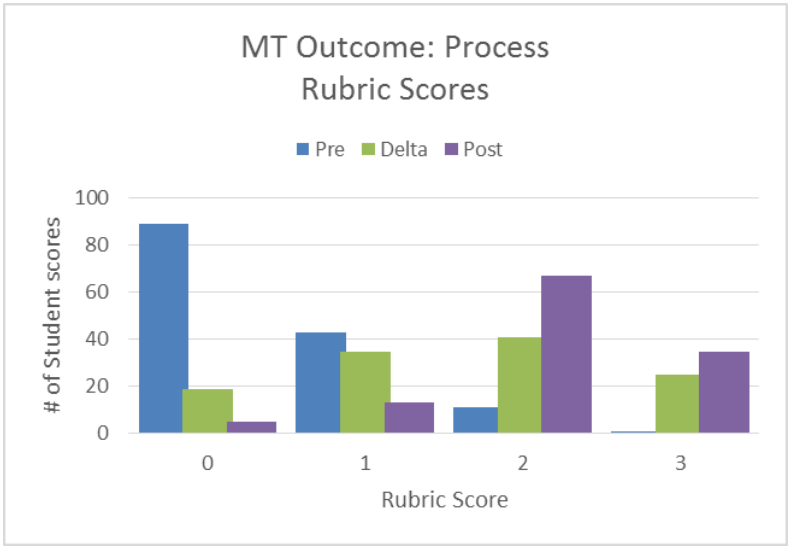
**New courses created in this program review cycle.*

C Microelectronics Technology: Degree Outcomes

i. Briefly describe the evidence you have that students are meeting your Degree outcomes. This section was revised 2/1/2018 for clarity.

1. Our 2016 assessment of the outcome of monitoring and maintaining semiconductor process rated all 15 students on eight different aspects of this outcome. The rubric is presented with the graph below. We would expect students to have a pre score of 1 based on their previous course outcomes. The benchmark post score is an average of 2 for each student, with an expected improvement (delta) of at least 1 in most aspects.

   Eight students met the benchmark post average score, 7 did not. The average post score was 1.8. 9 students showed significant improvement in at least 6 out of the 8 aspects. The graph below shows the distribution of scores for all students in all aspects.



Rubric:

- 3: Demonstrates a high level of ability – will be able to achieve the ability independently utilizing generally available resources,
- 2: Demonstrates an acceptable level of ability – will be able to achieve the ability in the short term under moderate instruction,

- 1: Demonstrates an inferior level of ability – will be able to follow directed procedures to achieve the ability, but may require additional or continuing direction/instruction to act independently,
- 0: Does not demonstrate the ability

Program outcome 1b: Equipment Troubleshooting Skill Assessment Result

	2013	2014	2015	2016
Total # of student	31	25	27	21
% of students meeting proficient criteria	94%	92%	89%	86%

Program outcome 1c: Equipment Maintenance Skill Assessment Result

	2013	2015
% of students meeting proficient criteria	87%	96%

ii. Reflecting on the last five years of assessment, provide a brief summary of one or two of your best assessment projects, highlighting efforts made to improve students' attainment of your Degree and Certificate outcomes.

A key learning outcome of our program is equipment troubleshooting skill. Technically, it is probably the most challenging outcome of all of the outcomes, as it requires higher level thinking skills. Also, troubleshooting skill is a soft skill that is harder to quantify than competence in equipment operation and maintenance. To make the assessment as realistic as possible, we decided early on not to use pen-and-paper tests, but instead to use on demand performance of a troubleshooting task to assess it. That is, students are ask to solve an error intentionally installed into the equipment by an instructor. We also decided that the test should include the entire process of the troubleshooting of an error, not just parts of it. Samples of errors we use were vetted by technical experts from companies on our advisory committee, to closely mimic the basic problems that equipment technicians would typically encounter. This way, when students can solve these problems, we have the assurance that they will meet or exceed any requirements they will have on the job.

Given that we only have time to examine the solving of one single error, it is critical that we can ensure that it is their general equipment troubleshooting

skill, not their familiarity with a specific problem, or just one-time luck that enables our students to successfully troubleshoot an error. By design, our grading rubric requires that students demonstrate a consistent pattern of the application of systematic troubleshooting methodology. At each juncture, students are asked to hypothesize what are all of the possible causes that can cause the error. Then they have to design diagnostic tests to systematically either confirm or eliminate the culpability of each possible cause, similar to the process a doctor would go through to discover the true cause of a person's illness. Each of the alternative possible causes represents an alternative way that the instructor could have stationed the error. This way, the instructor would have the confidence that even though the student in fact only solved one error, she has the judgement to potentially solve myriads of other problems.

Because of its realistic and holistic nature, the assessment test generates a rich host of data every year, much of which lead to insights about how teaching and learning can be improved. I will offer one example here. Many times during the administration of this test, I was a witness of the frustrations students experienced after they were stuck in the process, knowing the high stake of the exam too well, but not knowing how to proceed. Because of the strict guidelines imposed by the rules of the assessment, I as the instructor could not step in to offer any hint. Realizing that getting stuck is the rule, not the exception among even experienced troubleshooters, I finally grasped the importance of the teaching of recovery strategies of the troubleshooting process. After this, we instituted the teaching of it in our curriculum. In fact, although specific hints are still not forthcoming when students are stuck, these general strategies we teach are posted and are available during the exam. Now, I start to witness how students can stage dramatic come-backs in situations when they would have to be failed previously. I sincerely believe that students who underwent such an experience will relish it and will continue to reap benefit from it in the future, the full extent of which is impossible for us to fathom right at this moment.

iii. Do you have evidence that the changes made were effective (by having reassessed the same outcome)? If so, please describe briefly.

As a result of the yearly system troubleshooting assessment, and also of the continuous input received from the industry advisory board, the process equipment courses have continuously evolved in time, becoming more and more a simulation of 'on the job training and certification'. At the same time, the assessment itself is in the process of being changed, for details please the minutes included in Appendix 1.

iv. Evaluate your SAC's assessment cycle processes. What have you learned to improve your assessment practices and strategies?

The assessment of the equipment troubleshooting skills is done every year in the capstone class MT 228, the results are reported yearly as part of the Technical Skills Assessment. Please read the minutes form 10/2016 –Appendix 1 for changes in the assessment strategies.

v. Are any of PCC's Core Outcomes difficult to align and assess within your program? If yes, please identify which ones and the challenges that exist.

1. *Community and Environmental Responsibility maps to level 3 (demonstrated comprehension and is able to apply essential knowledge and skills) in one course, but maps to a zero in most other MT courses.*
2. *Cultural Awareness maps to a level 1 (limited demonstration or application of knowledge and skills) in two MT courses, and maps to a zero in all other MT courses.*
3. *About 50% of the required courses for the MT degree are non-MT; we do not control their content and outcomes, and it is difficult to track how they map to the college core outcomes.*
4. *We expect the PCC general education requirements allow students to achieve those core outcomes that do not align with our program content and outcomes.*
5. *Our advisory committee would not be happy with us if we reduced the MT content to allow for content that would make assessment of these core outcomes reasonable within our classes.*
6. *We have degrees in science and engineering and our professional competency and development are focused on highly technical semiconductor equipment and manufacturing. We are not the best qualified faculty at PCC for assessing these outcomes; the faculty aligned with the general education requirements are much more likely to be qualified for this assessment*

3. Other Curricular Issues

A. Which of your courses are offered in a distance modality (online, hybrid, interactive television, etc.), and what is the proportion of on-campus and online? For courses offered both via DL and on campus, are there differences in student success? If yes, describe the differences and how your SAC is addressing them. What significant revelations, concerns, or questions arise in the area of online delivery? (Contact the Office of Institutional Effectiveness for course-level data.)

i. *The department currently offers five courses via Desire2Learn: the introductory set of one credit classes (MT101, MT102, MT103, MT104) and the three credit Quality Methods class (MT222); this is about 10% of the MT courses, and 5% of the courses required for the MT degree. MT222 has been offered only in the distance learning mode until recently where a hybrid component has been added. We also can offer versions of all five of our first year electronic circuits classes as hybrid distance classes with the lecture offered online and the lab meeting on campus, but they have not run as hybrid in the past 5 years.*

In general we find that our students prefer campus based classes, though the flexibility of web classes helps many with scheduling challenges. There is a higher failure and dropout rate in distance classes associated with the additional student responsibility regarding time management and motivation.

Instructors continue to note that distance demands more work per student as compared to campus based classes as there is a greater tendency for one-on-one interactions as opposed to the group learning opportunities in a scheduled class. Likewise, group/team learning exercises are much more difficult to coordinate and in general less effective.

The continuing challenges connecting to D2L remain a concern which needs to be elevated as the problems are now being considered normal/acceptable.

