School of Engineering and Technology

COMPUTER SOFTWARE ENGINEERING TECHNOLOGY

2002-2003

DISCIPLINE/PROGRAM REVIEW FINAL REPORT

MAY 2003

Portland Community College

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PROGRAM HISTORY

In 1977, Intel and Tektronics approached PCC with a request to create a new program that would combine the basic skills and knowledge of a digital electronics engineering technician and a systems software developer in one person. Graduates of the new program were to be able to break the communication logjam between the electronic engineers and software developers. A system software instructor was hired, the program was developed and the first classes were offered in the fall of 1978.

Although initially neither Tektronics nor Intel hired any of the graduates, they had no trouble being placed within the fledgling microcomputer industry. By 1980, as demand grew, part-time faculty were added to the program. In 1983, a new full-time faculty member had 2/3 of his assignment in CSET; one year later, the instructor's entire assignment was dedicated to CSET.

Throughout the 1980's, the program continued to evolve by the addition and revision of individual courses to meet emerging skill requirements such as those of UNIX and C, Object-Oriented Programming, and Modula-2. Then 1987's, the original instructor left PCC. That position was vacant for one year before a replacement instructor was hired. By the late 1980's, the program had fallen behind the software technology curve and massive changes were needed.

Facing declining enrollments and new but unknown requirements from industry, the CSET was given two years to reinvent, renew, and reinvigorate itself in 1990. In depth industry survey results coupled with advice from our supportive advisory committee led to the creation of the ancestor of today's CSET program. That program adopted a four-strand curriculum:

- Operating systems use, administration, and programming
- Objects-first software engineering
- Computer architecture and low-level programming
- Technical math, writing, and communications

Today, CSET maintains its program as a unique provider of practical, pragmatic, best practice, current technology students who are well trained and ready to work upon graduation.

DETAILED ASSESSMENT REQUIREMENTS

1) *To improve the quality of teaching and learning by asking faculty, staff, and administrators to reflect upon and examine teaching methodologies, learning outcomes, and curriculum.*

   a) *Evaluate the curriculum using national and or professional program guidelines where available*

- Since 1992 our curriculum has adopted an objects-first strategy using C++ as the introductory programming language. However the first course focuses more on objects and object-oriented development skills than the C++ language. Our students are introduced to the object software development processes before learning how to express their solutions in a programming language.
- The Joint Task Force on Computing Curricula IEEE Computer Society and Association for Computing Machinery (the leading professional society for software developers) has since identified this as a preferred approach. [1]

  > "... the objects-first model does not specifically address many of the disadvantages common to programming-first approaches, *...Unless instructors take special care to introduce the material in a way that limits this complexity...*"

- The principal advantage of the objects-first strategy is the early exposure to object-orientated thinking. Object-oriented development has become increasingly important in both academia and industry. The December 2000 announcement by the College Board that they plan to introduce a more object-orientated approach in the Advanced Placement curriculum underscores the importance of this approach.[2]
- Innovative approaches such as those taken by the CSET program from its earliest inception are further recognized by the Joint Task Force on Computing Curricula IEEE Computer Society and Association for Computing Machinery in Section 7.1 [1]

  > "Given the current state of the art in this area, we are convinced that no one-size-fits-all approach will succeed at all institutions. *Because introductory programs differ so dramatically in their goals structure, resources, and intended audience, we need a range of strategies that have been validated by practice.* Given a field that changes as rapidly as computer science, pedagogical innovation is necessary for continued success."

- This program is different from those offered at other schools across the country as illustrated by the following samples:
  - Carnegie Mellon School of Computer Science offers a Certificate (five courses over two years) degree in Software Engineering.

- University of Maryland University College offers a Certificate (five courses over two years) degree in Software Engineering
- Missouri Tech, St. Louis offers an Associate of Software Engineering degree (but it focuses more in information systems)
- Oregon Institute of Technology offered an Associates degree in Software Engineering Technology that they have since dropped (They continue to offer a Bachelor's degree with which we articulate.)

b) *Review and revise, where necessary, learning outcomes for the program and/or for any sequence of courses within the discipline/program*

- The CSET SAC completed developing program outcomes for all current courses within the CSET curriculum in spring of 2001. (Appendix A)
- The CSET SAC has adopted a three-year cycle for revision of program course outcome guides. At this time, the CSET courses fall into one of six outcome revision sequences:
  - Operating Systems Administration
  - Object-Oriented Software Engineering
  - Multi-Tier Software Engineering
  - Embedded Software Engineering
  - Digital Computer Architecture
  - Multithreaded Software Engineering
- In Spring 2002, the CSET SAC, in collaboration with the CSET Industry Advisory Committee, began the process of program curriculum revision to the Multi-Tier, Embedded, and Multithreaded Software Engineering outcome sequences for introduction in the spring of 2003 and publication in the Fall 2003 catalog. The changes involved rearranging some course sequences, course content, course credits and hours, and replacing courses no longer relevant to industry with new ones. (See Appendix B)

c) *Give evidence that the discipline/program learning outcomes are being met by students.*

- The following CSET program learning outcomes were adopted in the spring of 2000.

CSET graduates will have the following skills:

1. To be employable within the software industry at or above the technician level.
2. To continue to learn software engineering and related concepts.

