

CIVIL/MECHANICAL ENGINEERING TECHNOLOGY PROGRAM

PROGRAM REVIEW FINAL REPORT

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Abstract

During the 2008-2009 academic year, the Civil and Mechanical Engineering Technology (CMET) SAC conducted a review of the CMET program, consistent with the PCC Program Review Guide. We assessed the current state of the program, and made a strategic plan for program improvement.

We found the CMET program to be serving students effectively. Feedback from our graduates was obtained through a survey conducted in February and March of this year: graduates considered themselves well prepared for work and continuing education, and found that the classroom format of the program was helpful in getting them started in the engineering field.

One aspect of CMET that we chose to highlight in our Program Review is CMET's role in supporting the college's strategic initiative for sustainability. The CMET program has historically emphasized engineering education in energy and environmental areas, and has recently examined several approaches to implementation of further green technology coursework. These are discussed within this report.

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1. Introduction and Program History and Philosophy

The Civil/Mechanical Engineering Technology (CMET) Program curriculum has evolved over the past thirty years to produce the current configuration. Initially, there were two separate and independent departments: CET and MET. The CET department offered a very traditional two-year curriculum. The MET program, on the other hand, was very different. It had low math prerequisites, long classes (some at four hours per day), and included courses not normally found in a two-year program, for example, a rigorous thermodynamics sequence. Both programs produced good results in terms of graduate success; however, the MET graduates often obtained positions with more responsibility and received higher salaries. During two periods of low enrollment, the two curricula were combined into what today has become the CMET Program. Many courses were already common to both civil and mechanical engineering technology, so joining the two reduced redundancy and increased class size. It was agreed that the curriculum would consist of a mixture of courses from the traditional CET and the innovative MET programs. The resulting curriculum, in place now for almost two decades, is non-traditional in that it retained several core features of the old MET program: low math entry/high exit, high program breadth and rigor, and long classes in the first year.

The CMET Program is designed to train the best possible Civil and Mechanical Engineering technicians in terms of overall technical competency. The Civil and Mechanical engineering fields encompass a broad spectrum of specialty disciplines, each requiring a high level of expertise. This program is not designed to provide in-depth specialty training; rather, it is intended to provide a solid technical foundation based on the study of basic engineering principles and exposure to a wide variety of engineering specialties. Graduates of the program have the flexibility to succeed in a number of technical fields. This flexibility, as well as having the essential tools required to accept increasing responsibility during one's career, are significant assets to possess in light of the rapid changes continually occurring in technology.

Since PCC is a Community College, the CMET Department has striven to provide for those in the community who want a good career, but do not have the time or the financial resources to pursue traditional pathways. To increase accessibility and to encourage a larger number of students to enter program, the math and writing prerequisites of the CMET Program are the lowest of any of PCC's engineering technology programs. However, upon graduation the students have excellent math skills, including differential and integral calculus, and writing skills at a minimum of WR 121. To obtain the desired academic outcomes the students' learning curve is very steep and the program is an intense experience. Student success is enhanced by offering many classes that meet on a daily basis for longer (up to four hours) than usual class time-periods. This methodology holds the students' interest while digesting a large volume of knowledge, and provides a stimulus for the creation of tightly-knit cohort groups. It also develops the students' ability to work with each other as members of a team, an extremely valuable skill in the engineering world.

Considering the numerous sub-disciplines found in Civil and Mechanical engineering, the CMET SAC needed to select specific topics to be the focus of the curriculum. While several options existed, it was decided to place in-depth emphasis on energy and environmental topics, skills courses (such as CAD), several traditional courses (including the mechanics sequence), and some special interest courses like project management, surveying, and structural design. Several materials and manufacturing courses are also included to give the curriculum breadth. A complete advising guide is included in the Appendix.

CMET's existing in-depth emphasis on environmental and energy topics dovetails very naturally with the increasing world interest in sustainability, energy efficiency, environmental issues, and in green topics in general. Please refer to section 2.17 for further discussion.

The primary objective of the curriculum is directed towards providing skills that will make the two-year associate degree student successful in the engineering work world, in a wide variety of job roles. A secondary program objective is transferability to four-year engineering technology institutions for students seeking bachelor and higher degrees. A third purpose is the use of the first year of CMET to prepare students for the university-transfer engineering ENGR program.

2. Outcomes and Assessments

2.1 Program Learning Outcomes

Upon satisfactory completion of the CMET program, students should be able to:

- Obtain employment in the civil, mechanical, or manufacturing engineering field.
- Solve civil and/or mechanical engineering problems by applying fundamental knowledge of mathematical, computational, scientific and engineering concepts.
- Acquire, with experience, the ability to identify, formulate, and design solutions to real-world engineering problems.
- Conduct experiments using appropriate laboratory equipment to collect, analyze, and interpret data.
- Use appropriate techniques, skills and modern engineering equipment and computational tools.
- Apply project management and technical skills in the planning, design, fabrication, construction, and operation of engineering systems or components.
- Interpret and create engineering drawings using modern computerized methods.

- Function and communicate effectively both at the individual level and within team settings.
- Understand the impact of engineering solutions in a global, societal, and environmental context.
- Understand professional and ethical responsibilities.
- Engage in life-long learning.
- Achieve success in continuing their education towards completion of a four-year degree in engineering technology or engineering.

See Outcomes Mapping in the Appendix for a breakdown on how the program addresses the above program outcomes on a class-by-class basis.

In developing these Learning Outcomes, care was taken to ascertain that they were compatible with what can be observed of successful CMET graduates. The results are that recent graduates have found excellent employment. For Spring 08 graduates, the average starting salary was in the neighborhood of \$37,000. Numerous CMET graduates still maintain contact with the Department. Some serve, or have served, on the advisory committee. Many of these graduates have assumed management positions. Some have gone on to obtain bachelor or master degrees.

PCC's MET Program has articulation agreements with Oregon Institute of Technology, that give our graduates junior standing in Mechanical Engineering Technology, and transfer many courses to Manufacturing Engineering Technology. Discussions with officials at OIT-Portland confirm that PCC transfer students come in with a very good depth and breadth of educational background and are well prepared for the 300 and 400 level OIT courses, and that their graduation rate is excellent.

2.2 Consistency with PCC Core Outcomes

The courses in the CMET program interface with PCC's Core Outcomes as follows:

Communication: WR 121 and SP 100/111 are listed in the curriculum. Technical Writing WR 227 is specifically recommended. Environmental courses require term papers, and several courses require lab reports. Project Management includes team-written reports and oral presentations, along with writing resumes. Machine Design has included oral project presentations. The emphasis on group work in all classes contributes to the development of good communication skills. In addition, most courses require that written problem sets be submitted.

Community and Environmental Responsibility: The CMET environmental and energy sequences provide students with the tools to analyze and make informed

decisions regarding environmental ramifications of existing situations and proposals for future development. Graduates have gone to work for DEQ and other environmentally related organizations in various capacities. The Service Learning component included in some CMET classes gets students involved in the community and contributes to a sense of community responsibility.

Critical Thinking and Problem Solving: The entire core curriculum of the CMET program is a sequence of courses involved with developing the skills necessary to evaluate and analyze information using the scientific approach.

Cultural Awareness: The CMET program has always made efforts to recruit students from diverse backgrounds. Instructors are sensitive to the fact that engineering continues to be a white/male dominated profession, and make every effort to create classroom environments that are safe and welcoming for under-represented groups.

The CMET NSF S-STEM grant “Increasing Access and Diversity in Technology Programs” strives to increase the representation of culturally diverse peoples. The program markets to women, Latino, Native Americans, and African Americans, offering scholarships for interested individuals that have some level of financial need. The NSF grant also reached out to Latino groups through the Oregon Leadership Institute.

Professional Competence: Graduates have been successful in obtaining excellent employment opportunities. They have advanced to important positions in industry. Graduates who go on to four-year schools have a very high degree completion rate.

Self-Reflection: One of the most important components of the CMET program is to train students to work together; this models the team working environments that they will most likely encounter in engineering employment. Students must be willing to accept and respect each other in accomplishing this goal. In the long four-hour classes student teams solve engineering problems on the blackboard relating to the topics being taught at that time. This provides an excellent platform for working together. Also, courses that have labs generally require that lab partners depend on each other to be successful.

See Outcomes Mapping in the Appendix for a breakdown on how the program addresses the PCC core outcomes on a class-by-class basis.

2.3 Program contribution to College mission

The CMET Program provides a “quality education in an atmosphere that encourages the full realization of each individual's potential.” Students learn through various different teaching and learning methods such as lectures uniquely designed for long classes, labs, group problem solving, individual research, and group projects. Saturday tutoring sessions, field trips, and guest lectures are also available to students.

Ever-increasing reliance on part-time instructors makes it more difficult to provide that “quality education” referred to above; most departments at PCC struggle with this issue. We very much value the contribution and efforts made by our part-time faculty, but assuring consistent quality and focused, effective teaching in the classroom is more difficult with fewer full-time instructors.

One of the current college-wide strategic initiatives of PCC is sustainability. As stated on the PCC website, “Portland Community College has a strong institutional commitment to sustainability.” The CMET Program has historically and currently made integral, significant and tangible contributions to the furthering of sustainability at PCC. Details of these past and present contributions and future developments for sustainability within the CMET Program are discussed in Section 2.17 Green Technology and Sustainability.

2.4 Instructor Qualifications

Full-time instructors in CMET must meet educational and experience requirements.

The minimum education required is an Associate degree in engineering technology. This requirement is somewhat moot, since all new hires for CMET must also be qualified to teach in the university transfer (ENGR) program. The ENGR program requires a Masters degree, or a Bachelor degree with PE license.