B. Has the SAC made any curricular changes as a result of exploring/adopting educational initiatives (e.g., Service Learning, Internationalization of the Curriculum, Inquiry-Based Learning, Honors, etc.)? If so, please describe.

i. *MT240 was flipped. This involved creating a series of animated presentations with instructor audio. The lecture time is now used in the lab for a variety of activities including additional lab work, homework review and quizzes. While students appreciate the availability of the "lectures" for review, there has been*

no noticeable impact on student success. The process of flipping this 3 credit class required major amounts of time – the process shall not be repeated for other courses without dedicated release time.

C. Are there any courses in the program that are offered as Dual Credit at area High Schools? If so, describe how the SAC develops and maintains relationships with the HS faculty in support of quality instruction.

i. *MT 111-Electric Circuit and Devices used to be offered as Dual Credit at Hillsboro HS. No MT courses are currently offered as dual credit.*

D. Please describe the use of Course Evaluations by the SAC. Have you developed SAC-specific questions? Has the information you have received been of use at the course/program/discipline level?

i. *The MT SAC is using only the college standard questions for student evaluation. The student input is usually taken very seriously by each instructor; however it is never discussed at the SAC level.*

E. Identify and explain any other significant curricular changes that have been made since the last review.

i. *The 2012 to 2016 period represents a phase rather free of significant curricular changes. The minor changes worth mentioning here are:*

1. *Development and approval of **MT 108** a new MT course that teaches applied statistics. This two credit course may be taken instead of MTH 243, and is a prerequisite for the Process Quality Control MT 222 class. The students who decide not to continue on their studies in a 4-year engineering program are advised to take it in order to avoid the more strenuous yet unnecessary statistics MTH 243 class.*
2. *Following the MT Board advice, the PLC class MT 131 is not a required class for the MT major. MT 131 remains though a requirement for the Automation and Solar Technology Options.*

4. Needs of Students and the Community

A. Have there been any notable changes in instruction due to changes in the student populations served?

i. *There have not been any notable changes in student populations served, so there have been no notable changes in instruction associated with changing populations. Recognizing changes in employment demands, with more technical skills required, we have discussed appealing more to high school graduates. This may advance an opportunity to update instruction methods.*

B. What strategies are used within the program/discipline to facilitate success for students with disabilities? What does the SAC see as particularly challenging in serving these students?

i. *The MT SAC follows the recommendations from the Office of Disability Services.*

C. What strategies are used within the program/discipline to facilitate success for online students? What does the SAC see as particularly challenging in serving online students?

i. MT does not have online students per se. All MT students must take an online class, however.

ii. *Due to the well-known rigorous technical, scientific and engineering content of the MT courses, we phased out the courses that have a lab component and once offered them on DL format. Classes like MT 111, 112, 113 are no longer offered on line.*

iii. *Classes like MT 101, 102, 103, 104, and MT 222, that do not have a lab component are still offered on line, for student convenience.Strategies employed to support student success focus on dealing with their time management and motivation deficiencies. These include enhanced communication with the students via email, phone and visits to their on-campus classes with the purpose of reminding them of their course commitments and consequences to their grades. We have also implemented an on-campus meeting for the course to tie the course to their weekly schedule and enable direct student-instructor communication.*

Challenges include: poor student time management skills, poor student

motivation in the online environment, high time demands required for effective online instruction, difficulty motivating student-student interaction, and unreliable access to D2L.

D. Has feedback from students, community groups, transfer institutions, business, industry or government been used to make curriculum or instructional changes (if this has not been addressed elsewhere in this document)? If so, describe.

i. *Our advisory committee has indicated some students have difficulty with interpersonal skills during interviews, including communication. There have been some efforts to infuse communication skills in certain classes, and to emphasize the communication challenges the students will face when they join the work force. These have generally involved using current instruction content, tools and assessments. In MT240 students are required to write formal lab reports; besides relating the importance of passing down lab activities to the next shift when working in industry, we work on the specifics of communicating technical information. In MT200 students must present orally, reinforcing the critical concept of working and communicating with teams.*

5. Faculty: reflect on the composition, qualifications and development of the faculty

A. Provide information on how the faculty composition, professional development, and teaching reflect the Diversity, Equity and Inclusion goals of the institution (from PCC's Strategic Plan, Theme 5). What have you done to further your faculty's knowledge and creation of a shared understanding about diversity, equity and inclusion?

i. *The full time faculty are one third female, one third non-Caucasian, two thirds use English as their second language. Current part time faculty are 25% female and at least 25% non-Caucasian. Looking at the four PCC diversity strategies, the one pertinent to what we can do is the fourth: provide opportunity and support for all students. In particular we support campus activities that bring underrepresented students into our labs to experience science, technology, and college opportunities.*

B. **Report any changes the SAC has made to instructor qualifications since the last review and the reason for the changes.**

No changes made.

C. How have professional development activities of the faculty contributed to the strength of the program/discipline? If such activities have resulted in instructional or curricular changes, please describe.

i. *Jody House participated in a summer book group at the TLC reviewing 'Small Teachings'. As a result of the participating in the book group, they have changed the instruction in the MT10x series: pre-assessment (I ask the students a few questions about the topics that will be covered in the class); meta-cognition survey at the start of MT101 - this asks the students about their learning styles; I use the same question format during the final that I use for quizzes; I try to arrive to class early: this gives the students more access to me, and creates an informal environment for me to touch base with their progress*

ii. *Dorina Cornea took on a new class, MT 180 Hi Tech Employment Strategies, resulting in the addition of a component of technical questions and implementing the mock interview exercise as a mandatory exercise. All the materials created are now posted on D2L for student convenience. By making these changes, we believe the students are better prepared for their job interviews.*

iii. *Dorina Cornea cofounded and coordinates the Rock Creek STEM Lab as an interdisciplinary "Makerspace" lab for students and faculty, equipped with rapid prototyping machines like 3D printers and scanners, a CNC machine, vinyl cutter, laser engraver, electronics benches. The lab is designed to facilitate collaboration among disciplines at PCC-Rock Creek and will be hosting the STEM workshops and STEM summer camps proposed in the MeMT program.*

iv. *Dorina Cornea was the lead manager of The* ***Intel Ultimate Engineering Experience****, a summer camp initiated and sponsored by Intel, offered in the summer of 2013 on site at PCC-Rock Creek campus. Designed to help with STEM college retention, a 6 week long program focused on STEM activities, accommodating 120 college students from around the state. (https://www.youtube.com/watch?v=I-xGTPKaV_U)*

v. *Dorina Cornea passed the "Master Reviewer" and "Expert Reviewer" tests for Quality Matters Org (QM) a self-supporting nationally recognized organization offering institutional subscriptions and a range of services including QM-managed course reviews and an array of professional development opportunities.*

vi. *Dorina Cornea-presenter at The 2015 HI-TEC National Conference on Advanced Technological Education – "SEMI High Tech U -A Unique Model of Partnerships Between Industry, Community Colleges and HS".*

vii. *Dorina Cornea Co-Principle Investigator:* **Young Innovators and Makers,** Intel PCC Foundation grant- 2015/2016, $25,000.

viii. *Dorina Cornea Co-Principle Investigator:* **New STEM Co-Curriculum Modules-An Approach to Engaging Underserved High School Students in STEM Activities,** Intel PCC Foundation grant- 2014/2015, $20,000.

ix. *Dorina Cornea Co-Principle Investigator:* **Targeted STEM Recruiting,** Internal PCC grant-Professional and Organizational Development Office- 2014/2015, 3X $1220.

x. *Dorina Cornea authored and was awarded an NSF S-STEM grant titled Me(ntoring)MT, intended to encourage and enable low-income academically talented women and minority students to enter the workforce and/or Baccalaureate study following completion of an Associate degree in Microelectronics Technology,. The proposal includes 80 one-year scholarships for the MT-PCC students, and 10 one-year scholarships for transfer students to Oregon Tech, all awarded over 5 academic years. Recognizing that scholarships alone cannot address low retention and graduation rates in Microelectronics, the MeMT proposal implements and tests a student mentoring program heavily*

based on faculty and MT alumni and industry participation. Targeted recruitment strategies of minorities will be adopted by offering a STEM Camp every summer and two STEM workshops each year over a five-year period. The camps and workshops will be open to High School seniors, with marketing and recruitment focusing on minorities and women. The award of $879,337 was granted to the MT program by the National Science Foundation.

xi. *Eric Kirchner has been acting as an advisor for Ruth Carranza Productions who is developing a new video on semiconductor manufacturing, hopefully with NSF funding. Ms. Carranza has previously produced a series of videos called Silicon Run, which the MT department has long used in our courses. Advising activities have included participating in a pre-production workshop at Stanford University on November 13, 2015 where decisions were made about content that should be covered and who the target audience should be. Continuing activities have involved communications making connections with knowledge and content from the semiconductor industry, and in the active pursuit of grant funding.*