3. To continue in a higher education program in software engineering.
4. To communicate effectively using: oral, written, and graphic communication skills.
5. To troubleshoot problems related to software engineering.
6. To work with others in a team environment.
7. To embrace change positively.

- Our evidence that CSET graduates have met those skill outcomes: [3]
  - To be employable within the software industry at or above the technician level
    - A.A.S. degree graduates usually obtain employment within 3 months of graduation. (June 2002 graduates are an exception due to temporary industry downturn.)
    - Graduates of the program have obtained jobs as:
      - Software engineer (a.k.a. software developer, programmer)
      - Software quality assurance engineer
      - Software support technician
      - Systems administrator
      - Internet software engineer (a.k.a. web/internet developer)
      - Build technician
  - To continue to learn software engineering and related concepts.
    - Scott Hanselman '95 is the regional representative for Microsoft.
    - Former students are working with languages and operating systems that are not part of our curriculum at prior to there graduation such as
      - Smalltalk (Murray Zenk '92),
      - Java (Steve Rawley '99),
      - Visual Basic (Athena Laird '97),
      - XML, Python (Jeff Holt '94),
      - Oracle (Jeff Holt '94)
  - To continue in a higher education program in software engineering.
    - Rich Claussen '02, John Garren '02, Justin Hill '02, Jamin Guy '02, Vincent Pate '02, Yi Huang '02, Liyan

Xiao '02 and others enrolled in Bachelors or Masters degree programs in September 2002

- Connie Piazza '94 and Lavinia Voin '94 graduated from OIT at Klamath Falls in Software Engineering Technology, June 1996
- Micah Githens '00, Naomi West '00, and Mike Van Grunsven '00 graduated from OIT at Klamath Falls in Software Engineering Technology, June 2002
- Scott Hanselman '95, while working in industry, enrolled part-time in the Portland OIT degree completion program; He will graduate June 2003.
- Joe Barnett '00 and Kyle Quest '00, while working for Netplane Systems in Boston, enrolled at Northeastern University in 2001

- To communicate effectively using: oral, written, and graphic communication skills.
  - During the Spring 2002 Mock Interviews, an industry participant and Technical Writer, Sharon McLeod, Radisys, commented that Liyan Xiao '02 should consider technical writing as a career based on her portfolio of work.
  - Scott Hanselman '95 has been a principle presenter at Microsoft Training Days both regionally, nationally, and internationally
  - Thane Gebbie '00, Steve Rawley '99, Rob Bennett '00, Robert Frame '97, Ron Gaut '88 and many other graduates make presentations at our Friday Student Success Seminars each term
  - Lee Middleton '99 was the keynote speaker at our Fall 2001 and 2002 CSET New Student Orientation.
- To troubleshoot problems related to software engineering.
  - Corillian's 2002 co-op position seeks a student to test Microsoft hot patches against their banking industry software before it's released to Corillian's customers.
  - Rob Bennett '00 was hired as the first and only software quality assurance engineer at SRS to establish quality assurance best practices process
  - Lee Middleton '99 found a PCI bus defect that had been undetected in an existing program used to test various computer cards for Intel during their final quality assurance phase and corrected it
- To work with others in a team environment.

- Helen Roth '97 was hired to introduce object-oriented software methodology to developers at a firm developing AutoCAD add-in libraries.
- Diane Whitfield '99 was hired to document a software based cell culture diagnostic development effort and quality assurance statistics at Lepo Instruments for evaluation by the FDA
- Ted Tarney '99 was hired as a member of a development team and subsequently moved to Iowa in 2001 to accept a position at First Data Resources as a Sr. Development Analyst leading a team of five.[4]

o To embrace change positively.

- Scott Hanselman '95 was hired as a Technology Evangelist by Corillian to lead the introduction of new technologies in their software products and has since been promoted to Chief Architect.
- Ted Tarney '99 worked first in COM/DCOM component development and now works in .NET, C# and C++ development.
- Joe Barnett '00 is a Principle Protocols Engineer at Netplane Systems in Boston
- Kyle Quest '00 is an Embedded Engineer at Netplane Systems in Boston

2) *To maintain instructional quality consistent with the academic standards of the Northwest Association of Schools and Colleges.*

a) *Assess the success of the discipline/program in contributing to the College mission "Quality educational programs and services that are affordable and accessible".*

- CSET trains and graduates students who are unable to attend universities due to financial, employment, and family constraints.
- CSET trains and graduates students who have attended universities, possibly having received advanced degrees, and are now changing careers.
- Over the last 25 years, the demand for graduates from this program and the high salaries earned by our graduates testifies to the quality of the CSET program.
- The success of our graduates in earning both Bachelors and Masters degrees after they graduate further attests to the quality of this program.[5]

b) *Report any changes the SAC has made to instructor qualifications and the reasons for the changes.*

- As a Professional/Technical program, the CSET SAC prefers hiring instructors with current technical development experience in industry rather than a combination of advanced degrees but little industry experience.
- The CSET SAC contends that in-depth development experience in software engineering is much more valuable to our students than academic degrees earned by instructors.
- Three or more recent years of varied commercial software development experience should be the minimum criteria for hiring decisions and should carry more weight than an advanced degree coupled with less industry experience.

c) *Describe how the students in this discipline/program are using the library or other outside the classroom information resources.*

evidence in Syllabi of use of resources outside of class.