Instructors are required to have a minimum of three years non-academic work experience in the engineering world. This practical experience is vital in a practical, applied, hands-on type of program such as CMET.

2.5 Updates to Curriculum

Since the last CMET Program Review, the CMET faculty has incorporated electronic resources into their classes. Several CMET classes now incorporate WebCT, Blackboard and myPCC My Course Tools into the curriculum. This allows for increased communication with students and trains the students to build strong computer skills. In consideration of the environment and the recent economic difficulties, this also aids in saving significant amount of paper and accustoms the students to working within a paperless environment.

Service-Learning has also been incorporated into several CMET courses. CMET students have volunteered with the following organizations: Community Cycling Center, Community Energy Project, the City of Portland Pesticide-Free Parks program and the 2009 PCC Science Expo. The CMET program has developed an especially strong relationship with the Community Cycling Center after volunteering for them for several quarters. Frequently, the CCC comments on the high level of effort and technical skills with which CMET students participated.

The CMET 211 lab now includes a module on the chemistry of biodiesel creation from used vegetable oil. The goal is to create a closed loop system where waste vegetable oil

from the Sylvania cafeteria is processed into biodiesel which is then used on campus. In Winter/Spring 2009 the class will provide 35 gallons to the Art department and Charlie Washburn to fire their oil-fired kiln.

CMET 214, Route Surveying, while still covering route/roadway issues such as laying out vertical and horizontal curves, now emphasizes developing students' technique with the more advanced functions of our electronic total station surveying instruments. The emphasis has been on the development of field skills and techniques that will be useful to employers.

CMET 214 and CMET 233, CET Applied CAD, have become more integrated, which has been a long-term goal for these two courses. While the two courses still exist as separate entities, students now use field data gathered in the surveying class and import that data directly into a project in the CAD class. The "electronic revolution" has fundamentally changed the surveying profession, and integration of the field aspects and CAD aspects in this way represents cutting-edge current techniques.

The lab for CMET 228, Construction Materials, has been expanded to cover more tests and procedures than previously, to give students better exposure to the type of tests most commonly done in industry. This seems to be working out very favorably, as several students over the past few years have obtained employment in materials testing. These students have reported back that the CMET program provided the background they needed to become certified test technicians in several areas.

CMET 237, MET Applied CAD, is the final computer-aided drafting course taken by MET students. In this course, students work with a solid modeling program. Students may choose from Solid Works, Pro E, or AutoCAD Inventor. Following advice from the Industrial Advisory Committee, we now encourage students to take Solid Works, as this program is the most commonly used in industry. All three courses are offered by the Drafting (DRF) program and cross-listed as CMET 237, but MET students must take a back seat to DRF students in these classes that often fill. To ensure the availability of Solid Works for MET students, we have offered our own section of Solid Works for the past two years. This has worked out very favorably: between DRF and CMET, we now offer a beginning Solid Works section Fall, Winter, and Spring terms. The CMET section is cross-listed to DRF 270, and this has helped filled any seats not needed by the MET students.

CMET 215, Manufacturing Processes, now features a hands-on component that has been very well received by the students. They work in the machine shop, and build a small project through the term. Students enjoy the opportunity to use the course material in such a practical and applied manner.

2.6 Faculty professional development activities

Some examples of recent professional development activities by CMET faculty include:

Attending professional workshops, conferences, and seminars to keep technical skills current. Examples include Green Engineering Conference, Sustainability Summit, Concrete Fundamentals Workshop, Sustainable Building Conference, Modern Surveying Workshop, Renewable Energy Conference, Emerging Technology Conference, the ASEE Conference, and grant workshops.

Participation in PCC Instituto de Cultural Oaxaca, and selection to participate in CIEE International Faculty Development Seminar.

Membership in professional Societies such as Engineers Without Borders, American Society of Mechanical Engineers, American Society of Engineering Educators, American Society of Civil Engineers.

2.7 Demographic shifts

Students in the CMET program have always been very diverse in age, educational background, and life experience. Only a small proportion of our students are traditional “college-age,” likely because young people who set their sights on an engineering career take lots of math and science in high school, and follow the university-degree path rather than seeking a career-technical program. With the current recession, we have many students who are retraining after being laid off from their former occupations. Some of these people are receiving funding through state employment services or federal programs for displaced workers; others are paying their own way. We are also seeing a large number of military veterans, and expect to see an increase in the near future.

In recent years, we have had many more students who are working while attending school. Far fewer students have the “luxury” of being “just students.” A student taking the CMET program full-time is making a huge time commitment, so this creates difficulties for students who also have many responsibilities to families and community activities, as well as a paying job.

In this year’s first-year students, we have a higher-than-usual proportion of women. Of the 43 students who started the CMET core courses this school year, 13 are female.

2.8 Program feedback from graduates

The PCC CMET Program Graduate Survey was conducted in February to March of 2009 and queried students that graduated during the 2004-2008 time period. Questions #13, #14, #15 and #20 were especially well-suited to gaining feedback from recent graduates of the program. Additional information and the raw data of this survey are included in Appendix 4.2 PCC CMET Program Graduate Survey.

- Questions #13 asked the open-ended question **“How well did the CMET program prepare you for either work or continuing education?”**

27 out of the 35 respondents answered this question. The responses to this question were overwhelmingly positive. Some example responses to this question are as follows.

“Excellent. Level of instruction in classes and student to teacher ratio in the CMET program is much better than University classes I have attended.”

“Very well. I am very prepared to apply what I've learned to real world situations.”

“PCC did a great job of preparing me for further education.”

- Question #14 asked the open-ended question **“What do you think should be added to the program from your experience?”**

25 out of the 35 respondents answered this question. The responses to this question were varied. More surveying and hands-on experience were the most common theme, but, even then, these were only seen in a handful of responses each. Some example responses to the question are as follows.

“I think a little more hands on experience could benefit students such as more time with surveying equipment or even field trips to more facilities.”

“The program should also be organized for those who are in part time status also. Having to take one class one year and the second half (Thermo II or Calc II) a year later makes it difficult to maintain a smooth learning transition.”

- Question #15 asked the multiple-choice question for the graduate’s opinion on whether **“The format of the CMET program with its long class-immersion approach and math classes taught 'in-house' was very helpful in my getting started in the engineering field.”**

33 out of the 35 respondents answered this question. 78.8% of the respondents either ‘Strongly Agreed’ or ‘Agreed’ with this statement, 12.1% of the respondents with ‘Disagreed’ or ‘Strongly Disagreed’ and 9.1% of the respondents had ‘No Opinion.’ Some example responses to the question are as follows.

“I loved the long class-immersion approach, it gives students that extra leg up and additional help they need to succeed.”

“They teach you what you need to know - period.”

- Question #20 asked for additional comments, **“Thank you for your time. Any additional comments.”**

Again, the responses to this question were overwhelmingly positive. For example:

“I love discussing the program- I would have too much to say to fit it in here.”

“I loved calculus with Eng :)”

“Thank you for providing me with the background and knowledge I needed to succeed in the engineering field.”

“Thanks for a great start at a new career.”

2.9 Marketing/retention strategies

Historically, enrollment in CMET has usually been fairly low. In most ways, this has been a positive thing, because small classes allow for lots of work with individual students, and the graduates each year have been able to find good jobs without flooding the market. We currently have a “cap” of 28 students per starting group (twice a year) and this is about the maximum number that can be handled well in the highly interactive classroom style we use.

In the Fall of 2005, we had a large number of applicants to the program. We expanded the number of starting students to 35, and deferred a few students to start in the Winter of 2006; since then our starting classes have been at a comfortable level. During the time period of 2004-2008, the overall CMET enrollment has been quite consistent. Data from the Deans Enrollment Report are in Appendix 4.5.

Our most productive marketing strategy has been our “math class visits.” Every Spring, Summer, and Fall term for the past 10 years we have made short presentations to math classes at all PCC campuses, focusing mostly on MTH 60-95, but also visiting many of the higher-level classes. We tell the students briefly about engineering fields and careers, and give them information about all of the engineering programs available at PCC. Many students (and math instructors) are very interested to learn of the opportunities to apply their math in practical ways and to possibly build an interesting career. This is especially effective for CMET recruiting, because our math prerequisite is relatively low, and students who complete MTH60 are ready to start the program. Sylvania classes are visited by faculty; other campuses are visited by contractors (mostly a retired engineering faculty member) funded by special grants we have secured.

Another marketing tool that has proven to be effective is the one-credit course Exploring Engineering, ENGR 100. This course is designed to give individuals (usually non-majors) the opportunity to learn about the various engineering professional disciplines and the educational paths in engineering available at PCC and elsewhere. It is taught

year-round in two formats: traditional classroom and online/distance-learning through the Blackboard System. This course has been successful in both providing a valuable service to students, and in bolstering the enrollments of all the engineering programs, both transfer and technology.

One outreach effort we participate in is a PAVTEC program to bring high school students to PCC to help them explore technical careers. This is a joint project with the Machine Manufacturing Technology department, and groups of young people learn about the engineering profession, and about the various programs and opportunities available at PCC, including CMET. These students then visit the engineering labs for a tour and demonstrations.

Some of the other outreach and marketing activities in which we have participated include: Women in Trades career day, Oregon Leadership Institute, Northwest Youth Career Day, PAVTEC conference for middle school girls, and Construction Career Day.