6. Facilities and Academic Support

A. Describe how classroom space, classroom technology, laboratory space, and equipment impact student success.

i. *Newly renovated spaces and "women, multicultural, writing, student resource centers" located in building 7, are usually the highlights of campus tours for prospective students. The up-to-date hardware and projection equipment, and the large and welcoming study spaces available in the science and technology building send a message that the campus is modern and in synch with the needs of incoming students. Touring these facilities, prospective students may imagine a curriculum in which the use of technology is seamlessly integrated into teaching and learning. This is a key factor because, students are attracted by technology is an "important" or "very important" factor in their choice of which college or program to attend. STEM Lab (linked directly to MT), or the maker space has moved to building 2, room 102. The space became a hub for Rock Creek students after being opened on January 25 2017.*

ii. *The biggest problem the MT SAC is facing now is the replacement of the clean room equipment used in the "equipment lab". More about this in the discussions-recommendation section of the report.*

B. Describe how students are using the library or other outside-the-classroom information resources. If courses are offered online, do students have online access to the same resources?

i. MT101, 102, 103, 104 – students search journal/news articles for current issues affecting the microelectronics industry and related effects on society. Online students generally use the same resources as campus based students.
ii. MT200 – students research holdings and reserve material for project topics presented in class.
iii. MT222 – students find published data describing a process for examination with quality control methods. Data can be found through the library, the internet, or other sources. Online students generally use the same resources as campus based students.
iv. MT111, 112, 113 – students use reserve books
v. MT240 – students reference databases for standard published technical information on properties of materials studied in class.

C. Does the SAC have any insights on students' use of Advising, Counseling, Disability Services, Veterans Services, and other important supports for students? Please describe as appropriate.

i. During this review period the MT program lost its long time support from Jobs and Internships, and went a long time without support from advising even though that support was funded by Perkins.

ii. Since then we have been able to focus our Perkins funds to Jobs and Internships and hire a specialist who is very dedicated and provides excellent support to the program and to the students. That support is very proactive making it very easy for most students to take advantage of it. Generally students that do not use this support already have jobs within the industry.

iii. The support from Advising was always barely adequate as the specialists provided did not have the skill or knowledge to support the MT students beyond basic advising and tutoring of learning skills, and were usually rotated out of the program before they could gain proficiency in these abilities. Most of the challenging advising duties fell on the department chair. The lack of a Perkins advisor now causes extreme difficulty for MT students that still must go to general advising for critical advising regarding academic holds and learning contracts, while the general advisors give them the run around not realizing there is no Perkins advisor for the MT program.

7. Career and Technical Education (CTE) Programs only. To ensure that the curriculum keeps pace with changing employer needs and continues to successfully prepare students to enter a career field:

A. Evaluate the impact of the Advisory Committee on curriculum and instructional content methods, and/or outcomes. Please include the minutes from the last three Advisory Committee meetings in the appendix.

The MT advisory committee meets once every term. It is composed of representatives from all prominent local companies in the industry. Our advisory committee serves the following critical functions:

1. Fosters relationship between the department and the industry, upon which all manners of communication and collaboration develop.

2. Updates the department of employment trends in the industry

3. Informs us of the skill sets required of workers in the industry. These skill sets are in turn reflected in the MT program outcomes.

4. Recommends, evaluates and approves major changes in curriculum.

5. Advises us on issues such as recruiting methods, training methodology, assessment methodology, etc.

6. Advocates for the MT program in the community, industry, professional groups, and other educational institutions.

7. Provides feedback on the performance of our graduates on the job.

As often as the committee meets, more work is done behind the scenes in sub-committee meetings, company visits, and one-on-one discussions, made possible through the human connections made during the committee meetings.

One example of the impact of our advisory committee is how it helps us to continue to refine our assessment methodology. Upon implementing the original design of equipment troubleshooting assessment test, it was found that the test was thorough but unsustainably long. On hearing our proposal to cut it short, the committee advised us on what aspects of the test can be shortened without compromising the quality of the assessment, and what other aspects have to be maintained to assess the essential skills that the industry is keen to see in prospective employees.

Based on our experience working with our advisory committee, we can envision several ways to make the advisory process even more effective:

1. Some companies only send representatives with human resources background but not representatives with technical background. Some companies do the opposite. While representatives with human resources background can provide us with the most comprehensive and accurate information on the hiring needs of their company and offer the most direct help for our students in job applications, technical representatives give us the most insightful inputs concerning our curriculum. In the future, it would be nice to ask both types of representatives to be present if possible.

2. Sometimes items discussed in the committee meetings require follow up. It may make sense to assign specific persons to be responsible for the follow up tasks during the meeting and review the status of completion in the next meeting.

3. Even though most companies in the industry are represented in the committee, some potential employers of our students are not. For example, we may try to recruit more semiconductor equipment makers to the advisory board in the future.

4. Some of the companies on our advisory board are very large. This requires that we cultivate long term relation with relevant branches within these companies, not just the representatives on the board.

B. Describe current and projected demand and enrollment patterns. Include discussion of any impact this will have on the program/discipline.

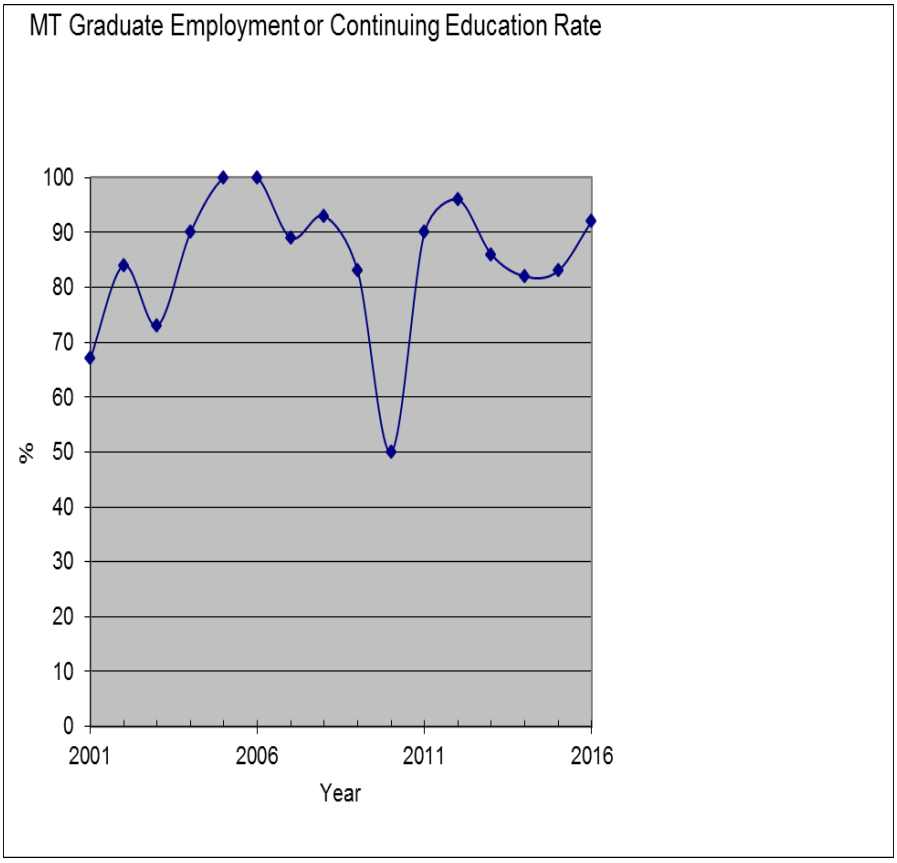
i. *Historically, demand for the program has always been cyclical, and we expect that to continue. For the most part of the last 5 year review cycle, we saw a large surge of demand. Indeed, for two out of the 5 years, we graduated record large classes two years in a row. However, this year, enrollment in our first year classes is very low. The largest factor determining demand is Intel. Intel is the largest private employer in the region, and locally is larger than any other microelectronics employer by a factor of 10. Five years ago Intel publicly announced and began the construction of a new fab for which they would need to hire many technicians. Then last year they announced layoffs. It is worth noting that this impact is much greater than the impact of the greater economy that is driving general enrollment trends at PCC. While PCC's recent enrollment decline has abated, the MT enrollment has plunged, even though there continues to be extremely high demand for MT graduates*

ii. *Following historical patterns, we would expect in the next five years Intel will run out of capacity at their current fab and will require a new fab in which to develop the latest technology. At that point we would again expect enrollment to spike, continuing the cycle.*

iii. *There are some developments that might impact this cycle. Technology improvement has reached a natural limit which is expected to increase costs. Unless discovery and invention find a way around this barrier it will be very difficult to predict how the industry grows in the future. There has also been much political discussion in the past few years regarding supporting technical education, the lack of technical ability in the workforce, and a significant pool of citizens lacking quality career paths. Depending on how these societal influences align there is great potential for growth in the program. And, to take advantage of this potential, the program has finally been able to get support with marketing to connect those potential students with this career.*

C. Review job placement data for students over the last five years, including salary information where available. Forecast future employment opportunities for students, including national or state forecasts if appropriate.