- CSET students rely on the library for its technical journals more than its books. The number of books published each year on software topics tied to their typically short lifetime places book purchases beyond the resources of the library. Recent book acquisitions by the library targeting fundamental topics may improve its use by future students.
- CSET students are more likely to purchase additional computer books than borrow books from the library. Students prefer being able to write in the books as well as have copyright permission to the CDROM and WWW material that frequently accompanies the books.
- CSET students use the Internet extensively for research on technology and for class materials. By the time technical books are published, most material in them is outdated. The most current technology information is only available on the Internet.

3) *To describe how the discipline/program is responding to the changing needs of students.*

a) *List the professional development activities of the faculty over the last three years and describe any instructional or curricular changes made as a result of those activities.*

- Attended Microsoft Developer Days 1999, 2000, 2001, 2002 in Portland
  - Contributed to revisions of the operating systems platform in the labs and CST 106 and 206
  - Contributed to revisions in the development tools for CST 115, 116, 211, 126, 258, 268, 256, 266, 250
  - Contributed to program revisions for fall 2003 program
- Completed C# programming course at PCC
  - Contributed to 2003 program and course revisions for CST 268, 263, 264

- Attended Microsoft ABET 2001, Seattle
  - Contributed to revisions in the development tools used for CST 115, 116, 211, 126, 258, 268, 256, 266, 250
  - Contributed to revisions of the 2003 program
- Reading and evaluating dozens of books each term
  - Contributes to the ongoing content adjustments made to currently offered courses
  - Contributed to revisions to the 2003 program
- Reading articles from 13 monthly professional journal subscriptions and two weekly newspapers.
  - Contributes to the ongoing content adjustments made to currently offered courses
  - Contributed to revisions to the 2003 program
- Attended several web delivered e-seminars.
  - Contributes to the ongoing content adjustments made to currently offered courses
  - Contributed to revisions to the 2003 program
- Attended WebCT training in 2002
  - Required for the development of online course offering
  - Contributed to the revisions made to CST 140 that split off a distance-learning course in Perl scripting as well as revisions to the remaining classroom course.
- Attended Visual Basic for Programmers
  - No curricular changes resulted.

b) *Describe any significant numbers in student demographics that has impacted instruction within your discipline.*

- Increased student familiarity with basics of software use and MS Windows operating systems led to elimination of one course and revisions to another.
- The prior change along with other the program changes have resulted in a recommendation to return to a three-term one-year certificate rather than a four-term one-year certificate in CSET.

c) *Give examples of how feedback from students, business and industry community groups or institutions that our students transfer, was used to make curriculum or instructional changes.*

- CSET Industry Advisory Committee has guided program and course revision decisions since 1990 and continues to collaborate actively on current and future program changes. A principle agenda item at each

quarterly meeting involves curriculum assessment, revision, and review.

- Periodic student surveys have resulted in reordering the sequence of the digital electronics courses for Fall 2002 for both the EET and CSET programs with the approval of the CSET Industry Advisory Committee.
- Microsoft's evolution of the Windows operating system led to several successive revisions of the specific tool knowledge students acquire in the Operating Systems Administration, and Object-Oriented Software Engineering course sequences with the approval of the CSET Industry Advisory Committee.
- Microsoft's refinement of C++ led to changes in the focus of the Data Abstractions in C++ course from classical object-oriented data abstractions to the Standard Template Library (STL) based library template abstractions with the approval of the CSET Industry Advisory Committee.
- Microsoft's release of the .NET development platform led to the addition of a second course in multi-tier architecture focused on .NET technologies with the approval of the CSET Industry Advisory Committee.
- Along with the .NET development platform, Microsoft released a new family of programming languages including C# (pronounced "C sharp"). That led to the adoption of C# as the programming language in the CST 258 and CST 268 windows programming sequence with the approval of the CSET Industry Advisory Committee.

d) *What strategies are used within the discipline/program to increase enrollment, improve student retention and student success?*

- CSET faculty members, graduates, students, and CSET Industry Advisory Committee members participate in high school career days or make presentations regarding the career opportunities available as a CSET graduate.
- CSET offers weekly Friday Students Success Seminar (thanks to Maniza Johnson's planning and coordination) to encourage students to learn about topics beyond the course material. Although this is not a credit class, students are actively encouraged to attend.
  - "Resume Writing and Interview Skills" by Gary Hewitt
  - Practice Job Interviews for second-year CSET students by various local employers followed by a panel on interviewing for all CSET students.
  - "How to Effectively Communicate with a Technical Writer" by Sharon McLeod