CMET faculty and staff are committed to student success and retention. The structure of the program is designed to offer a great deal of support to students, both in and outside of class. Most CMET classes have lots of interaction among students, in small-group problem-solving sessions with instructor guidance and feedback. First-year students have approximately 33 hours of classroom time per week, and almost all of this time is in CMET classes with the same group of students. This cohort approach has a major effect on retention: students get to know each other and watch out for each other; when a student has difficulties, a classmate very often is able to offer assistance or help find resources. The students also get to know their instructors well. Most of the instructors for CMET courses (especially first-year classes) are full-time instructors; we feel that this is very important, since it provides continuity and consistency of instruction, and availability of instructors during office hours and other times.

We have tutoring available for first-year students on Saturdays for four hours per week. This tutoring is currently being funded by an NSF S-STEM grant, but has been funded by other grants and department funds in the past.

Thanks also to the efforts of Todd Sanders, we have a \$596,214 NSF grant to provide scholarships to engineering technology students. The scholarships will be available to all engineering technology students, and are targeted at under-represented groups. This grant has also paid for some of the above-mentioned tutoring.

2.10 NSF Scholarship Activities

Since 2003, NSF-funded scholarships have supported fulltime CMET students with demonstrated need. Over 40 CMET students have been awarded scholarships equivalent to tuition and books for the two years attended. The scholarships have helped increase diversity within the program, especially recruiting and retaining of female students. The current scholarship program will continue through 2012.

In addition to the financial support for CMET students, the scholarship program has funded tutoring for the students and has funded the math visits marketing program. CMET is not the only program benefiting from this program, though CMET faculty run the project. Electronics Engineering Technology, Microelectronics Technology and Machine Manufacturing Technology receive the same financial and tutoring support. Machine Manufacturing's Summer Robotics Camp for 2007 was fully funded by the scholarships program funds and part of all future Robotics Camps will be funded through the scholarship program.

2.11 Student access

The CMET program has been designed to be accessible to many segments of the community, by having low prerequisites and lots of student support. Many students who had unsuccessfully tried more "traditional" engineering educational approaches have been able to learn mathematically rigorous engineering content in the environment provided by CMET.

However, because of the long hours in class, and the interconnection and sequencing of courses, accessibility to part-time students and those seeking evening classes has been a problem. Having our first-year CMET courses offered twice each year allows some flexibility of scheduling that makes many part-time plans possible. We have worked with many students to develop three-year or four-year plans. Sometimes these plans use math department courses instead of our technical math sequence. Some students enter the CMET program with considerable math and science backgrounds; for these people, university-transfer engineering (ENGR) courses can be substituted for most of the first-year CMET requirements.

Since the early 1980's, the CMET program has mostly offered only daytime classes. Our most recent attempt to offer evening classes was in 2000 and 2001, when we offered first-year classes at night, with shorter hours and higher prerequisites, hoping to reach a different group of potential students. We did not succeed in attracting enough students to continue these classes, and those who took the evening classes did not continue on to the second year of the program. We then returned to our pattern of two daytime starting groups each year, and have had much better enrollments and higher student-to-instructor ratios in second-year classes. However, people who work during the day and can only attend classes in the evening are excluded from the program.

Although we have designed the program in many ways to be accessible, it takes extraordinary dedication, hard work, and a positive attitude to complete a program of CMET's technical breadth and depth in just six terms. The required classes are numerous and demanding; many hours of class participation, and independent and group study are needed. Many of our students have work, family, and other commitments to balance with their academic requirements. When this balance cannot be maintained, the student can quickly get behind in his/her schoolwork, and in a program as intense as CMET, it is very hard to catch back up. Most of the attrition in our program comes not from lack of interest or hard work or ability, but from conflicting time demands. In many cases,

faculty advisers can help the student to devise a three-year or four-year plan, but in many other cases, the student drops out of school. Our approximate attrition rate is 30%; most of this occurs in the first two terms, as students experience the drastic changes in their lives that come from starting an intense educational program.

2.12 Facilities and other resource issues

The CMET program has moderate equipment and resource needs, usually necessitated by maintenance, changing technologies, the aging of existing equipment, or the relatively rare decision to offer new program content. Since the ENGR program also uses most of the equipment used by the CMET program, equipment costs are usually shared between the two programs.

Examples of annual maintenance costs are software contracts (annual licensing for AutoCAD software is also shared with the Visual and Performing Arts Division) and the upgrading of lab computers and printers.

A highly valued program resource is the Civil-Mechanical Lab in the AM building. All the CMET lab classes (Surveying, Environmental, Material Science, Construction Materials) are taught in this space, as well as some lectures. When not in use as a classroom, this space is used by students as a place to study, eat lunch, and “hang out.” Saturday tutoring sessions meet here. We are continually making improvements to the lab. A long-term goal for the lab is a remodel that will allow us to better utilize this space; we are excited that the bond measure that recently passed will provide funds for this. The lab has been in its current configuration for more than two decades; it is long overdue for this type of upgrade.

2.13 Advisory Committee impact

The CMET Industrial Advisory Committee’s (IAC) advice on curriculum and instructional methods has been beneficial to the success of the Program. The CMET faculty and IAC meet twice per year and the IAC also plays an integral role in the mock interviews that the 2nd year students participate in to prepare themselves for interviewing with potential employers. Occasionally, these interviews have led to actual employment with members of the IAC. Currently, the most critical need identified by the IAC is the incorporation of sustainability and green technology into the Program. Members have commented on the market and potential market for individuals trained in solar and wind energy and sustainable building. How CMET is addressing these suggestions is covered in Section 2.17 – Green Technology and Sustainability.

2.14 Graduate employment statistics

Questions #3 thru #11 from the PCC CMET Program Graduate Survey are especially well-suited to gaining feedback from recent graduates of the program regarding employment. This survey was conducted in February to March of 2009 and queried students that graduated during the 2004-2008 time period. Additional information and

the hard data of this survey are included in Appendix 4.2 PCC CMET Program Graduate Survey.

- **Question #3: What did you do after graduation?**

Education	17.6%
Engineering-related employment	55.9%
Both	26.5%

- **Question #4: What was the approximate starting salary of your first job after graduation, if applicable?**

There were various answers for this question as one might expect. 6 of the 28 responses were \$50000/year or greater.

- **Question #5: Was this full-time or part-time work?**

Full-time	90.6%
Part-time	3.1%
Not Applicable	6.3%

- **Question #6: What is your current employment status (choose all that apply)?**

Full-time employed	67.6%
Part-time employed	2.9%
Full-time student	8.8%
Part-time student	11.8%
Unemployed	17.6%
Retired	2.9%

- **Question #7: If employed, is your current job engineering-related?**

Yes	69.7%
No	6.1%
Not Applicable	24.2%

- **Question #8: OPTIONAL: What is the name of your employer?**

There were 23 out of 35 respondents who answered this question. The list of employers contains many impressive names and is an interesting mix of public and private employers. The table below shows the responses received.

AEC
Bonneville Power Administration
Northwest Engineering Service Inc.
EPC Consultants, Inc. - sub for Portland Water Bureau

PCC
 URS Corp.
 WHPacific
 Kleinfelder
 Restaurant
 ODOT
 Tektronix
 CH2M Hill
 Intel
 BERGER/ABAM Engineers, Inc.
 City of Portland
 Black & Veatch
 Stacy and Witbeck, Inc.
 Intel
 Boeing
 Kiewit
 Intel
 Blount INC.
 City of Portland, BES, Waste Water Engineering

- **Question #9 OPTIONAL: What is your current annual salary (if unemployed or retired, base this on most recent salary)?**

29 of the 35 respondents answered this optional question. This data indicates that the majority of the respondents are earning a 'living wage' or better with their CMET AAS degree.

<\$25,000	17.2%
\$25,000-\$35,000	10.3%
\$35,000-\$45,000	41.4%
\$45,000-\$60,000	24.1%
\$60,000-\$75,000	6.9%
>\$75,000	0.0%

- **Question #10. If applicable, what employment sector are you in?**

State or local government	16.7%
Federal government	8.3%
Consulting engineering	37.5%
Manufacturing	20.8%
Construction	29.2%
Self-employed	4.2%

- **Question #11. If applicable, what type of work do you do (choose all that apply)?**

Engineering design	34.5%
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Sales	0.0%
Project management	13.8%
Testing/laboratory	10.3%
Supervision/Management	13.8%
Training and/or teaching	3.4%
Surveying	13.8%
Technician	55.2%
Drafting	20.7%
Other, please specify	6.9%

‘Other, please specify’ responses were ‘Technical Communications,’ ‘unemployment,’ and ‘Mechanical Engineering.’

2.15 Industry skill requirements of Program graduates

The needs of business and industry, with respect to what constitutes an ideal employee, have changed with the advent of computer technology and the usage of the internet. On one hand, the employee needs to be resourceful and productive in using the computer and internet to research, validate and document technical design. On the other hand, the employee needs to work comfortably and communicate effectively in the project teams to which they will be assigned. The approach taken with the CMET program is to introduce the student to learning situations that involve computer and internet usage in order to prepare them for the continued learning that will be required in the face of rapidly changing technologies. In addition, most courses involve technical work in small groups that will help students make the transition into the project team environment in their future jobs.

2.16 Graduate employment forecast

The following summarizes some of the information from Appendix 4.1.

According to the Oregon Employment Department, Civil Engineering Technicians (CETs) can expect the field to grow about 14.1 percent from 2006 to 2016. The statewide average annual wage for CETs in 2008 was \$50,818. Forty-three total (17 growth + 26 replacement) CET job openings statewide is projected annually.