Job placement rate maintains high throughout this review cycle. The following chart shows MT graduate employment rate statistics from 2001 to 2016. This data includes students who obtained employment in MT or related fields or who went on to 4 year engineering programs. Currently we obtain this information by asking students personally one at a time towards the end of their second year. Some students do not graduate by then and we may lose track of them. So, some of them are not counted in this statistic.



As we can see MT graduate employment and continuing education track record is very strong. In the last three or four years demand for our graduates far outstripped supply. Essentially all students who were qualified and were willing to apply obtained jobs. The remaining 10~20% who were not employed were mostly students who did not perform up to standard in school (having grades of low Cs and Ds).

In the 2015~2016 academic year for example, 20 different employers came to us to help them recruit workers for a total of approximately 310 job positions, far exceeding our capacity to provide candidates. (One major high tech partner actually had several hundred entry-level job opportunities but only 50 were included in the 310 total.) Approximately 35 job offers were made to MT students who responded to these postings; several students received more than one offer.

In fact, employers are competing with each other to secure our students and graduates. More and more often, we see companies trying to intercept our students at earlier and earlier stages of their MT studies. Intel for example, comes to recruit our students 4 months before graduation. Now some other companies do so at the end of the fall term of the students' second year.

While students are studying in our program, there are many job opportunities as well. Multiple companies ask for our assistance to recruit our students into Operator positions just one or two terms after students enter into our program. The Operator positions are one level lower than Technician positions that our AAS graduates typically seek. Still this allows them to make connections between what they learn in the classroom and what actually happens in the industry. It also offers them the opportunity to get their feet into the door of this industry. Based on these facts, our students have outstanding prospects of employment while still in the program as well as upon graduation.

Furthermore the positions our graduates obtain are high wage jobs. Our entry level jobs generally pay well in excess of $40,000 per year. For an associate degree holder with no industrial experience, this is indeed a very decent wage, given many bachelor degree holders cannot compete with this. Technicians with several years of experience can easily earn more than $60k to $70k per year. This wage level thrust our graduates firmly into the middle class.

Intel continues to be the predominant source of employment of our graduates. Our program has greatly benefited from Intel's position as the leader in this industry and its large presence in Oregon. The Oregon Intel site focuses primarily on Research and Development (R&D). Research and development facilities like Intel's are much less likely to be off-shored than manufacturing. That is why the large scale lay-offs affecting other Intel sites largely spared Oregon until last year. Our program and our graduates have benefited from this stability so far. The inauguration of Intel's newest and largest ever R&D fab D1X in Hillsboro demonstrates its continuing commitment to the Oregon economy, and has fueled the explosion in MT enrollment in recent three to four years.

*Another accomplishment of our program over the last five years is the building up of the MT brand. The list of companies who came to us to recruit looks like the *who's who* of the semiconductor industry. For example, in recent years, all of the pillars of semiconductor original equipment manufacturers (OEMs) came to recruit our students. This is a new development unseen in the previous review cycles in the history of this department. Positions in OEMs require a much higher level of equipment maintenance and troubleshooting competence required by Intel. Our ability to place graduates into these technically higher echelon positions validates our effort to strengthen our equipment maintenance and troubleshooting curriculum over the past decade.*

A smaller semiconductor manufacturer--Maxim also came to recruit. This is a measure of the increased visibility of the MT brand. Another measure of our name recognition is how smaller companies that we have never reached out to, came to know our program somehow and contacted us for recruiting. For example, we fielded calls from Daifuku, and from MicroSemi in Bend.

One reason our program is so well recognized by the industry is the quality of our graduates. Another one is that our curriculum is so relevant to the skillset that is required of this industry. Our industry advisors continue to give us feedback attesting to the quality of our students. They were very satisfied with the performance of our graduates hired by them. They recognized that there is a special skillset that our students have that is hard to find elsewhere. They then start to come back to recruit from us year after year. Some of the companies start to regard us as the preferred venue of recruitment. Some requested that their staffing agencies to come to us to recruit. An advisor stated that the standard of our program is so solid, that he is interested even in students who fail our capstone equipment troubleshooting exam.

Some challenges remain in the placement of our graduates. First, even though more companies than ever come to recruit our students, Intel remains the predominant player. And this is not due to the lack of jobs offered by other companies like in previous program review cycles. The jobs are here but the students are not ready. This is mainly caused by the perception of our students. Most students enter this program having a set mind of working for Intel as the end goal. This mindset is not something that can be changed overnight at the time when a company comes to recruit. For this reason, we are working with other companies to help our students to broaden the perspective of our students. For example, we are changing our intro course learning outcome to include the awareness of the breath of companies in Portland and the relative advantages of working for each. We also plan to invite the companies to make presentations to our students at multiple stages of their MT career.

Secondly, even though we have had great success placing students in Intel and original equipment manufacturers (OEMs), the placement into semiconductor manufacturers other than Intel is very limited. We have placed only a small number of graduates directly into technician level positions at these companies. Since most local OEMs serve Intel directly, we are still vulnerable to Intel downs if we fail to place more students into other local semiconductor manufacturers.

Thirdly, the recent trend of local semiconductor manufacturers coming to hire our students as operators, while beneficial to our students in some ways, can take valuable study time away from them as these jobs require > 40 hr/week full time working schedules. This is impacting their learning outcomes. We would like to work out with their employer's possible solutions to this problem such as job sharing amongst students.

Looking into the near future, we see continued reliance on Intel as the dominant employer of our graduates. As competition to its leadership intensifies, it is experiencing an overall contraction of its labor force, evidenced by the layoffs started last year. Until a viable alternative to its current business model emerges, this trend may persist. However, Intel's presence in the Oregon economy as its largest private employer will

continue to loom large in the near future. With the newest and largest ever research and development fabD1X firmly established in Hillsboro, its position in the local economy is entrenched. Last year and this year, Intel continues to visit our campus to conduct record setting hiring simultaneously while it was staging large layoffs. Given these conflicting trends, it is hard to predict exactly what the future holds.

Any impact of a downturn at Intel can be mitigated by other smaller local companies picking up some slack, knowing that they are eager to get their hands on our students, and often have to wait in line after Intel to do so.

From a broader perspective, we also face pressure resulting from foreign competition of U.S. manufacturing. Asian companies have taken over a large share of semiconductor and solar voltaic manufacturing. This can lead to depressed wages at home and continuing pressure to off-shore manufacturing jobs. As we pointed out in the last review, this challenge also presents an opportunity for community college programs like ours. To meet this foreign competition, the U.S. has to be able to train highly skilled workers including technicians at a globally competitive wage. Many U.S. companies feel the need to upgrade the technical skills of their operator work force to manage the tasks previously handled by higher paid, experienced technicians. Community colleges can fulfill that training need to keep American manufacturers competitive. It will require ingenuity on our part to develop innovative solutions to meet these challenges.

The technology field that we are engaged in is rapidly changing and thus provides both opportunities and challenges. One such opportunity is the convergence of many fields and economic sectors around the theme of smart or automated machines. In the near future, machines in manufacturing, transportation, medical, office, building maintenance, distribution (whole-sale, retail, or e-commence) will become very similar. That is why Apple and Google want to build cars, and Amazon is building automated fulfillment centers and building drone delivery vehicles. The machine of the future, be it a self-driving car, a drone delivery vehicle, a robot in the distribution centers, your office machines, or your HAVC machines in buildings will be hard to distinguish. They will all utilize similar sensors, electromechanical actuators such as motors, pneumatic devices, and smart controllers. The maintenance and troubleshooting of these machines require a mixture of electronic, electrical, computer, electromechanical and mechanical skills, which traditionally have been taught in dedicated disciplines. Because the semiconductor industry has been a pioneer in automation, our program has been empowering students with this unique blend of skills for a long term. As other industries catch up, we foresee a potential for a much greater demand for our graduates across many industries.

Here we also call upon the college to take an active role in the coordination of the collaboration of the various PCC programs that are on this converging path, such as MT, EET, CMET, CIS, automotive, HAVC, etc. Perhaps the sharing of equipment, curriculum and instructors can be fostered.

D. Data on the number of students completing Degree(s) and/or Certificate (s) in the MT program. Analyze any barriers to degree or certificate completion that your students face, and identify common reasons why students may leave before completion.