- Some seminars target retention by connecting students with past graduates who describe their success following program completion.
  - "Surviving in the Trenches of the Technology Wars" by Ron Gaut '88
  - "Developing a Software Project" by Lavinia Voin Gatlenburg '96
  - "What I Do as a Software Engineer" by Lee Middleton '99
  - "n-Tier Architecture" by Steve Rawley '99
  - "Introduction to Developing in .NET" by Rob Bennett '00
  - "Key Elements of a Testing Career" by James Cassidy '00
  - "The PCC Experience and My Job at Corillian Corp" by Thane Gebbie '00
- Other seminars target specific life and learning success skills.
  - "You Deserve!" by Les Brown (a motivational video about achieving one's goals)
  - "The Power to Change!" by Les Brown (a motivational video about achieving one's goals)
  - "Show Me the Money" by Clarice Anderson and Irene Pereira
  - "Becoming a Master Student" by Taylor Hanna
- In 1998, CSET began offering the first year of the program for evening students who must work part-time. Students from the evening group contributed 20% to 80% of each of the past three years graduating classes. (The disproportionate number of evening students in the recent graduation statistics is due to the ability of day students who dropped back and retake courses from the evening offering when they experienced difficulty with the course material or life changes that made completion of the day offerings impossible.)
- Second-year students mentor and tutor first-year students in the open lab as a service-learning component of one of their courses.
- CSET Industry Advisory Committee advised developing a mentoring program for CSET students. Subsequently we advised students to enroll in a national mentoring network for college students, MentorNet (www.mentornet.net).
- Engineering faculty members visit math pre-college classes to promote engineering technology as a career choice. They attempt to answer the age-old question, "What do I do with all this math?"
- Faculty members work to renew or extend CSET articulation agreements with two area high schools. Several high schools' agreements are pending further development, and others have expressed interest in articulation.

- Faculty members maintain and strengthen articulation agreements with OIT and seek to develop an articulation agreement with PSU
- Faculty members presented a workshop during the PCC Technology Fair 2001 to give prospective students a glimpse of CSET as a career
- Faculty members presented the CSET program at PAVTEC's 2000 high school articulation dinner for Beaverton High School technology instructors.

e) *Report any changes made in the last three years to increase student access and diversity.*

- CSET distributed scholarships for students to encourage co-op participation for the 2001-2002 in partnership with OIT.
- Faculty planned and developed a distance learning course in Perl scripting first offered in Spring 2003 to both entice prospective students to enter CSET and to reach out to professionals requiring this skill set.
- The engineering division has been awarded a $399,118 NSF CSEMS award to fund scholarships for CSET, CMET, MT, and EET students.

f) *Identify any operational issues faced by the SAC that impact student learning in your area, (e.g., facilities, availability of part-time faculty and other needed resources*

- An insufficient number of labs prevent offering the second year of the CSET program in the evening. (This will be resolved by sharing a new lab with CAS program when the new technology building is built in 2004.)
- Lack of availability of small group meeting rooms in proximity to the CSET software lab for student project meetings. This does not appear to be resolved outside the new labs being built in new technology building. Access to LRC meeting rooms is inconvenient for ad hoc meetings and term-length scheduling is unavailable.
- Recent attempts to hire a replacement full-time faculty member resulted in the member's resignation after only three weeks in winter 2002. Unanticipated and excessive workload was the proximate cause. While we re-advertised the position in February 2002 and awaited applicants, the CS program hired our temporary replacement faculty member. That individual was the only other qualified applicant for the original position as it turned out. That position has subsequently been lost due to low program enrollment.
- Qualified part-time faculty candidates continue to be exceedingly difficult to attract even with the recent salary increases. Average pay in industry is $55K, or $34.38 per hour.[4] With the current economic downturn in software, applicants for adjunct positions are unlikely to remain when the economy improves. Most of the skill sets this

program requires are not found in recent bachelor's or master's graduates nor in the average software developer. Our program graduates with three years experience are more likely to have the skill set we are trying to find.

- Lack of knowledgeable skilled tutors for first-year students is a factor in attrition. Second–year students are unable to meet the demand due the their own course load although they help to the extent possible.
- Lack of knowledgeable skilled tutors for second-year students is an ongoing student frustration. The skill sets required of possible tutors are the same as those sought in part-time faculty members but the pay is considerably less.
- The high cost of development software, usually sold on a per-seat basis, prevents us from acquiring and training our students with more of the development tools they will encounter in industry. Recently, some of our advisory committee members have offered to assist us in negotiating better prices. Even so, our budget continues to fail to cover these costs on a long-term basis. Fortunately Microsoft, our principle development software vendor, makes the development software available for an affordable price for our lab. Additionally, we depend on open source and freeware products for the remainder of our needs.
- The accelerating rate of change in software development cannot continue to be met by too few faculty members with neither the release time nor the funding support for conference tutorials, special seminars, or industry training workshops which typically cost $500 per day or $2000 to $4000 per week for registration only; travel and lodging are often an additional $750 to $1500 per week depending on the location. Most conferences are not in Oregon. We are surviving on a regimen of self-study and those rare activities that fall within our current budget of $300 per faculty member.

4) *To assess that this professional technical program is adequately preparing students to enter into a career field.*

   a) *Evaluate the impact the advisory committee has on curriculum and instructional methods.*

   - This program began at the request of Intel and Tektronics in 1978. Between then and 1990, it was guided principally by the knowledge, experience and judgment of its faculty. In 1990, we were given the choice of redefining CSET or dying from lack of relevancy. We began by recruiting new advisory committee members.
   - For the next two years, the CSET SAC and advisory committee worked to survey industry needs, interpret the results, and prepare an entirely new curriculum.
   - Since the new curriculum's implementation in September 1992, our advisory committee has been essential in offering guidance,

suggestions, assistance, and confirmation of CSET's goals, programs and course changes. A principle agenda item at each quarterly meeting involves curriculum assessment, revision, and review.