Mechanical Engineering Technicians (METs) can expect the field to grow about 12.2 percent from 2006 to 2016. The statewide average annual wage for METs in 2008 was \$59,609. Twenty-two total (8 growth + 14 replacement) MET job openings statewide is projected annually.

2.17 Green Technology and Sustainability

Since the Fall quarter of 2008, CMET has been attempting to capitalize on the current local and national focus on green technology and sustainability. With the allocation of 80 billion dollars to green technology included in the recently passed American Recovery

and Revitalization Act of 2009, the CMET faculty expects even a greater opportunity in the marketplace for CMET graduates with training in green technology and sustainability. There is also a possibility of PCC-Sylvania becoming the first 'Net Zero' campus in the country which would offer additional job and training opportunities for CMET students.

The CMET program has had an emphasis on energy and environmental concerns for many years. CMET first included environmental engineering courses for CET students in 1980; by around 1990, all CET and MET students were taking two to three terms of both environmental and energy courses. For a few years in the early 1980's, there were two options within MET, a Design Option and an Energy Option. All MET students took courses in thermodynamics, HVAC, and energy production and use; the Energy Option also included energy management, equipment design, and solar energy. Also in the early 1980's, CMET faculty members worked on the design of the solar hot water system for the HT Building swimming pool. In 1995, a straw bale building was constructed on campus by faculty, engineering students, and volunteers. This was a research project to demonstrate that straw bale construction was a practical method even in our damp climate – a moisture study was conducted for three years and readings are still being monitored. This lab facility is fully solar-powered and off the grid; tours are conducted often, for PCC classes and groups and for others in the community. Over the years, instrumentation has been added, and two solar hot water systems are almost complete, so that the facility can be used for thermodynamics and fluid mechanics labs.

Through the 2008-2009 school year, the CMET faculty have expended a significant amount of time and energy considering what approach should be taken regarding the implementation of further green technology and sustainability within the CMET program. (CMET already includes two Environmental courses in its present form.) Most of that effort was put towards obtaining a NSF IEECI grant that offered a track focused upon 'Integrating Sustainability into Engineering Education'. After much deliberation on how to approach the grant proposal, a Draft Needs Assessment was written and the NSF was consulted by the PCC Grants Office to see if the approach was going to be within the scope of the grant. Unfortunately, the NSF was looking more for research on how students learn about sustainability content, rather than on the addition of the sustainability content itself. This grant was determined to be inconsistent with the vision of the CMET faculty.

CMET is planning to implement a Green Technology and Sustainability Option within the CMET program. This option would consist of four existing classes from other departments. Potentially, the student interested in obtaining this option within their CET or MET AAS degree would take 4 classes total. Two of these courses would be Introduction to Renewable Energy Systems and Introduction to Sustainable Business. The student would then choose 2 out of the following 3 courses to fulfill the requirements for the option: Introduction to Environmental Sociology, Introduction to Geographic Information Systems, and an Environmental Science course. These courses may also apply toward the general education requirement. This approach will be brought to the next Industry Advisory Committee meeting on May 7th, 2009 for consideration by the IAC.

3. Recommendations and Conclusions

3.1 Assessment of program strengths and weaknesses

Student retention: historically, a major strength of the program has been its ability to bring students in at a low academic skill level, and maintain high retention rates while taking the students through technically demanding material. This remains true to the present. This positive result is due to a variety of factors:

Large number of classroom hours for beginning students: the large amount of time spent with instructors and fellow students helps insure that students have support systems available, and promotes cohesion among students.

One important classroom activity that leads to student success is having the students in many of our first year classes and some second year classes, in groups of two or three, solve problems at the chalkboard. The instructor circulates from group to group, keeping the students on track and commenting on their problem-solving method. With this “board work” (which can be viewed as a lab activity) being an important component of our classroom instruction, regulating class size becomes very important. We believe that a class size of 20-25 students works best for this activity, with a maximum of 28. We have had as many as 35 students enroll in the program for the “long class,” and it proved difficult to manage such large groups utilizing this method of instruction.

Another important component of achieving high retention rates is having most classes, and especially the crucial first-year classes, taught by full-time instructors. For this reason, we feel that it is critical to replace full-time instructors as they retire. We respect and appreciate the job that part-time instructors do for us, but we believe to maintain high retention rates and program continuity and quality, full-time CMET faculty members should teach most classes.

Faculty pride in the program philosophy is another program strength. CMET is designed to bring in students at a low academic skill level, and give these individuals the opportunity to launch professional/technical careers doing interesting work in well-paying jobs. The faculty takes a great deal of pride in playing such a positive role in peoples' lives, and this pride is reflected in the classroom. Historically, the program has been extremely fortunate in finding faculty members who are dedicated to and motivated by this philosophy, and who possess the solid technical skills, teaching ability, and industry experience to “round out the package.”

Individuals who possess the qualities and experience indicated above can be difficult to find; these people also have significant earning potential working in the private sector, and coming to work at PCC often represents a significant pay cut. Finding and retaining quality faculty members in a small department such as ours is of absolute importance in ensuring program continuity and viability into the future.

Existence of the winter start: the winter term start represents a program strength for several reasons.

For students starting in the CMET program, there are two points of entry: fall and winter terms. The fall term starters are often referred to as the “lead class” and the winter term starters as the “lag class.”

Students who start the program are extremely diverse in terms of academic background, age, life experience, etc. Many have not attended school for many years; for these students, the return to academia and a rigorous program such as ours can be a real shock. The lag class provides a “safety net” for the students who start in fall term. If a student does not successfully complete all the first-term classes during fall term, the existence of the lag class means that all first-term classes will be repeated winter term, and missing or not completing a required class will not require the student to wait a full year for the next offering of the class. This is an important part of a program that prides itself on being accessible to students from a wide variety of academic backgrounds.

The lag class also helps bolster enrollment in second year classes by combining the lead and lag classes together into a single second-year group. History has shown that this produces second-year classes that are of reasonable size. During the recent years when the lag class was not offered, second year enrollments suffered badly, and the second year classes lacked the synergy necessary for a truly vital learning environment.

The existence of the lag class also provides students with an 18-month option to complete the AAS degree; some funding providers require students to finish their retraining in this amount of time. Students starting in January of 2009 can finish and have the AAS degree in June of 2010.

For any program which uses this lag class concept to bolster second year enrollments, the lag class must be seen as an investment in the future: the students in this year's lag class represent filled seats in next year's second year classes. For all these reasons, we believe that lower enrollment minimums for the lag class are appropriate for programs that use the lag class concept. Even for a small lag class, the college will be able to recoup much of its investment through higher student-teacher ratios in second year classes the following year. We believe that the preservation of the lag class is of vital importance in maintaining quality and insuring the very survival of the CMET program, and for all programs that use a second start to ensure adequate second-year enrollments.

Providing students with a variety of options: another program strength is that we provide our students with various options for career paths. Among these are:

Some of our beginning students are interested in obtaining a traditional engineering degree, not an engineering technology degree. The first year of the CMET program

provides an ideal “pre-engineering” curriculum for individuals who don’t meet the requirements for entry into a traditional four-year engineering program. Students bring their math and verbal skills up to the required levels, while gaining in-depth experience in engineering-style problem solving. This also affords these students the opportunity to determine if they enjoy and have an affinity for engineering-style solving very early on, since students in the CMET program do “real” engineering work (in the form of Statics) in their first term.

Another career path for our students, perhaps the one most often chosen, is to complete the two-year CMET program, receive their AAS degree, and go to work in the engineering field. Both civil and mechanical engineering are very broad fields, with many potential areas of specialization. Program graduates have the broad background, technical skills, and self-learning skills that often enables them to find work in the engineering world in an area that matches their interests.

Another career path available for our students is to continue their education in engineering technology (ET), and work toward a Bachelor or higher degree. We currently maintain articulation agreements with OIT in Mechanical ET and Manufacturing ET. We are currently investigating a possible four-year path for CET students, which will involve articulating the two-year CET AAS degree into the BS in Building Construction Management program at Boise State University.

Having too much content for a two-year program is one program weakness that we have identified. This is, of course, also a strength, since our students graduate with a broad skill set that enables them to succeed in the workplace or in continuing academic pursuits. But the program’s sheer volume of content is hard on even the most dedicated and conscientious students. We have arranged the CMET courses so that first-year students should have to take no more than four classes in a term, and second-year students, no more than five. This still represents a very substantial academic load.

Lack of a required Co-op educational experience is related to the above, and has been cited as a program weakness. Students have Co-op available to them, but there is no term with a built-in time slot free for the students. Therefore, few students take advantage of the existing Co-op opportunity. We all recognize the benefits of Co-op or internship experience, and our Advisory Committee concurs. Faculty do assist students in finding summer internships for students who express interest, but this is an option only available to about half the students: those who started the program in the Fall.

Outmoded facilities could be seen as another program weakness. While we have kept equipment current by continually upgrading, the laboratory space itself could serve us much better. Its current configuration has been in place for about three decades. We are excited that it is slated for remodeling through the recently passed bond measure.

Over-reliance on part-time instructors can be seen as a program weakness. Currently, there are 5 full-time instructors that teach the Civil/Mechanical courses in two programs: CMET and ENGR. Of these 5 instructors, 0.5 IFTE is lost to release time for FDC duty,

and another 0.5 IFTE is lost to release time for pursuing and administering grants. This effectively leaves 4 full-time instructors to teach these courses for the two programs. At current enrollment levels, it takes about 4.2 full-time equivalent instructors to staff all classes in the CMET program alone. This has led to an over-reliance on part-time instructors in both these programs (a similar argument can be made for Electronics Engineering Technology program as well). The number of full-time instructors in the engineering office has steadily declined over the past decade; as individuals have retired or moved on to other positions, they have often not been replaced. We are currently very lucky to have a number of part-time instructors that are dedicated and talented teachers, but it can be very difficult finding engineers with both the desire and ability to teach. It is very difficult to assure program quality, consistency, and continuity when we must rely so heavily on part-time instructors.