Major	Description	Degree	2011-12 Completers
AUT	MT: Automated Manuf Technology	AAS	1
MT	Microelectronics Technology	AAS	24
MTS	MT:Solar Voltaic Manuf Techno	ACERT	4
MTS	MT:Solar Voltaic Manuf Techno	ACERTP	6
SOL	MT: Solar Voltaic Manuf Techno	AAS	17

Major	Description	Degree	2012-13 Completers
MT	Microelectronics Technology	AAS	29
MTS	MT:Solar Voltaic Manuf Techno	ACERTP	7
SOL	MT: Solar Voltaic Manuf Techno	AAS	16

Major	Description	Degree	2013-14 Completers
MT	Microelectronics Technology	AAS	20
MTS	MT:Solar Voltaic Manuf Techno	ACERTP	1
SOL	MT: Solar Voltaic Manuf Techno	AAS	7

Major	Description	Degree	2014-15 Completers
AUT	MT: Automated Manuf Technology	AAS	1
MT	Microelectronics Technology	AAS	20
MTS	MT:Solar Voltaic Manuf Techno	ACERTP	22
SOL	MT: Solar Voltaic Manuf Techno	AAS	3

Major	Description	Degree	2015-16 Completers
AUT	MT: Automated Manuf Technology	AAS	3
MT	Microelectronics Technology	AAS	14
MTS	MT:Solar Voltaic Manuf Techno	ACERTP	14
SOL	MT: Solar Voltaic Manuf Techno	AAS	1

We believe one reason why many of our beginning students are leaving the program, sometimes switching to different majors or simply dropping out of college all together, is the lack of academic and mental preparation. They start the program with enthusiasm, usually after taking a long break from school, and when they are faced with the rigor of our MT curriculum, they get discouraged and before we, the instructors or student support staff are able to identify any issue and offer them help, they decide to change their major. The second reason would be financial hardship: many of them are joining the program as under or unemployed people, with the hope that they will get hired sooner rather than later. When that happens while the student is still in the program, before graduation, the decision of dropping the program is immediate, yet completely understood. These may be people living off unemployment or who ran out of benefits, perhaps the main bread winner of a family with children, and are never blamed for choosing full time work over degree completion. All these were the incentives in writing a grant proposal that was submitted to NSF in May 2016.

E. Describe opportunities that exist or are in development for graduates of this program to continue their education in this career area or profession.

i. *This career/profession generally does not require further education beyond industry specific training classes offered internally to company employees. Many technicians fulfill their life career advancing up the technician ladder which is mainly a function of experience and ability, not academic training.*

ii. *Almost all companies in this industry will pay for their employees' further education to expand their abilities and opportunities that align with company goals and function. If a technician would like to branch into engineering, supervision or management, most companies will support that.*

iii. *For students that would like to expand their opportunities beyond the microelectronics technician career, we have a long standing articulation*

agreement with OIT where an MT student can complete a BS in EET in two additional years. All of the credits required for the MT AAS apply to the OIT BS in EET. For students that wish to pursue degrees at other institutions about half of the MT required credits (in chemistry, physics, math, communication, writing and general education) will likely transfer towards that degree.

8. Recommendations

A. What is the SAC planning to do to improve teaching and learning, student success, and degree or certificate completion, for on-campus and online students as appropriate?

i. *Teaching and assessing "teamwork" professional development program at the TLC: This was a recommendation from our 2012 program review. Availability of funds for professional development was advertised out of the Teaching Learning Centers, and we jumped on that opportunity to request this training. The TLC program was designed around our needs, and it is hoped that we can directly use this training to develop teaching and assessment tools that we can directly plug into our curriculum.*

ii. *Hired a Student Resource Specialist to support recruiting and retention, advising, counselling, learning and time management skills: The Science and Technology division at Rock Creek campus was able to hire a specialist to support the CTE programs. This will finally allow us to address the specific needs of MT that have never been adequately addressed through the Rock Creek directed Perkins funds and General Advising. Since we must share this resource with the other CTE programs, not all of our needs will be immediately addressed, but it is hoped that this person will be able to grow into this position and develop the skills and abilities to support our critical needs.*

iii. *Implementing the newly awarded NSF MeMT grant.*

iv. *Continuing outcomes and technical skills assessment activities.*

B. What support do you need from administration in order to carry out your planned improvements? (For recommendations asking for financial resources, please present them in priority order. Understand that resources are limited and asking is not an assurance of immediate forthcoming support, but making administration aware of your needs may help them look for outside resources or alternative strategies for support.)

i. *Continue funding our Student Resource Specialist: the needs of MT, BIT and VT are diverse and will require time for the specialist to become effective in all these*

critical areas. We need this person to be part of the program for years. There is little value in having them for a year or two and then seeing them go, taking all that they have learned with them.

ii. *Support the program through then next two lean years (low enrollment): To keep the program viable we need to support the challenging schedules of our students. With unemployment currently at record low levels most of our students are working. Some work days, some work nights, and some work compressed work week schedules that are the norm in the microelectronics industry (working Sunday, Monday, Tuesday and every other Wednesday, or working every other Wednesday, Thursday, Friday and Saturday). Many students are taking classes part time. To accommodate their schedules we need to run our classes around the compressed work week (classes meeting either Monday/Tuesday or Thursday/Friday) and also evenings. This forces dilution of class fill levels, making it difficult to meet an enrollment target. We also need to continually get enough students through the first year classes in order to have sufficient numbers for the second year classes.*

iii. *Lab Process Equipment: One of the crown pieces of the PCC MT program is the set of five Lam Research 8 inch plasma etchers donated to the program by Intel when they closed down one of their fabs. Each of these new might have cost $1,500,000. Unfortunately, they were designed to run continuously, and do not take kindly to the repeated power cycling required in a training environment. As a result of this they are suffering failures that are becoming more difficult and more expensive to repair. We would greatly benefit to replacing these with another set of five tools from a fab. Ideally these would be donated. We continually impress this idea on our advisory committee, but recognize that these people working at the ground level in production and human resources are not the ones making decisions about multi-million dollar donations. We have been working on the management of equipment obsolescence. We develop a list of parts that are most likely to fail. We have identified a reliable vendor of the most important parts, through a lead from one of our industrial partners who is also using our model of equipment in their production. This should help continue to supply us with critical parts for some years to come. This is only a stop-gap measure, as even the parts in stock at the vendor are continuing to age on the shelf. We are currently evaluating the possibility of replacing our equipment not by whole pieces of process equipment, which are exorbitantly expensive, but by functional parts. We have also identified aging supporting equipment that are prone to failure. We developed the solution of replacing them with smaller but more modern alternatives, which are not powerful*

enough for factory use, but suit our educational purpose adequately. The price of such modern alternatives are such that we can purchase and stock them up with our budget at a faster rate than the failure rate of our aging equipment.

We do hope our administrators will explore opportunities to interact with high level management of these companies in the community. We hope the administration can educate those decision makers about the huge benefit they gain from having our students to hire, and the synergetic situation they can enable at PCC.

iv. *An alternative to getting donated equipment would be to purchase tools on the highly competitive used market. The cost would likely be prohibitively high unless we can fund the purchase with a grant. There is also the challenge of finding a set of five identical tools*

v. *Professional Development opportunities designed for CTE: While we appreciate any professional development training that the Teaching Learning Center can provide, these are usually presented by people more associated with and more directed at lower division education. The content can be difficult to translate to the CTE environment, and the trainers often have difficulty appreciating the differences. Any effort put towards developing, fining or presenting CTE specific training would be appreciated.*

Appendix 1: Minutes from the MT advisory board meetings for fall 2016, fall 2015

MICROELETRONICS

ADVISORY COMMITTEE MEETING

10/12/16

Forwarded to Academic Services 11/18/16

ATTENDING:

Steve Klaus, Aerotek (Chair)	Eric Kirchner, PCC Department Chair
Rick Bloemendaal, Intel	Robert Beadle, Instructional Support Technician
Stephen Harder, Managed Technical Solutions Group	Dorina Cornea-Hasegan, PCC Faculty
James Kutscher, Biotronik/MSEI	Shelton Fu, PCC Faculty
Jorge Rodriquez, On Semiconductor	Erika Heider, Interim Division Dean
Phil Scheller, Applied Materials	Bill Manley, Jobs & Internship Specialist
Steve Thompson, Automation Solutions	Niki Steele, PCC Admin Support

The meeting was called to order at 8:37 AM by Steve Klaus, Chair. Introductions were given around the table. Newly attending were Stephen Harder with Managed Technical Solutions Group, and Erika Heider, Interim Division Dean for Rock Creek Science & Technology.

The minutes of the 5/18/16 meeting were approved by the committee as submitted.

Changes to Technical Skills Assessment – Shelton Fu

Our proposal is to shorten the time required for the Equipment Troubleshooting Assessment which is required by the State as one of our Perkins technical skills assessments. The assessment is applied at the end of the Microelectronics Technology curriculum in the Process Equipment III course. We install an error in the equipment and the students must find it and fix the problem. When we initially implemented the test we estimated that it should take 4-7 hours, but in reality for most students it takes 8-9 hours, and for some slower students can be as much as 11 hours a day.

We are today seeking approval by the committee of possible changes to the test to reduce time. The State requires signature approval by the Advisory Committee of any changes to the assessment in writing. Shelton explained why the test is taking so long, suggested possible solutions, and approached the committee on how they want to proceed today on this request.