- Our committee has guided us in the timing and choice of our operating systems replacements (Windows 3.1 to Windows 95 to Windows NT to Windows 2000 to Windows XP), development platforms (Borland to Microsoft), and evolving technology (single threaded software development of systems and technical applications to graphical user interface windows applications to embedded, multithreaded, and multi-tier software engineering). This assistance and advice has enabled and will continue to enable the program to train students for tomorrow's jobs.
- The use of Linux in place of UNIX System V for CST 140 and CST 240 allowed students to gain greater experience by being able to have the operating system installed on their home computers just as it was in the lab. Additionally, students could gain experience in areas that our facilities made impossible, such as mixed platform LAN installations. Again, our advisory committee approved these changes.
- Finally, our advisory committee has discussed the benefits and problems of distance learning as a delivery system for our program's courses. Where we can benefit, they have encouraged and supported our progress in this area.

b) *Review job placement statistics of students in your program over the last three years, including salary information where available*

- Most students have been paid a starting wage as software technicians at more than twice the average Oregon wage. In 2001, most graduates started at a salary of more than $45,000 a year.
- Promotions have been rapid. Raises have been frequent. Layoffs have been infrequent with the exception of graduates in firms that close.
- Graduate Survey Data[5]

c) *Analyze the program learning outcomes, competencies, and skills as compared to the business and industry needs today and in the immediate future.*

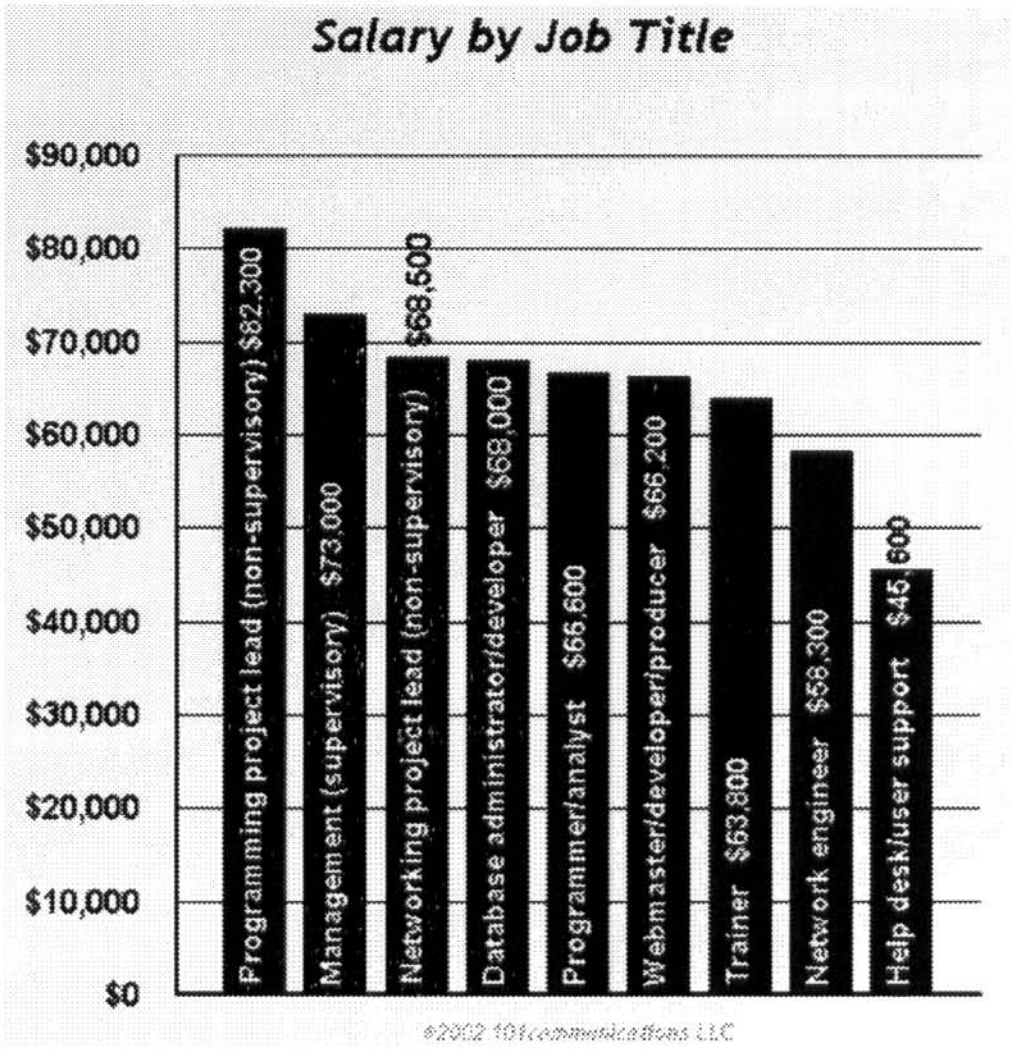
- Our industry advisory committee has continuously endorsed this program, its courses, content, and future direction, including the 2003 program changes.
- Our 2002 industry survey was inconclusive. The results showed a variety of job opportunities for our exceptionally flexible students, but lacked sufficient sample size to be statistically meaningful. We continue to rely on our advisory committee for the future.