3.2 Recommendations for Program improvements

As discussed in Section 2.17, the CMET program plans to implement the Green Technology and Sustainability Option. The CMET faculty believes this option will give CMET graduates an advantage in an ever-increasingly environmentally conscious marketplace. Also, the CMET faculty believes that the Green Technology and Sustainability Option will attract additional students to the program. It is also possible that graduates of the CMET program would return to take the required classes to obtain this certificate option.

Increasing the number of full-time engineering instructors on faculty would decrease our current over-reliance on part-time instructors, as discussed in 3.1 above. This would represent a huge improvement for not only CMET but for our sister programs ENGR and EET as well.

3.3 Strategic Plan

Our strategic plan for the future is simply to have the program continue doing what it has been doing since its inception: provide solid Civil and Mechanical Engineering Technology education, accessible to individuals possessing minimal math skills, that enables them to build careers in these technology fields. We recognize that in order for the program to remain viable, we must build enrollments and maintain them at acceptable levels. During the early years of the program, very little marketing was required to fill the classroom. This is no longer the case, due to several factors beyond our control. We now recognize that there will be a continual need to market the program, to ensure adequate enrollments.

We hope to capitalize on the increasing public interest in environmental, energy, and sustainability topics, and anticipate a “bump” in our enrollments with the new Green Technology and Sustainability Option.

For the past many years, we have actively marketed the program, through both focused marketing efforts and outreach. We recognize that this will need to be an ongoing effort,

and we will continue to market and be actively involved in outreach. Section 2.9 provides more detailed information about these efforts.

4. Appendices

Appendix 4.1 Oregon Employment Department projections

Civil Engineering Technicians

2008 Average Annual Wage = \$50,818 (Oregon statewide);

High = \$55,289 (Multnomah/Washington Counties);

Low = \$44,608 (Jackson/Josephine Counties).

Projected ca 2016 job openings = 1,338 (up 165 or 14.1% from ca 2006 figure of 1,173;

Oregon statewide job openings = 1,173 in ca 2006 (range = 12 to 410*);

*Combined Multnomah & Washington Counties.

Mechanical Engineering Technicians

2008 Average Annual Wage = \$59,609 (Oregon statewide);

High = \$62,257 (Multnomah/Washington Counties);

Low = \$46,166 (Jackson/Josephine Counties).

Projected ca 2016 job openings = 700 (up 76 or 12.2% from ca 2006 figure of 624;

Oregon statewide job openings = 624 in ca 2006 (range = 0 to 405*);

*Combined Multnomah & Washington Counties.

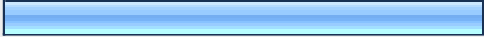
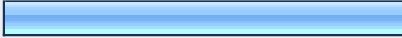

Appendix 4.2 PCC CMET Program Graduate Survey

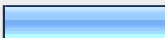
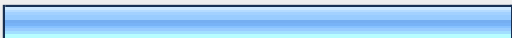

In an effort to gather 'real-time' information regarding the program from a graduate's perspective, the CMET program sent a surveymonkey.com PCC CMET Program Graduate Survey to 71 graduates from the years 2004-2008. Nine of these emails were found to be no longer valid. Of the remaining 62 graduates, 35 responded to the survey, a response rate of approximately 56%. The survey asked 20 questions in regards to the graduate's employment status, the graduate's opinions of the CMET program, etc.

The survey data, in entirety, are on the following pages. The first 7 pages contain the percent response data, while the last 5 pages show all of the responses for the open-ended questions.

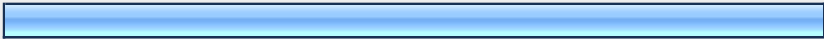


PCC CMET Program Graduate Survey

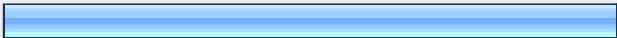


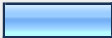


1. What year did you complete the CMET program at PCC?		Response Count
		34
<i>answered question</i>		34
<i>skipped question</i>		1



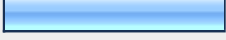
2. What is your degree from PCC?		Response Percent	Response Count
AAS MET		52.9%	18
AAS CET		44.1%	15
None		2.9%	1
Other (please specify)			1
<i>answered question</i>			34
<i>skipped question</i>			1

3. What did you do after graduation?		Response Percent	Response Count
Education		17.6%	6
Engineering-related employment		55.9%	19
Both		26.5%	9
Other (please specify)			0
<i>answered question</i>			34
<i>skipped question</i>			1

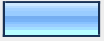
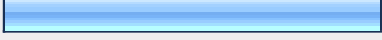
4. What was your approximate starting salary of your first job after graduation, if applicable?		
		Response Count
		28
<i>answered question</i>		28
<i>skipped question</i>		7

5. Was this full-time or part-time work?			
		Response Percent	Response Count
Full-time		90.6%	29
Part-time		3.1%	1
Not Applicable		6.3%	2
<i>answered question</i>			32
<i>skipped question</i>			3



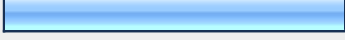

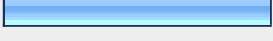

6. What is your current employment status (choose all that apply)?			
		Response Percent	Response Count
Full-time employed		67.6%	23
Part-time employed		2.9%	1
Full-time student		8.8%	3
Part-time student		11.8%	4
Unemployed		17.6%	6
Retired		2.9%	1
<i>answered question</i>			34
<i>skipped question</i>			1

7. If employed, is your current job engineering-related?			Response Percent	Response Count
Yes			69.7%	23
No			6.1%	2
Not Applicable			24.2%	8
			<i>answered question</i>	33
			<i>skipped question</i>	2

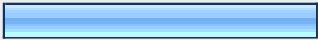
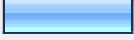
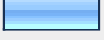
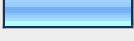

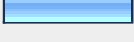
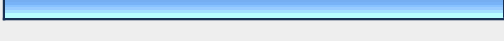
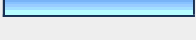

8. OPTIONAL: What is the name of your employer?		Response Count
		23
		<i>answered question</i>
		23
		<i>skipped question</i>
		12

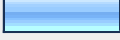

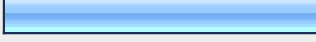

9. OPTIONAL: What is your current annual salary (if unemployed or retired, base this on most recent salary)?			Response Percent	Response Count
<\$25,000			17.2%	5
\$25,000-\$35,000			10.3%	3
\$35,000-\$45,000			41.4%	12
\$45,000-\$60,000			24.1%	7
\$60,000-\$75,000			6.9%	2
>\$75,000			0.0%	0
			<i>answered question</i>	29
			<i>skipped question</i>	6

10. If applicable, what employment sector are you in?

		Response Percent	Response Count
State or local government		16.7%	4
Federal government		8.3%	2
Consulting engineering		37.5%	9
Manufacturing		20.8%	5
Construction		29.2%	7
Self-employed		4.2%	1
		Other (please specify)	3
		answered question	24
		skipped question	11

11. If applicable, what type of work do you do (choose all that apply)?






		Response Percent	Response Count
Engineering design		34.5%	10
Sales		0.0%	0
Project management		13.8%	4
Testing/laboratory		10.3%	3
Supervision/Management		13.8%	4
Training and/or teaching		3.4%	1
Surveying		13.8%	4
Technician		55.2%	16
Drafting		20.7%	6
Other, please specify		6.9%	2
		Other (please specify)	3
		answered question	29
		skipped question	6

12. What is your education after the CMET program?			
		Response Percent	Response Count
Bachelor's degree in Engineering or Engineering Technology		12.5%	4
Master's degree in Engineering or Engineering Technology		0.0%	0
MBA		0.0%	0
Other Bachelor's degree		3.1%	1
Other Master's degree		0.0%	0
Other degree		0.0%	0
Currently pursuing degree		34.4%	11
No additional degree		50.0%	16
Please specify degree & school, if applicable.			16
answered question			32
skipped question			3



13. How well did the CMET program prepare you for either work or continuing education?		
		Response Count
		27
answered question		27
skipped question		8

14. What do you think should be added to the program from your experience?		
		Response Count
		25
answered question		25
skipped question		10

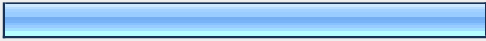

15. The format of the CMET program with its long class-immersion approach and math classes taught 'in-house' was very helpful in my getting started in the engineering field.

		Response Percent	Response Count
Strongly agree		39.4%	13
Agree		39.4%	13
Disagree		9.1%	3
Strongly disagree		3.0%	1
No opinion		9.1%	3
Any additional comments regarding the format of the CMET program.			11
<i>answered question</i>			33
<i>skipped question</i>			2

16. Would you be interested in speaking in a current CMET class about your experiences in the engineering world?

		Response Percent	Response Count
Yes		50.0%	15
No		50.0%	15
<i>answered question</i>			30
<i>skipped question</i>			5

17. Would you be interested in communicating with current CMET students, on a one-on-one basis, perhaps serving as a mentor?