Current Testing Method:

- Testing all students - typically 15 students/session X 2 sessions = 30 students
- Test 3 students/day * 4 days * 2 wks. = 24 students + additional 6 student testing after term is over.
- Every day 8.5 hr. for most years. Last year many slow students, every day 11 hours for > 2 weeks.

What is taking so long:

- Report writing (>50% of test time, to ensure I have a record to judge the students by).
- Waiting in line behind other people.
- Students get stuck on one point, no matter how trivial, can take hours to recover. Example, interpreted a normally open valve as a normally closed valve. Test result does not match with expectation. Throws them off track.
- Systematic, comprehensive trouble-shooting (potentially solving many problems).
    - Step 1: List of possible causes: What are all of the blocks that can possibly cause the problem?
    - Step 2: Test design (comprehensive): design a test for each possible cause, to test out which one is the actual cause. The comprehensive nature of the test design step gives me confidence that they do have a systematic methodology + they can solve many other possible scenarios.

Possible Solutions:

1. Waive the requirement of fixing the problem (i.e. identification of the problem is sufficient) will save ~ 1 hour (fixing + verification that the fix works)
2. Give instructor discretion to deem a student proficient after observing 2 rounds of isolation, even if identification of the problem requires, say, 5 rounds. This will mostly apply to good students. But it will help me to save time to focus on slower students.
3. Waive testing for A grade students;
4. Waiving the comprehensive test design requirement.

Committee Discussion of possible solutions: ***Questions from the Committee***

50% of test time is tied up in written documentation; could this be remedied by use of video equipment?

Shelton explained that the problem requires interaction between him and the student and he needs to make a determination as to whether or not to let them go on; making that judgement involves time. Shelton would have to playback the recording and then judge if the student could proceed. This puts lots of responsibility on the instructor because if the student fails the course and fails to graduate, they will have to wait another year to retake and pass the class in order to be employed. The writing part really guarantees that the instructor is fair to the student in reflecting their true abilities. There is also a need for written documentation of the process a student followed, in case there is any dispute after the fact. Some advisors concur with Shelton on the need for written documentation of the trouble-shooting process; request was to have them document everything that they are doing to get to the problem. If a unit breaks down tomorrow, the technicians need to know where to start looking and where you left off. Good documentation cuts through a lot of time.

Would eliminating one round of isolation in Item #2 really produce that much time savings (i.e. 1 hr.)?

Shelton responded that it takes a lot more than one hour per isolation round. If one student gets stuck, others are waiting in line. One round can take 3 hours on average, and later in the day can take longer due to fatigue or burnout. Eliminating some rounds will allow him to do more close observation of slower students (i.e. perhaps giving the student a hint that will initially cost them points, but won't leave them stuck for hours on minor problems).

Is it possible to bring in someone to assist Shelton in this testing?

Perkins requires that multiple graders arrive at consistent test results. Both Robert and Shelton are designated to assess. Robert steps in if Shelton is not available.

Waiving testing for A Students in Item #3 is a problem; the committee wanted a capstone objective to compare students showing that they really did pass. Committee expressed that industry is impressed with the tool sets of

our students, and we should have an assessment for everyone. All committee members agreed that they absolutely did not want to enact Item #3 and waive testing for A grade students.

The Committee asked if there is a way to modify the request on Item #4, to waive the comprehensive test design requirement. They felt that test design on all blocks was not necessary. Get to the problem quickly was of the essence. Most advisors held the view that if a student can provide the correct justification for choosing to test one block first over other blocks, the requirement of designing tests for all blocks could be waived. Shelton suggested that we modify Item #4 giving instructor discretion on whether or not to require the comprehensive test design on all suspect blocks. For slower students who can't give the reason as to why they chose one block over another, at his discretion he may require them to design tests for all suspect blocks. If they have vulnerability, he needs assurance that they can solve other alternate scenarios by requiring more test designs.

The Microelectronics Advisory Committee agreed to approve the following revisions to the Troubleshooting Assessment:

At instructor discretion:

- ***Waive the requirement of fixing the problem (i.e. identification of the problem is sufficient). If waived, students need to write proposed verification tests.***
- ***Deem a student proficient after observing 2 rounds of isolation, even if identification of the problem requires, say, 5 rounds.***
- ***Waive the comprehensive test design requirement (requirement of the design of tests for all suspect blocks) after a student offers sound justification of his/her prioritization of the test of one block over others.***

MT advisory committee disapproved the proposal to waive testing of A level students.

Shelton will mail out signature forms to Committee members to sign and return, documenting down their acceptance of the revisions they agreed on.

Microelectronics Technology Program Review – Shelton Fu

- Comprehensive analysis of strengths and weaknesses of Microelectronics Technology Program is presented to PCC Administrative Staff
- Required every five years
- Presentation is scheduled for March 10, 2017, 2:00-4:00 PM on Rock Creek Campus
- Advisory Committee will be invited to attend; love to have committee members there to report to those attending on how proficient our program students are when hired by industry.

Grant Proposal for Improved Retention: Dorina Cornea Hasegan

- Feedback from NSF sounds promising on funding the grant; award letter has not yet been received.
- If awarded, will start receiving funding in Jan 2017.
- Part of the grant proposal is a mentoring program supported by you, our industry partners. We will start mentoring students by the end of this fall term, even before the grant is funded.
- Intel already has such a mentoring program in place that started last August and targets STEM students.

Mock Interviews for MT 180 (High Tech Employment Strategies): Dorina Cornea-Hasegan

Two dates have been set for Mock Interviews for this course:

10/19/16 3:00-6:00 PM and 11/30/16 3:00-6:00 PM

Dorina thanked all the industry partners who had already committed to volunteering their time to participate in these mock interviews. If others are interested, she will be glad to resend another reminder regarding these dates for upcoming mock interviews.

Communication Classes: Eric Kirchner

Due to time constraints this was tabled to next meeting.

Update on Fall Enrollment and Graduates: Bill Manley

- Second year classes have 31 students who might be on target to graduate in December, June, or next September.
- Have only one student from last year's graduates who does not have a job; this student has not applied to some employment opportunities.
- Biotronik has an upcoming Career Fair on October 14th.
- Maxim, Intel, and Applied Materials have scheduled recruiting events as well on campus visits.
- Bill thanked the committee for being so supportive of our Microelectronics Technology students.

Recruiting for Winter Term: Eric Kirchner

First year enrollments are way down this Fall Term. We will be putting out a flyer requesting the Committee's help in recruiting new students to the program for Winter Term which starts January 9, 2017.

Projected Job Openings for MT Graduates/Students in 2016: Committee

Steve Thompson, Automation Solutions, has an immediate need to fill an Estimator/Project Manager position.
Phil Scheller, Applied Materials, has openings for 10 Junior Customer Service/Field Technician Engineers.

Update on Internships: Bill Manley

Intel just announced 5 internships in Facilities Management:

- Two-year internship
- 20 hours per week
- $17.45 per hour
- Intel will work with college class schedules

Microelectronics Technology program is very glad to see that Intel is opening up their internship program again.

Set Winter Meeting Date

Winter meeting date was set for Wednesday, February 22, 2017 at 8:30 AM in Bldg 7/116

Meeting Adjourned 10:12 AM

MICROELETRONICS
ADVISORY COMMITTEE MEETING

10/14/15

Sent to Academic Services 12/2/15

ATTENDING:

Steve Klaus, Aerotek (Chair)	Eric Kirchner, PCC Department Chair
Rick Bloemendaal, Intel	Robert Beadle, Instructional Support Technician
Vivek Dixit, Qorvo	Dorina Cornea-Hasegan, PCC Faculty
James Kutscher, Biotronik/MSEI	Shelton Fu, PCC Faculty
Bonnie Melius, Biotronik/MSEI	Betsy Julian, Division Dean
Phil Scheller, Applied Materials	Bill Manley, Jobs & Internship Specialist
Steve Thompson, Automation Solutions	Niki Steele, PCC Admin Support

The meeting was called to order at 8:35 AM by Steve Klaus, Chair. Introductions were given around the table. Newly attending were Rick Bloemendaal, Operations Manager, Intel D1C, attending for Kevin Foster, and Bonnie Melius, Staffing Consultant, with Biotronik/MSEI.

The minutes of the 5/13/15 meeting were approved by the committee as submitted.

Curriculum Updates – Shelton & Eric

In previous meetings we had the committee's approval to drop Intro to PLC from the MT AAS Degree. We took that proposal to the PCC Curriculum Committee and the change has been approved. No new course or requirement was added to replace the PLC requirement in the MT AAS Degree. Intro to PLC remains as a requirement in the Automation and Solar AAS Degrees.