- Our Graduate Survey showed that positions in industry varied from Technician (recent graduates) to Senior Software Engineer (graduates with two or more years experience).
- Nationally, industry demand for computer professionals is expected to outpace supply through the current decade.[4]
- The US Department of Labor Occupational Outlook Handbook [6] further makes the following significant points (this survey was completed prior to the dot com bust):
  - Computer software engineers are projected to be the fastest growing occupation over the 2000-2010 period.
  - Computer software engineers must continue to acquire new skills as computer technology experiences rapid change.
  - Employment of computer software engineers is expected to increase 36% for all occupations as businesses and other organizations continue to adopt and integrate new technologies and seek to maximize the efficiency of their computer systems.
  - Median annual earnings of computer professionals who worked full time in 2000

Median	**$67,670**
Highest 10 percent	**>$106,680**
Middle 50 percent	**$53,390 to $85,490**
Lowest 10 percent	**<$42,710**

  - Our graduates' average salary is within the median range for all computer professionals.
- The fastest-growing occupations for 2000-2010 as projected by the Bureau of Labor Statistics will be:
  - Applications software engineers
  - Computer support specialists
  - Systems software engineers
  - Network and computer systems administrators
  - Network systems and data communications analysts
  - Desktop publishers
  - Database administrators
  - Personal and home care aides
  - Computer systems analysts
  - Medical assistants

- Nationally, searchWin2000.com 2001 Salary Survey report:



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- Regionally, according to the National Association of Colleges and Employers, the job outlook for 2002 for the west:

  "Among employers in the West, 27.9 percent expect to increase, 30.9 percent expect to maintain, and 41.2 percent expect to decrease their college hiring this year.

  On average, employers in the West project a 44.8 percent drop in college hiring this year."

d) Forecast future employment opportunities for students in your program.

- The current recession has resulted in few advertised job opportunities for anyone in the high tech industry. Local, state, and federal government forecasts continue to be optimistic for the future expansion of employment opportunities in software development.

- The need for embedded software (software found in "smart" devices) will open new jobs for graduates beyond 2005.
- Multi-tier, distributed software needs will continue to open new jobs as Microsoft's .NET technology gains adherents.
- Cyber security has recently been recognized as an occupational growth area and one lacking suitable training programs.[8] This is a logical extension of the CSET program.
- Locally, the Oregon Labor Market Information System Occupational Information Center states the following:

  "2000 employment for Computer Programmers is estimated to be much larger than average. Growth is projected to be about as fast as average. Annual new openings are expected to be much higher than average."[9]

- According to the Portland Metropolitan Chamber of Commerce:

  "High technology is vital to Portland's economy, with more than 1,700 high tech companies employing some 64,200 workers located within the metropolitan area. Low-cost utilities, a skilled work force, strong infrastructure, access to West Coast and Asian markets and a high quality of life all combine to create a desirable place for technology companies to locate or expand.

  The region accounts for nearly 86 percent of Oregon's technology jobs and almost one-fifth of the state's total manufacturing. Expansions, together with spin-offs, start-ups and foreign investment, have led to a 49 percent increase in high tech jobs since 1990. Electronic products account for more than 50 percent of the state's total exports."

- Portland ranks third in computers at home (69 percent) and fourth in home Internet access (58 percent), making it one of the most "wired" regions in the country, according to a 2001 Nielsen/NetRatings survey.

e) *Analyze any barriers to degree or certificate completion that your students face and describe the main reasons students leave your program before program completion.*

- Most CSET students in this program are adults returning to school to facilitate a career change. Many have not been previously successful in college. Many are focused on the end product when the means should be their concern. All have forgotten that failure is a part of learning just as success is overcoming failure through persistence.
- Most CSET students have the responsibilities of adults for their own financial support as well as the support of their family. Though the financial cost of education at PCC is comparatively low, highly technical programs like CSET require extreme time commitments from students for two-years. Students attempting to work and attend school on this basis find the program extremely stressful. Families

often lose sight of the long-term benefits they and their student will reap.

- Most students leaving the program early cite:[10]
  - Financial difficulties
  - Family problems
  - Medical problems
  - Dissatisfaction with future career requirements or skills
  - Enlightenment regarding the discovery of what they really wanted to do (students then enroll in another PCC program)

5) *To develop recommendations for improvement in the program/discipline.*

a) *Assess the strengths and areas in need of improvement in the program/discipline*

- Strengths
  - Dedication of the faculty to maintain the highest quality program possible
  - Dedication of the faculty to change the lives of their students in a positive way
  - Willingness of the faculty to work far in excess of their contractual obligations for the benefit of their students
  - Success of graduates in their new careers.
  - Continuous revision of the program and its curriculum to keep pace with appropriate software development technology innovations
  - Object-oriented first approach to software engineering
  - Emphasis on the need to life-long learning and equipping students with the tools and skills to do so
  - Multidisciplinary integration of digital electronics and software development with operating systems administration and discipline appropriate math and writing
  - Support of industry advisory committee
- Areas that need improvement
  - Widespread industry recognition and support of this program and its graduates
  - Increased professional development funding and opportunities
  - Faculty IFTE load reduction due to both the amount of time that must be spent grading software projects (analogous to English faculty members grading writing assignments) and the need for

additional professional development to keep up with the rate of change in the industry