		Response Percent	Response Count
Yes		53.1%	17
No		46.9%	15
<i>answered question</i>			32
<i>skipped question</i>			3

18. Please provide updated contact information (address, phone number, email).		Response Count
		29
	<i>answered question</i>	29
	<i>skipped question</i>	6

19. Are you in contact with any other CMET graduates? If so, who?		Response Count
		29
	<i>answered question</i>	29
	<i>skipped question</i>	6

20. Thank you for your time. Any additional comments:		Response Count
		13
	<i>answered question</i>	13
	<i>skipped question</i>	22

Graduates	What year did you complete the CMET program at PCC?		What is your degree from PCC?		What did you do after graduation?			What was your approximate starting salary of your first job after graduation, if applicable?		Was this full-time or part-time work?
	Open-Ended Response		Response	Other (please specify)	Education	Engineering-related employment	Both	Open-Ended Response		Response
1		2007	AAS CET				Both	40000		Full-time
2		2006	AAS MET			Engineering-related employment		\$50,000 per year		Full-time
3		2005	AAS MET		Education					
4		2008	AAS MET				Both	35500		Full-time
5		1996	AAS CET			Engineering-related employment		53k		Full-time
6			None			Engineering-related employment		29000		Full-time
7		2008	AAS MET				Both	\$12.00/hour		Full-time
8		2008								
9		2008	AAS CET			Engineering-related employment		\$20.00/hrs		Full-time
10		2006	AAS MET		Education					Not Applicable
11		2006	AAS CET			Engineering-related employment		\$18 per hr		Full-time
12		2007	AAS CET			Engineering-related employment		40000		Full-time
13		2006	AAS CET			Engineering-related employment		36000		Full-time
14		2007	AAS MET		Education					
15		2007	AAS CET			Engineering-related employment		\$15.00/ hr		Full-time
16		2007	AAS MET			Engineering-related employment		12		Part-time
17		2006	AAS MET		Education					Not Applicable
18		2007	AAS MET				Both	\$39182 plus benenfits, 401k		Full-time
19		2008	AAS CET			Engineering-related employment		3100/month + benefits		Full-time
20		2008	AAS MET				Both	\$15.36/hour		Full-time
21		2008	AAS CET			Engineering-related employment		\$33,500 annual		Full-time
22		2008	AAS MET			Engineering-related employment		14		Full-time
23		2006	AAS MET				Both	14		Full-time
24		2005	AAS CET			Engineering-related employment				Full-time
25		2006	AAS CET			Engineering-related employment		30k		Full-time
26		2007	AAS CET			Engineering-related employment		\$32,000 a year		Full-time
27		2008	AAS CET			Engineering-related employment		58800		Full-time
28		2008	AAS MET				Both	40,000 a year		Full-time
29		2005	AAS MET		Education			60000		Full-time
30		2009	AAS CET			Engineering-related employment		16.50/hr		Full-time
31		2006	AAS MET		Education			60000		Full-time
32		2008	AAS CET			Engineering-related employment		18.00/hr		Full-time
33		2007	AAS MET				Both	17		Full-time
34		1996	AAS MET			Engineering-related employment		14.75		Full-time
35		06/01/2007	AAS MET	also General Studies			Both	50K		Full-time

Graduates	What is your current employment status (choose all that apply)? Full-time e Part-time e Full-time s Part-time s Unemployed Retired	If employed, is your current job engineering-related? Response	OPTIONAL: What is the name of your employer? Open-Ended Response	OPTIONAL: What is your current annual salary (if unemployed or retired, base this on most recent salary)? Response
1	Full-time employed	Yes		\$45,000-\$60,000
2	Full-time employed	Yes	AEC	\$45,000-\$60,000
3				
4	Full-time student	Unemployed		
5	Full-time employed	Not Applicable		\$35,000-\$45,000
6		Yes	Bonneville Power Administration	\$45,000-\$60,000
7	Full-time employed	Unemployed		\$25,000-\$35,000
8	Part-time student	Yes	Northwest Engineering Service Inc.	<\$25,000
9	Full-time employed	Yes	EPC Consultants, Inc. - sub for Portland Water Bureau	\$35,000-\$45,000
10	Part-time employed	Part-time student	PCC	<\$25,000
11	Full-time employed	Yes		\$45,000-\$60,000
12	Full-time employed	Yes	URS Corp.	\$35,000-\$45,000
13	Full-time employed	Yes	WHPacific	\$35,000-\$45,000
14		Unemployed		
15	Full-time employed	Yes	Kleinfelder	\$35,000-\$45,000
16		Unemployed	restaurant	<\$25,000
17	Full-time student	Not Applicable		<\$25,000
18		Unemployed		<\$25,000
19	Full-time employed	Yes	ODOT	\$25,000-\$35,000
20	Full-time employed	Yes	Tektronix	
21	Full-time employed	Yes	CH2M Hill	\$35,000-\$45,000
22		Retired	Intel	\$35,000-\$45,000
23	Full-time student	Not Applicable		\$25,000-\$35,000
24	Full-time employed	Yes	BERGER/ABAM Engineers, Inc.	
25	Full-time employed	Yes	City of Portland	\$35,000-\$45,000
26	Full-time employed	Yes	Black & Veatch	\$45,000-\$60,000
27	Full-time employed	Yes	Stacy and Witbeck, Inc.	\$45,000-\$60,000
28	Full-time employed	Part-time student	Intel	\$35,000-\$45,000
29	Full-time employed	Yes	Boeing	\$60,000-\$75,000
30		Unemployed		
31	Full-time employed	Not Applicable		
32	Full-time employed	Yes	Kiewit	\$60,000-\$75,000
33	Full-time employed	Yes	Intel	\$35,000-\$45,000
34	Full-time employed	Part-time student	Blount INC.	\$35,000-\$45,000
35	Full-time employed	Yes	City of Portland, BES, Waste Water Engineering	\$35,000-\$45,000
		Yes		\$45,000-\$60,000

Graduates	What is your education after the CMET program? Response	Please specify degree & school, if applicable.	How well did the CMET program prepare you for either work or continuing education? Open-Ended Response	What do you think should be added to the program from your experience? Open-Ended Response
1	Currently pursuing degree	Civil Engineering, Portland State University	Very well. I am very prepared to apply what I've learned to real world situations.	Plan reading. Perhaps a larger chemistry & physics sequence?
2	Other Bachelor's degree	B.S. History, PSU (graduated 1987)	Somewhat helpful as a credential	I loved the environmental engineering coursework, but it really does not belong in the mechanical engineering category. ProE should be eliminated from all the programs!
3	Currently pursuing degree		It fully prepared me to continue my education. I had all the knowledge needed to be placed in advanced classes at OSU.	Possibly an internship requirement during the last two terms.
4	Currently pursuing degree	Mechanical Engineering PSU Transfer		The program should also be organized for those who are in part time status also. Having to take one class one year and the second half (Thermo II or Calc II) a year later makes it difficult to maintain a smooth learning transition.
5	Currently pursuing degree	Mechanical Bachelor Degree OIT	VERY WELL	More field related work.
6	No additional degree		Good. It showed the theory of the real world.	
7	Currently pursuing degree	Bachelor Mechanical Engineering Technology @ OIT		
8			I think the program did a good job preparing me for the work that I've been doing. I don't like the idea that if you go through the CMET program then later decide to continue with a four year degree that you have to start completely over.	More Excel classes
9	Currently pursuing degree	Looking into 4yr at PSU	Excellent. Level of instruction in classes and student to teacher ratio in the CMET program is much better than University classes I have attended.	More basic physics; mostly mechanics.
10	Currently pursuing degree	BSME at WSUV	The CMET program provides students with the background they need to start a career in many different types of engineering fields. It gives them that leg up they need to get started and hopefully land a job. Once there, additional job training is usually always required.	Another Surveying class. But I could be a little biased in this area considering I'm a surveyor right now...
11	No additional degree			I thought the overall curriculum was fairly inclusive. Aligning calculus and physics classes with transfer classes may make it easier for students to pursue bachelor's degrees later on.
12	No additional degree		Worked well, problem solving and critical thinking techniques helped alot	More technical surveying classes
13	No additional degree			
14		drafting certificate		Please include a class specifically for the reading and development of construction plans and specifications. VERY IMPORTANT! Also, technical writing should be required rather than just encouraged. We had to write many reports for our classes, which was extremely helpful, but technical writing has specific language and rules.
15	No additional degree		I am well prepared for the job I currently do. I picked a weird company to work for- I don't get to use much of what I learned in the program. Instead, I am drawing from many of the transferable skills from my former "career." I do feel as though I have enough technical background to know what the people around me are talking about... I just would have liked to be able to use more of my engineering and math skills.	for MET they need to focus more on drafter using auto CAD 3D or solid work and test lab project such as electrical or manufacturing!!!
16	No additional degree		not enough	
17	Bachelor's degree in Engineering or Engineering Technology	Oregon Institute of Technology. BA in MET and MFG engr tech	fairly well. some subjects such as fundamentals of electricity and calculus were lacking in my opinion. i didn't feel well enough prepared in calculus, or with electrical circuits.	Tutor specifically for CMET students, specifically for the arth pieces of the program. In fact, regular tutoring sessions should be available throughout the program a few times a week for a few hours each time.
18	No additional degree	OIT	I am happy with the education I received from the CMET program. I think that it prepared me well for my career though I am frustrated with the only job openings being almost solely drafting. I didn't spend countless weekends doing complicated mathematics and problem solving to draw pictures!	Plan reading
19	Currently pursuing degree	Taking some time before going back to school but OIT	I have great things to say about the CMET program and the instructors.	
20			CMET without a doubt got me hired and gave me basic understanding for what I am doing for my employer.	
21	No additional degree		As of right now, I am not using as much engineering skills as I hoped so this question is more difficult for me to answer.	Improve the Electrical Class. It is not micro circuits, but three phase high KVA machinery power that needs to be addressed.
22	No additional degree			For civil engineering program, more LDD training (or Civil 3D). Having this experience is a valuable skill which can be utilized immediately in the job. Having the skills to make alignments, cut cross sections, plan and profiles, and calculate cut-fill amounts is a highly sought after skill in the engineering consulting industry. With this skill, one could immediately participate in site development projects.
23	Bachelor's degree in Engineering or Engineering Technology	Will begin Masters in Manufacturing Eng. June 09	For the most part very well, but too much Civil and not enough Mechanical/Manufacturing emphasis.	More classes related to surveying.
24	No additional degree			I think a little more hands on experience could benefit students such as more time with surveying equipment or even field trips to more facilities.
25	No additional degree		Very well	
26	No additional degree		The CMET program, gave me the knowledge to succeed in the engineering industry. I know for a fact that I would not be able to do the job I do now without having been taught the fundamentals of engineering.	Just some more project management courses.
27	No additional degree		Very well. I think that there could have been some more "Project Management" type courses though explaining the processes of construction engineering and management though. Also it would have helped some of the other students who were not as proficient as myself with computers if there were more classes on computer software related to the construction industry. I.E. Expedition, Primavera, On-Screen Take-Off. Not everyone has gone into heavy construction though like I have.	A basic class about computers and there components.
28	Currently pursuing degree	OIT	The group and board work was very helpful in preparing me to work with other people.	Hand on experience
29	Bachelor's degree in Engineering or Engineering Technology	OIT	Good	students who don't have computer skills need to be brought up to speed before the Enviro, Structural Steel, Civil CAD and surveying classes. We wasted too much time helping those who were computer illiterate when we could have been learning useful Engineering Tech skills. Same concept behind the chemistry requirement before we take enviro. Students who don't know how to operate Windows comfortably need to learn to before these classes.
30	No additional degree			
31	Bachelor's degree in Engineering or Engineering Technology	Bachelor's MET from OIT	gave me the chance to get a "foot in the door" for employment. CET doesn't transfer so it's not good to pursue if you want more education.	
32	No additional degree		PCC did a great job of preparing me for further education.	The program should be tailored better towards both disciplines. I took at least 4 classes that, while they were informative and enjoyable from a learning standpoint, did not transfer to OIT for continuing forward towards a 4 year degree.
33	Currently pursuing degree	OIT	so far so good	I really think that the students should be encouraged and helped obtain internships. Or given more of an opportunity to meet former grads to find out what they are getting into. The engineering orientation did this a little and the resumé and interview class did not give us enough time to talk to people. When I stepped into my current position I had no idea what to expect.
34	No additional degree			More AutoCad, Solidworks etc.
35	Currently pursuing degree		Good but need more AutoCad related in the program.	