Regarding possible proposed changes to the communication courses required for the degrees:

- Handout given to committee with course descriptions for:
  - ✓ COMM 100 Introductions to Communication 4 credits
  - ✓ COMM 101 Oral Communication Skills 3 Credits
  - ✓ COMM 110 Voice and Articulation 3 Credits
  - ✓ COMM 111 Public Speaking 4 Credits
  - ✓ COMM 130 Business & Professional Communication 4 Credits
  - ✓ COMM 215 Small Group Communication: Process and Theory 4 Credits
- OIT Articulation Agreement with the Microelectronics Degree does require COMM 111, as do other degrees at PCC. An Oregon Transfer Degree requires COMM 111 or 112.
- COMM 130 and COMM 215 are both currently required in the MT Degree along with COMM 111
- MT Students have stated that they feel COMM 130 and COM 215 are so similar that they do not understand why both are required. These courses teach skills in how groups dynamically work and presentation making.
- COMM 111 develops public speaking ability; not necessarily interview skills.
- Requesting committee input on possibly requiring only two of the three communication courses. Input is as follows:
  - ✓ More required of student down the line than just interview skills; on the job, technicians must be able to lead and present on a project.
  - ✓ More emphasis on email and text communication. Speak in full words.
  - ✓ Presentation skills are important; there is a benefit to putting your thoughts into story before presenting.
  - ✓ Graduates who present and lead well help make a case for employers seeking hires, to hire again from our Microelectronics Technology graduates.
  - ✓ Students who take COMM 111 Public Speaking do not regret it; they may dislike it at the time, but they don't regret it.
  - ✓ Survey our MT graduates and see which of the three communication courses they found more beneficial after they started to work in the industry.
  - ✓ How hard would it be to combine the best attributes of COMM 130 and COMM 215 into one course? Due to Communications being a districtwide subject is much more complicated than just making a change in a Microelectronics (MT) course; is possible but a lot less feasible.
  - ✓ Committee asking whether we can require the communications instructors to bring in mid-level industry managers to talk about what their expectations are for presentation at their companies.
    - Academic freedom allows instructors to teach course material within the required content and outcomes in their own way. Not sure we can require communication instructors to bring in industry managers to address their presentation requirements.
    - We do incorporate developing interview skills with the assistance of industry partners within our own MT courses, particularly in MT 180.
  - ✓ Committee is suggesting requiring COMM 111 and either COMM 130 **or** COMM 215.

Eric suggested that we discuss this amongst department faculty at our next Subject Area Committee meeting and come up with a proposal to present to the MT Advisory Committee at our winter meeting. If the Advisory Committee approves of the proposal, we will go through the PCC Curriculum Committee for approval and the change would be effective Fall Term of 2017.

Physical Requirements/Disabilities – Betsy & Shelton

We have experienced increased service animals on campus. Recently we had a student in a chemistry lab class who had a service animal. Current PCC policy did not exclude the service animal from the lab. We met with the Safety & Risk Department at PCC to get a policy agreement establishing that we will use animal cages for dogs in an adjoining room in areas where PPE is required. Service animals are protected by ADA, but therapy dogs are not protected. An instructor cannot ask the student if the dog is a service or therapy dog; they can only approach the student if the animal's behavior suggests that it is not a service dog.

Betsy is soliciting input from the committee of instances in their facilities where service dogs are requested, and what policies they may have established. In addition, we would like information that we might provide to students with disabilities as they seek employment in the industry. We are hoping perhaps that companies have already approached their lawyers regarding some of these questions and come up with some verbiage. If you are unaware of these instances, perhaps you can take the question back to your human resources department to see if they have additional input. The following was discussed:

- ✓ No animals allowed in clean room.
- ✓ Even some medical devices cannot be accommodated in a clean room.
- ✓ Employer makes reasonable accommodation; but it all depends on the work setting.
- ✓ Safety of product and other employees are considered first.

When we have a student in the program that requires accommodations, how would we properly address this? As a college we are pretty accommodating, but we don't want the student to waste their time if their disability is going to preclude them from employment in industry after graduation. Input was as follows:

- ✓ We can advise them upfront on how realistic their expectations are; not wait until two years of training is complete before discussing it.
- ✓ We can give them an approximate percentage of their chances of employing with a disability.
- ✓ ADHD and physical disabilities are greatly different in how addressed in the workplace.
- ✓ If a student has a hearing deficit, tell the employer upfront that they have a deficiency so that the employer can accommodate with special lights on telephone etc. Intel has employed candidates with hearing disabilities.
- ✓ In interviewing, companies question upfront if candidate can lift 25 lbs., can they climb around equipment in the fab, and will they be able to be on hard metal floors on their feet for 9-10 hour shifts.
- ✓ Provide sample of job requirements from each of the respective companies to our students.
- ✓ Shelton is asking if all companies can give us the physical requirements of their job descriptions so that we can share these with our students early on in their technical education.

Dorina currently incorporates a question on diversity in her behavioral sample questions for MT 180; she presents to students on how diversity plays a role in the workplace. She cites an example of a VP with Microsoft who had a son diagnosed with ADHD. As a result the VP was proactive in changing policy at Microsoft to hire candidates with ADHD, finding value in the unique characteristics and strengths that these employees have. They are particularly good at programming, having exceptional abilities to stay focused on writing code. Everyone can bring a contribution to the company.

Recruiting Strategies for Winter Term

Marketing Support - Eric

We are in the same situation as last year and need a good push to fill the Winter Term classes. Last year the committee did a good job of recruiting, and we are hoping this year we can count on the same support in getting the word out at your companies to your employees, employee families, and friends.

Steve Thompson asked if our program is paired up with Work Sources of Oregon. Work Sources will make referrals to get the underemployed back in the workforce and the State will pay up to $6500 for the retraining. They also fund someone who is currently employed and wants to move up in the workforce with additional training. Eric has found that sometimes these students are not close to the math level required to complete the program; they are allowed to attend for only two years making it impossible for them to graduate in the two year time period with the initial lagging math skills. He would still appreciate the Work Sources referrals; it just may not be the best source for new students for our program.

Eric explained that PCC has a small marketing department that generally cannot provide much support; in addition, our department has little expertise in formulating a marketing plan. If you have anyone interested in volunteering ideas for marketing for the program, we would welcome the help. How do we appeal to students at PCC that don't know what Microelectronics Technology is? Posters and flyers get lost on bulletin boards and video postings for the campus TV screens generally have so many words on the screen you can't read it.

The committee responded with the following:

- ✓ Graphic design displaying name
- ✓ Clean room photo on marketing tool listing percentage of jobs placed and starting salaries
- ✓ Show products produced by the industry that tie to students personally
- ✓ Place advertising on PCC shuttles
- ✓ Market to the high schools and plant seed early to sophomores
- ✓ STEM teachers at high schools are our biggest advocates
- ✓ Heidi Edwards – Outreach Coordinator for PCC
- ✓ Advertise on pop radio stations that students frequent
- ✓ Advertise in malls on video displays
- ✓ Facebook
- ✓ City and county economic development folks connect with Chamber of Commerce and high schools for recruiting potential students from both the adult and youth perspective

Bill Manley reported on the six informational sessions for Microelectronics Technology that were held prior to Fall term to recruit new students:

- ✓ Shelton promoted these at Westview High School
- ✓ Bill, Dorina, and Eric hosted the sessions with good prospects for such a short time period of marketing
- ✓ Flyers were sent to the advisory committee and networked through their companies and families
- ✓ Qorvo had several employees attending
- ✓ Intel had several contracted operators interested in what it would take to complete the AAS Degree in Microelectronics Technology
- ✓ 22 actual prospects attended with 11 enrolling in Fall MT classes (6 of whom signed up for more than one course)
- ✓ Sessions included a well-received lab tour
- ✓ Attendees were very receptive to industry compressed work week and excellent salaries
- ✓ Similar informational sessions will be offered to recruit for Winter Term

Northwest Youth Career Expo – Shelton

Shelton explained that in the past most of our best recruiting has been through word-of-mouth by employees of companies represented in our committee; he is hoping that we can send out marketing flyers for Winter Term and they will promote the program on their campuses. Together we can keep the pipeline full to make our graduates ready for your openings.

The department is contemplating participating in the NW Career Expo on Feb 24, 2016 at the Oregon Convention Center. The annual NW Youth Careers Expo is the Northwest's premier career-education event, attended by 5,600+ high school students representing 50 high schools with 130+ exhibitors. The Expo shows students the region's amazing diversity of career opportunities, as well as the skills and education needed for those jobs. The goals are to connect employers to their future workforce and help students make informed, inspired decisions about their education after high school -- whether a four-year university, community college or apprenticeship training center. Shelton is looking for input from the committee to see if they would be interested in partnering with us at our booth for this event and possibly covering some of the cost:

- ✓ Early deadline to register is 11/30 and cost is $250 booth fee for educational institution, which includes 10 x 10 booth space, 8-ft draped table and 2 chairs.
- ✓ Committee is receptive and suggests having two booths for a larger presence.
- ✓ One long banner for Microelectronics Technology should span both booths.
- ✓ Location should be close to restrooms as this brings more exposure.
- ✓ Biotroniks/MSEI does career fairs all the time will participate.
- ✓ Intel and Applied Materials will also participate.
- ✓ Bring cool modules and props for display from their companies.
- ✓ Possibly have some item give away for the students.
- ✓ Recruiting even 10 students out of 5,000 attending would make this worth it.