- Faculty specialization in teaching assignments involving fewer program sequences
- Lab tutors capable of helping second-year students

b) *Given the above analysis and other findings of the SAC in this review process, prepare a set of recommendations that cover areas such as curriculum and professional development, recruitment and retention of students, obtaining needed resources and being responsive to community needs.*

- We have developed 5-year goals based on our review. These are included in the following section.
- Curriculum
  - Drop CST 106 as a degree requirement; offer it as a pre-engineering technical course for students with no computer experience (Done)
  - Expand CST 206 to four credits, picking up the few pieces departing with CST 106 and strengthening the networking component (Done)
  - Adopt .NET C# programming language and WinForms for CST 266 (Done)
  - Replace the content of CST 266 to focus on Linux and real-time embedded software engineering in C (Done)
  - Shift CST 206, 140, and 240 forward one term each (Fall 2003)
  - Move CST 256 to the fourth term (Fall 2003)
  - Adopt .NET C# programming language and WinForms for CST 256 (Winter 2003)
  - Move CST 263 to the fifth term (Winter 2004)
  - Add CST 264 to the sixth term (Spring 2004)
  - Move CST 266 to the sixth term (Spring 2004)
  - Facilitate industry instructors by providing coordination with a fulltime instructor
  - Encourage job swapping between skilled, knowledgeable software engineers in industry and faculty
  - Explore team teaching with industry specialists
- Professional development
  - Solicit inclusion in training programs industry partners offer their employees

- Seek training grants from federal government sources
- Encourage participation in summer internship opportunities and training program opportunities with industry
- Facilitate industry instructors by providing coordination with a fulltime instructor
- Encourage job swapping between skilled, knowledgeable software engineers in industry and faculty

- Recruitment and retention of students
  - Increase employability as measured by 80% find employment within 6 months of graduating
  - Increase demand for program until students are again waiting to be admitted to the program
  - Create a huge pool of successful graduates.
  - Be known as the model for national programs. Challenge other schools to meet our expectations of students.
  - Develop a recruiting strategy that increases the success rate of the students
- Obtaining needed resources
  - Develop industry partnerships promoting material and financial support
- Being responsive to community needs
  - Explore the development of specialized offerings for professional development training in the form of full-time concentrated 3-5 day courses.
  - Explore the expansion of specialized offerings for professional development training in the form of CEU courses developed by knowledgeable professionals offered on consecutive evenings for one week or two full Saturdays
  - Increase percentage of graduates
  - Add short one-credit distance learning courses in targeted technologies such as bash shell scripting following the model of CST140S

End Notes

[1] ACM2001 Joint Task Force on Computing Curricula IEEE Computer Society and Association for Computing Machinery, 2001, http://www.acm.org/sigcse/cc2001/cc2001.pdf
[2] College Board Advanced Placement Announcement, December 2000
[3] CSET 1999 Student and Graduate Surveys, 1999
[4] Email from Ted Tarney, 2002
[5] CSET 2001 Graduate Survey, 2001
[6] "US Department of Labor Occupational Outlook Handbook, Computer Software Engineers. Bureau of Labor Statistics", http://www.bls.gov/oco/ocos267.htm
[7] http://searchwin2000.techtarget.com/salarySurvey/0,289712,sid1,00.html
[8] "Protecting Information: The Roll of Community Colleges in Cybersecurity Education", June 2002, http://www.aacc.nche.edu/cybersecurity
[9] Excerpted from the following websites: http://www.bls.gov/oes/2001/oes151031.htm and http://www.bls.gov/oes/2001/oes151032.htm
[10] Exit interviews with CSET early leavers, 2000-2003

Program Outcomes
for
Computer Software Engineering Technology
Graduates

what does the mean?

- Ready to work within the software industry at or above the technician level
- Well trained for advances in software engineering technology
- Communicate effectively using: oral, written, and graphic communication skills
- Troubleshoot problems related to software engineering
- Work with others in a diverse team environment
- Embrace change positively
- Ready to continue a college level program in software engineering

Adopted by CSET Faculty and Advisory Committee
2002-2003

Computer Software Engineering Technology Program

	First Term	Second Term	Third Term	Fourth Term	Fifth Term	Sixth Term
Operating Systems & Multi-Tier Architecture	CST 206 Windows System Administration 4	CST 140U/S UNIX Systems/ Perl Script Programming 3/1	CST 240 UNIX Systems Administration 4	CST 256 Software Engineering in C 4	CST 263U Multi-Tier Architecture Software Development 4	CST 264W Multi-Tier Architecture Software Development 4
Software Engineering	CST 115 Introduction to Software Engr. in C++ 4	CST 116 Software Engr. in C++ 4	CST 211 Data Abstraction in C++ 4	CST 126 Software Methodology 4	CST 258 Windows Programming w/MFC 4	CST 268 Advanced Windows Programming 4
Computer Architecture & Embedded Software Engineering	EET 178 Microcomputer Systems Servicing 4	EET 176 Digital Fundamentals I 3	EET 177 Digital Fundamentals II 3	EET 241 Microcomputer Systems I 4	CST 250 80x86 Assembly Language Programming 4	CST 266 Linux & RTOS Software Engineering in C 4
Math & Technical Electives	MTH 111C College Algebra 5	MTH 231 Discrete Math 4			Technical Elective 4	Technical Elective 4
Writing	WR 121 English Composition 3		WR 122 or WR 214 Writing Elective 3	WR 227 Technical Report Writing 3		
General Education		General Education Elective 3	General Education Elective 3	General Education Elective 3		
Total Credit Hrs	20	18	17	18	16	16