Graduates	The format of the CMET program with its long class-immersion approach and math classes taught 'in-house' was very helpful in my getting started in the engineering field	Response	Any additional comments regarding the format of the CMET program.	Thank you for your time. Any additional comments:
				Open-Ended Response
1	Agree		Higher math pre-requisite might be more helpful, perhaps mth 111?	CMET is a great program. Keep up the good work!
2	No opinion		Does not apply to my situation.	
3	Strongly agree			I loved calculus with Eng :)
4	Strongly disagree		To get into bachelor's program, Physics, Math and some others have to be repeated. The program should also be organized for those who are in part time status also. Having to take one class one year and the second half (Thermo II or Calc II) a year later makes it difficult to maintain a smooth learning transition.	
5	No opinion			
6	No opinion			
7	Agree			
8				
9	Strongly agree			To all the staff and personnel, thanks for everything :)
10	Agree			Thankyou for providing me with the background and knowledge I needed to succeed in the engineering field.
11	Strongly agree		I loved the long class-immersion approach, it gives students that extra leg up and additional help they need to succeed.	
12	Agree		I don't know if it was necessary for me to get started in the engineering field but it is definitely my preferred way of learning.	
13	Agree		The CMET students might take some classes that are not useful in the civil field	
14	Disagree			
15	Agree		I have always had he opinion that the math requirement should be raised for the program (MTH 111C), and that the calculus class should be more challenging... and USED in the second year. I've forgotten everything. But that's just me.	I love discussing the program- I would have too much to say to fit it in here. they need to cut off unnecessary class which is not related with MET and more focusing on ET class.
16	Strongly agree			
17	Disagree			I would love to work with students going through the CMET program. I know all to well how demanding/difficult the program is, I think mentorship would be a GREAT addition for the success of each student. I had a student from the year above me take me under his wing through my time there and his help/encouragement was invlauable to me. In fact it still is as he has gone on to OIT.
18	Agree			
19				
20	Strongly agree			
21	Agree			
22	Agree			To increase enrollment, combine your CMET with a Manufacturing Engineering Tech. Program as per my curriculum that has been shared with the Mfg. Dept and its Dean. I will be glad to speak to you regarding it. I currently am mentoring several OIT students.
23	Strongly agree			
24	Disagree			
25	Agree		It taught me very well, but it was hard to hold a job while doing it.	Thanks for a great start at a new career.
26	Strongly agree			
27	Strongly agree		They teach you what you need to know - period.	
28	Strongly agree			
29	Strongly agree			Thank you for the wonderful instructors that you had during my years in school.
30	Agree			
31	Strongly agree			Thanks for a good program!
32	Strongly agree			An opportunity in the area for civil graduates to expand their possibilities would be nice. I was interested in Civil engineering but with no chance to move toward a 4 year degree I was forced to take the Mechanical route, not that the mechanical route is a bad thing. Environmental 1 and 2 could be replaced by a real physics class and a statistics class.
33	Agree		math in house was much easier to understand compared to the math dept at PCC where some classes were taught using powerpoint	
34	Strongly agree			
35	Agree			nope none have a great day

Appendix 4.3 Advising Guide

Following is the advising guide for 2008-2009.

CIVIL & MECHANICAL ENGINEERING TECHNOLOGY

Effective: 2008-2009

Last revised 11 September 2008

Term	Course Number	Course Title	H'rs	Cr's	General Education (16 credits req'd)
1	CMET 110	Statics	8	4	<u>A&H</u> SP 100 or 111 4 <hr/> <u>SS</u> <hr/> <hr/> <u>M&S</u> CH 104 5
	CMET 111	Eng'g Tech'y Orientation	10	4	
	CMET 112	Tech Algebra/Trigonometry	9	4	
	CMET 113	Eng'g Tech'y Graphics	6	3	
			33	15	
2	CMET 121	Strength of Materials	8	4	
	CMET 122	Tech Engineering Physics	10	4	
	CMET 123	Tech Algebra/Analytic Geometry	9	4	
	CH 104	General Chemistry ¹	7	5	
			34	17	
3	CMET 131	Applied Calculus	18	8	
	CMET 227	Applied Electricity Fundamentals	4	2	
	WR 121	English Composition ²	4	4	
		General Education ¹	4	4	
			30	18	
4	CMET 132	Plane Surveying (CET) or			
	CMET 226	Dynamics (MET)	6	3	
	CMET 133	Materials Technology	6	3	
	CMET 221	Environmental Systems	7	4	
	CMET 213	Fluid Mechanics	6	3	
	SP 100/111	Speech Communication ¹	4	4	
		29	17		
5	CMET 228	Construction Materials (CET) or			
	CMET 215	Manufacturing Processes (MET)	6	3	
	CMET 212	Thermodynamics I	8	4	
	CMET 211	Environmental Quality	9	4	
	CMET 241	Structural Steel Drafting	7	3	
	CMET 254	CMET Seminar	1	1	
	General Education ¹	4	4		
		35	19		
6	CMET 214	Route Surveying (CET) or			
	CMET 235	Machine Design (MET)	6	3	
	CMET 233	CET Applied CAD or			
	CMET 237	MET Applied CAD ³	4	3	
	CMET 222	Thermodynamics II	8	4	
	CMET 223	Project Management	3	3	
CMET 236	Structural Design	6	3		
		27	16		

Optional: CMET 280A, Cooperative Education, available any term after completing Term 3.

See reverse for explanatory notes

Civil & Mechanical Engineering Technology **Effective 2008-2009**

- (1) **GENERAL EDUCATION:** 16 credits are required for an Associate of Applied Science degree, and must be selected from the General Education Course List in the current PCC Catalog. Each of the three areas below must be covered and suggested courses are listed. A maximum of 8 credits is allowed in an area.

(AAS) indicates courses required for the Associate of Applied Science degree.

(OIT) indicates courses required for graduation from Oregon Institute of Technology in Mechanical or Manufacturing Engineering Technology (MET or MfgET). While these courses may be taken at PCC, they are not required for transferring to OIT.

Arts & Humanities:

SP 100, Introduction to Speech Communication (AAS) or
SP 111, Fundamentals of Speech (AAS) (OIT)

Social Science:

EC 200 or 201 or 202, Principles of Economics (OIT); PSY 201, General Psychology (OIT);
GEO 265, Introduction to GIS (Good choice for CET students).

Mathematics, Natural & Physical Sciences:

CH 104, General Chemistry (AAS) (OIT)
CIS 120, Computer Concepts I (OIT, MfgET)
MTH 243 and MTH 244, Statistics I and Statistics II (OIT)
PHY 202/212, General Physics (OIT)
PHY 203/213, General Physics (OIT, MET)

Confirm that your selections are on PCC's General Education Course List.