Update on Fall Enrollment and Potential Graduates – Eric & Bill

- ✓ 39 first year students currently enrolled in MT 111 (Electronics Circuits and Devices).
- ✓ Program can handle 80 students for first year; 40 students for second year.
- ✓ Difficult to add class sections for second year due to equipment limitations.
- ✓ Retention can be as much as 70% from first year to second year.
- ✓ Many times students drop out because they are not mentally prepared for college and/or they work full-time and it is difficult to find time to study.
- ✓ Some students attend part-time and this makes it difficult to anticipate how that will affect our enrollment numbers.
- ✓ 27 students are starting their 2nd year.
- ✓ Expect to have 20 graduates this year as some of the second year students are attending part-time.

Discussion occurred on why we have trouble tracking graduates enrollment and employment status. Eric explained that it is a matter of privacy. When they get a job they are gone from the college, and the company cannot tell us when they hire them. Also students have control over their major selection and their official degree or degree declaration may not be Microelectronics Technology.

An alumni group was suggested for networking future graduates with those that are already employed in the industry to help students connect and get those first jobs in the industry. This is a group we should be spending a lot of time marketing our graduates to. Shelton explained that this takes a lot of work and we are a very small department; we would need a part-time recruiter who could assist the department in establishing this alumni group.

Bill Manley reported on employment status of our graduates from fall of 2014 through summer of 2015:

- ✓ 23 students graduated with AAS Microelectronics Technology Degrees
  - 18 students had job offers
  - 15 at Intel
  - 1 at Maxim
  - 3 are unconfirmed but likely do have job offers in the works from Intel, Cascade Microtech, and Biotronik/MSEI
  - 2 are still unemployed, one of whom is a recent high school graduate with no driver's license
- ✓ 7 students did not graduate that were working already or obtained jobs elsewhere

Update on Internships – Bill More internships are needed for this year. So far we have:

- ✓ Biotronik/MSEI (James Kutscher & Bonnie Melius) two internships currently available – Criteria is second year student in last 6 months of the MT Degree.
- ✓ Qorvo (Joe Chinn) – meeting with Qorvo tomorrow to discuss criteria for new internships at the operator level for students that are in the first year of the MT Degree.

Projected Job Openings for MT Graduates/Students in 2016 - Committee

Rick Bloemendaal, Intel: Hiring 30-50 manufacturing technicians that will start in the next 2-3 months.
Steve Thompson, Automation Solutions: Hiring a production technician in next 4-6 months.
Steve Klaus, Aerotek: Looking for what other member companies of the committee are looking for!
Vivek Dixit, Qorvo: Joe Chinn, Qorvo Director of Manufacturing Operations, and Bill Manley will be meeting tomorrow to discuss internships and positions.
Phil Scheller, Applied Materials: Nothing open at this time.
James Kutscher & Bonnie Melius, Biotronik/MSEI: Will hire one technician a month; would hire three now if they could. They will hire twelve over the next year. Two internships available in January and they will have interviews for these on October 27th. If they find more than two candidates for internships there could be more offered. They are looking for interns from an academic setting with attributes for science based learning, theoretical and less practical.

NSF Grant Application – Dorina

May of 2016 is the deadline for application for the NSF Scholarships in Science, Technology Engineering, and Mathematics (S-STEM). We are planning to apply for this grant which would supply scholarship money and funds for recruiting and marketing. The goals for the grant are as follows:

1) To increase the number of low-income, academically talented students with demonstrated financial need obtaining degrees in STEM and entering the STEM workforce or graduate study.
2) To improve the education of future scientists, engineers, and technicians with a focus on academically talented low-income students.
3) To advance understanding of the factors or curricular and co-curricular activities affecting student success.

There are three possible approaches but we would be applying under the Strand 2 projects expected to:

- establish scholarship programs that also provide strong academic and student support (e.g. high quality curriculum, professional, and workforce development activities) to increase student success and degree attainment (including student transfer, if appropriate)
- increase retention, student success and graduation in STEM and the quality of the STEM workforce
- focus on cognitive or non-cognitive aspects of student experiences and success (such as research experiences, **internships, participation in student cohorts, the mentor/mentee relationship**)

This would be a $1,000,000 grant over 5 years which would be used 60% for scholarships and 40% for recruiting, retaining, and graduating low income students in STEM fields. Without the committee's help we cannot make a strong enough case in the eyes of NSF. With your support and ideas we feel we can write a very good proposal. Collaborating with our colleagues in the PCC Grant Office, Dorina will come up with a first draft of the application

and run it by the committee at the winter meeting for their input. The specific dynamic of the Microelectronics Technology Advisory Committee will be the special touch in the application. A grant like this could become your company's free resource for improving the internal "diversity landscape;" you just have to invest a little bit of your time now.

Some initial suggestions regarding the application were:

- Include money for marketing fees for paying for radio recruiting adds
- Part-time position for a program recruiter, who may be an alumni of the program
- Tier the scholarships to one-half or one quarter to affect more students
- Offer tuition for one year of a two-year program to affect more students
- Perhaps your companies have already made a commitment to increase minorities in their establishments; you could connect us with those individuals affiliated with this commitment so that we could gather their input also
- Committee is requesting a copy of the draft by email if Dorina completes it before the next meeting

Mock Interviews for MT 180 High Tech Employment Strategies: 10/28 & 11/4 – Dorina

Currently we have enough volunteers for the mock interviews to be held 10/28 and 11/4.. We will be asking for your help again in the Winter Term for MT 180 mock interviews scheduled for January 20th and January 27th 3:00-5:30 pm. Dorina will send out another invitation and she is very appreciative of the committee's support.

Biotronik Invite to Interview Tech Students for Internships 10/27/15 3:00 – 6:00 PM

Bonnie Melius, Staffing Consultant, announced that they will have an event at their campus in Lake Oswego on 10/27/15 to tour their facility, network with staff, and have a 15 minute interview for students interested in obtaining a paid internship with their company. Bonnie handed out a flyer on the event:

- Students who will be graduating within a year may apply
- RSVP and email resume to Bonnie Melius to schedule the 15 minute interview
- Two or three staff will conduct the interviews
- Networking with current staff will occur while student is waiting for interview
- Two internship interview events a year are planned; event will repeat in the Spring
- If hired for internship, will start working in November or December and is flexible on start date around holidays
- Come prepared with resume and bring 5-6 hard copies.

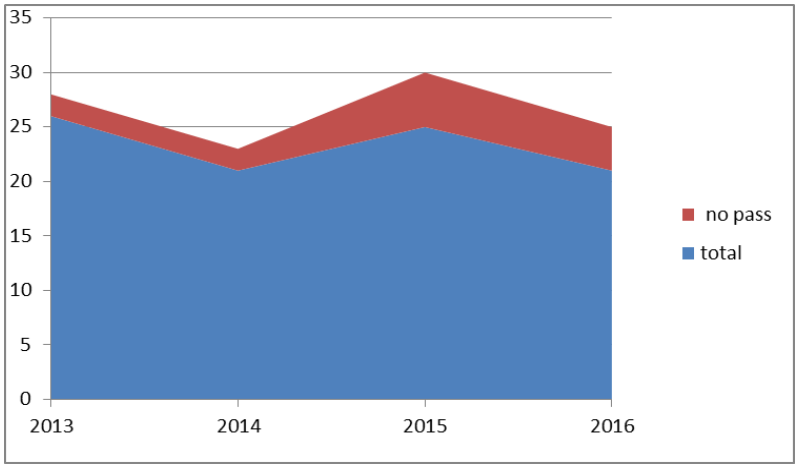
Set Winter Meeting Date

Winter meeting date was set for Wednesday, February 17, 2016 at 8:30 AM in Bldg 7/116

Meeting Adjourned 10:10 AM

Appendix 2: TECHNICAL SKILLS ASSESSMENT RESULTS 2013-2016

	Tot.	No pass
2013	26	2
2014	21	2
2015	25	5
2016	21	4



Appendix 3: MeMT NSF Grant and Recent Publicity

PCC lands federal grants to boost access to science and technology: PCC's press release about garnering nearly $2 million in federal grants to address access to sciences for underrepresented students generated significant coverage:

- *Business Tribune* (Feb. 7, print edition) -- http://pamplinmedia.com/but/239-news/343461-223213-pcc-wins-2-million-for-tech-and-manufacturing-programs
- *Lake Oswego Review* (Feb. 2, print edition) -- http://portlandtribune.com/lor/106-business/343081-222036-pcc-gets-2-million-to-create-mentor-programs-for-women-minorities-
- *Portland Business Journal* (Jan. 27, print edition) -- Color photo and news brief. Not posted online.
- *Portland Observer* (Jan. 25, print edition) -- News article (not posted online)