105 Credits

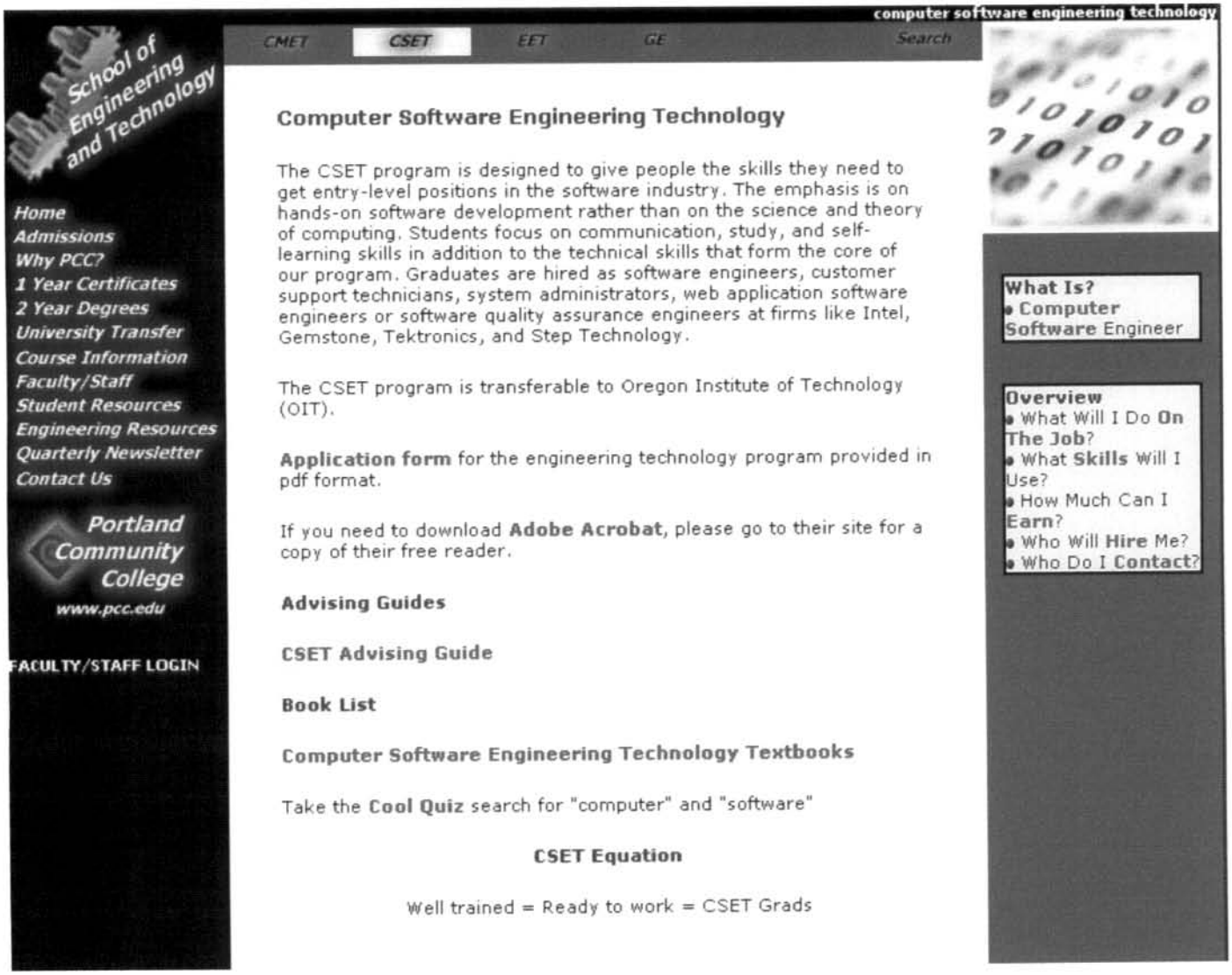
Technical Elective Tracks

Intern Track:	CST 280A	Cooperative Work Experience (for two terms)
O-O/Web/RTOS Developer Track:	CST 270	Special Projects: Analysis & Design
	CST 272	Special Projects: Implementation & Testing
Web Database Track:	CIS 275	Database Development I
	CIS 276	Database Development II
OIT Track:	CIS 233B	Intermediate Visual Basic
	CIS 234B	Advanced Visual Basic

Personalized Technical Elective Sequences may be arranged with your CSET advisor.

PCC Engineering Website

WELL TRAINED == READY TO WORK == CSET GRADUATE



http://www.engineering.pcc.edu/cset.htm