- (2) **COMMUNICATIONS:** WR 121 is required as a basic competency requirement for the AAS degree. It does not, however, count as general education credit. (WR 115 is a prerequisite for WR 121). WR 122 is required by OIT.

WR 227, Technical Writing I, is highly recommended to all students and required by OIT. WR 121 is a prerequisite for WR 227.

- (3) CMET 237, MET Applied Computer Aided Design: there are several options, utilizing different CAD programs, from which students may choose.
- (4) TI-89, TI-89 Titanium, or TI Voyage 200 are the calculators used in the CMET program.

- (5) **FORMS OF RECOGNITION:**

Certificate: For completion of terms 1 through 4.

Associate of Applied Science Degree: For completion of terms 1 through 6.

- (6) OIT has a normal limit of 108 credits of community college work being applied to a Bachelor of Science in Engineering Technology degree. OIT will, however, accept more credits provided that you submit and have accepted, prior to receiving your AAS degree, a plan for the additional credits to be transferred. See a PCC Engineering Technology advisor for a suggested letter to OIT's Registrar that may be used in obtaining permission.
- (7) OSU's Construction Engineering Management program accepts some credits from the CMET program. See a CMET advisor for details.

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Appendix 4.4 Outcomes Mapping

This table maps each course in the curriculum to the PCC core outcomes. Courses are rated on a scale of 1 to 3, with 1 low and 3 high, as to how well the course contributes to the particular outcome.

CMET Curriculum Mapping for Outcomes										
Course		Course	College Core Outcomes							
Term	Number	Title	Hrs	Cr's	Communi- cation	Community and Environmental Responsibility	Critical Thinking and Problem Solving	Cultural Awareness	Professional Competence	Self-Reflection
1	CMET 110	Statics	8	4	2	1	3	2	3	2
	CMET 111	Eng'g Tech'y Orientation	10	4	2	2	2	2	3	2
	CMET 112	Tech Algebra/Trigonometry	9	4	1	1	3	1	3	2
	CMET 113	Eng'g Tech'y Graphics	8	3	2	1	3	1	3	1
			35	15						
2	CMET 121	Strength of Materials	8	4	1	3	3	2	3	2
	CMET 122	Tech Engineering Physics	10	4	1	2	2	2	3	2
	CMET 123	Tech Algebra/Analytic Geometry	9	4	1	1	3	1	3	1
	CH 104	General Chemistry (1)	7	5	1	2	3	1	2	1
		General Education (1) (2)	3	3	2	2	2	3	2	3
			37	20						
3	CMET 131	Applied Calculus	18	8	2	1	2	2	3	2
	CMET 227	Applied Electricity Fundamentals	4	2	2	2	3	2	3	1
	WR 121	English Composition (2)	3	3	3	2	2	2	3	3
		General Education (1)	6	4	2	2	2	3	2	3
			31	17						
4	CMET 132	Plane Surveying (CET) or			2	1	3	1	3	1
	CMET 215	Manufacturing/Robotics (MET)	6	3	2	1	2	1	3	1
	CMET 133	Materials Technology	6	3	3	1	3	1	3	1
	CMET 211	Enviro Engr Tech I	9	4	3	3	3	3	3	2
	CMET 213	Fluid Mechanics	6	3	1	3	2	1	3	1
	SP 100/111	Speech Communication	3	3	3	2	2	3	3	3
			30	16						
5	CMET 228	Construction Materials (CET) or			2	2	3	1	3	1
	CMET 226	Dynamics (MET)	6	3	1	3	3	1	3	1
	CMET 212	Thermodynamics I	7	4	1	1	3	1	3	1
	CMET 221	Enviro Engr Tech II	7	4	3	3	3	3	3	2
	DRF 241	Structural Steel Drafting	6	3	1	1	2	1	3	1
	CMET 254	CMET Seminar	1	1	3	3	0	3	2	3
		General Education (1)	3	3	2	2	2	3	2	3
			30	18						
6	CMET 214	Route Surveying (CET) or			2	1	3	1	3	1
	CMET 235	Machine Design (MET)	6	3	1	1	3	1	3	1
	CMET 233	CAD Elective - CET (CET) or			2	1	1	1	3	1
	CMET 237	CAD Elective - MET (MET)	4	3	2	2	3	1	3	1
	CMET 222	Thermodynamics II	7	4	2	1	3	1	3	1
	CMET 223	Project Management	3	3	3	2	2	2	3	2
	CMET 236	Structural Design	6	3	1	1	3	1	3	1
			26	16						
					1.9	1.7	2.5	1.7	2.8	1.6

The table on the following page maps each course in the curriculum to the program outcomes. Courses are rated on a scale of 1 to 3, with 1 low and 3 high, as to how well the course contributes to the particular outcome.

CMET Curriculum Mapping for Outcomes																
Term	Course Number	Course Title	Hrs	Cr's	Obtain employment in the civil, mechanical, or manufacturing engineering field	Solve civil and/or mechanical engineering problems by applying fundamental knowledge of mathematical, computational scientific and engineering concepts	Acquire, with experience, the ability to identify, formulate, and design solutions to real-world engineering problems	Conduct experiments using appropriate laboratory equipment; and collect, analyze, and interpret data	Use appropriate techniques, skills and modern engineering equipment and computational tools	Apply project management and technical skills in the planning, design, fabrication, construction, and operation of engineering systems or components	Interpret and create engineering drawings using modern computerized methods	Function and communicate effectively both at the individual level and within team settings	Understand the impact of engineering solutions in a global, societal, and environmental context	Understand professional and ethical responsibility	Engage in life-long learning	Achieve success in continuing their education towards completion of a four-year degree in engineering technology
1	CMET 110	Statics	8	4	3	3	3	1	3	1	1	3	1	1	3	3
	CMET 111	Eng'g Tech'y Orientation	10	4	3	1	2	1	3	1	3	3	1	1	3	3
	CMET 112	Tech Algebra/Trigonometry	9	4	3	3	3	1	2	1	1	2	1	1	3	3
	CMET 113	Eng'g Tech'y Graphics	8	3	3	1	3	1	3	1	3	3	2	2	2	3
			35	15												
2	CMET 121	Strength of Materials	8	4	3	3	3	3	2	3	3	3	3	3	2	3
	CMET 122	Tech Engineering Physics	10	4	2	2	3	3	2	2	1	2	3	2	3	2
	CMET 123	Tech Algebra/Analytic Geometry	9	4	3	3	3	1	2	1	1	2	1	1	3	3
	CH 104	General Chemistry (1)	7	5	2	3	2	3	3	1	1	2	1	1	2	3
		General Education (1) (2)	3	3	2	1	1	1	1	1	1	3	3	2	3	3
			37	20												
3	CMET 131	Applied Calculus	18	8	3	3	3	1	3	1	1	3	1	1	3	3
	CMET 227	Applied Electricity Fundamentals	4	2	2	3	3	3	2	1	1	2	3	2	3	3
	WR 121	English Composition (2)	3	3	3	1	1	1	1	2	1	3	2	2	3	3
		General Education (1)	6	4	2	1	1	1	1	1	1	3	3	2	3	3
			31	17												
4	CMET 132	Plane Surveying (CET) or			3	3	2	3	3	1	3	3	1	3	2	3
	CMET 215	Manufacturing/Robotics (MET)	6	3	2	2	2	1	2	1	1	2	1	1	2	2
	CMET 133	Materials Technology	6	3	3	3	3	3	3	1	1	3	2	2	3	3
	CMET 211	Enviro Engrg Tech I	9	4	3	3	3	3	3	1	1	3	3	3	3	3
	CMET 213	Fluid Mechanics	6	3	3	3	3	3	2	3	1	2	3	3	3	3
	SP 100/111	Speech Communication	3	3	3	1	1	1	1	1	1	3	1	1	2	3
			30	16												
5	CMET 228	Construction Materials (CET) or			3	3	3	3	3	1	1	3	2	2	1	3
	CMET 226	Dynamics (MET)	6	3	3	3	3	3	2	3	1	2	3	3	3	3
	CMET 212	Thermodynamics I	7	4	3	3	3	1	2	1	1	2	1	2	1	3
	CMET 221	Enviro Engrg Tech II	7	4	3	3	3	2	3	1	1	2	3	3	3	3
	DRF 241	Structural Steel Drafting	6	3	3	1	2	1	2	3	3	3	1	1	2	3
	CMET 254	CMET Seminar	1	1	3	0	0	0	0	0	0	3	3	3	3	3
		General Education (1)	3	3	2	1	1	1	1	1	1	3	3	2	3	3
			30	18												
6	CMET 214	Route Surveying (CET) or			3	3	3	3	3	1	3	3	1	2	2	3
	CMET 235	Machine Design (MET)	6	3	3	3	3	1	3	3	2	3	2	2	2	3
	CMET 233	CAD Elective - CET (CET) or			3	1	2	1	2	1	3	3	1	1	2	3
	CMET 237	CAD Elective - MET (MET)	4	3	3	1	3	1	3	1	3	3	2	2	2	3
	CMET 222	Thermodynamics II	7	4	3	3	3	1	2	1	1	2	1	2	1	3
	CMET 223	Project Management	3	3	3	2	1	1	3	2	3	2	2	2	2	3
	CMET 236	Structural Design	6	3	3	3	3	1	3	1	2	1	1	3	2	3
			26	16												
					2.8	2.2	2.4	1.7	2.2	1.4	1.5	2.6	1.9	1.9	2.4	2.9

Appendix 4.5 Enrollment Data

The following graphs summarize program enrollments for Fall and Winter terms from Fall, 2004 to Winter, 2009.

