College of San Mateo — Program Review Submission

Instructional Program Review

Program Name: **Engineering**
Program Contact: **Demsetz, Laura**
Academic Year: **2013-2014**
Status: **Submitted**

1. Description of Program

Provide a brief description of the program and how it supports the college's **College Mission and Diversity Statements**, **Institutional Priorities, 2008-2013**, **5 in 5 College Strategies, Spring 2011**, and other **Institutional Program Planning** as appropriate.

The engineering program provides the lower division engineering classes necessary for transfer to baccalaureate programs in various engineering fields. Though occupational demand in specific fields fluctuates over time, engineers and the problem-solving skills developed through an engineering education are considered critical to the region's economic development.

The engineering program supports the college's mission of providing a comprehensive curriculum, as not all community colleges offer engineering. The program supports Institutional Priority 3: Promote Relevant, High-quality Program and Services, by preparing students for high-demand careers and by offering classes in both on-campus and hybrid modes. The program's full-time faculty member also serves as a faculty advisor, a role that enhances communication between instructional programs and student services, and has been actively involved in participatory governance, supporting Institutional Priority 5: Enhance Institutional Dialog.

Engineering students typically take Math (251, 252, 253, 270, 275), Chemistry (210, often 220), and Physics (250, 260, 270). Depending on transfer school and major, students also take 0-6 engineering classes and 0-3 CIS classes along with general education requirements. Due to the continued diversification of lower division transfer requirements and the increased popularity of majors such as bio/biomedical engineering and environmental engineering, some students who transfer in engineering may not take any engineering courses. However, the presence of an engineering program may be part of what initially draws these students to CSM.

Although the program offers an A.S. degree in engineering, the B.S. degree is considered necessary for work in the field and most students do not take classes beyond the many required for transfer. The program also offers an A.S. degree in engineering technology, which allows students to focus on a particular technical area.

2. Student Learning and Program Data

A. Discuss Student Learning Outcomes Assessment

Reflect on recent SLO assessment results for courses and degrees and certificates offered by the program. Identify trends and discuss areas in need of improvement.

The 80% threshold for success is met for most SLOs (note: SLO assessment results for Sp 13-F13 have not yet been entered in TracDat due to the full time faculty member's work on accreditation. TracDat information will be updated in June 2014). Teaching "soft skills" and assessing the associated SLOs continues to be a challenge.

The Engineering AS degree SLO survey was completed by 5 students, one of whom noted that s/he had taken engineering courses at Canada College, not at CSM (the major requirements currently include math, science, and CIS courses in addition to engineering

courses). All respondents agreed or strongly agreed that they could “use math, science, and engineering concepts to identify, formulate, and solve engineering problems” and could “communicate the results of design and analysis orally and through text and graphics.” Four out of five respondents agreed or strongly agreed that they could “use the techniques and tools of engineering at an elementary level to design a device, program, or process to meet specified constraints” and could “work effectively in teams.” It should be noted that the degree SLOs were not worded with student self-evaluation in mind.

Degree requirements, courses (in particular, ENGR 260), and SLOs may be modified in the near future, as C-ID descriptors and the Engineering Model Curricula are vetted at the state level.

B. Student Success Indicators

1. Review **Student Success and Core Program Indicators** and discuss any differences in student success indicators across demographic variables. Also refer to the **College Index** and other relevant sections of the **Educational Master Plan: Update, 2012**, e.g., Student Outcomes and Student Outcomes: Transfer. Basic Skills programs should also refer to **ARCC** data.

Student success rates in engineering courses had historically been around 75% (higher than the math/science division average of 67%), with retention rates a bit above 80% (close to the division average). Both measures decreased in 2010-11 (success: 65%; retention 76%) and 2011-12 (success: 63%; retention 74%). In 2012-13, success rates increased to 70%, the same as the college average, with a large increase in spring success rates (59% à 69%).

Engineering enrollments remain heavily male; the percentage of women students (14%) remains slightly lower than the national average for undergraduate engineering programs (18% in 2009, http://www.nsf.gov/statistics/wmpd/2013/pdf/tab2-10.pdf). However, the national average includes bioengineering and environmental engineering, which have larger fractions of women but typically do not require many lower division engineering courses for transfer. In 2012-13, women and man succeeded at roughly the same rate.

Like other community college programs, the engineering program at CSM serves as a gateway for traditionally underrepresented students. At CSM, 70% of engineering enrollment is from students who identify as other than white, compared with 33% nationally (2009, **http://www.nsf.gov/statistics/wmpd/2013/pdf/tab2-9.pdf**). Success rates across ethnicity vary in roughly the same pattern as in the college as a whole, except that success rates for students who identify as Filipino are lower in engineering (53%) than in the math/science division (73%) or the college as a whole (73%). Faculty members are aware of this gap and will look for ways to improve the success of students who identify as Filipino.

The number of engineering students who are 30 or older is small. Students in the 25-29 age category show 70% success during 2011-12 and 2012-13 (slightly lower than the division an college averages), compared with 59% for 20-24 year olds (lower than the division and college averages, 75% and 73% respectively) and 73% for students 19 and below (higher than the division and college averages, 62% and 68% respectively). The high success rate of the youngest group is not surprising; those who have completed the math and science prerequisites and are ready for engineering courses at a young age have the ability and skill-set required to be successful students.

2. Discuss any differences in student success indicators across modes of delivery (on-campus versus distance education). Refer to **Delivery Mode Course Comparison**.

Enrollment in the hybrid cross-listed offerings of ENGR 215 and ENGR 230 remains low, so changes in percentages should be viewed with caution. In fall 2012, success and retention rates in the hybrid cross-listed offering of ENGR 215 remained 10-15 percentage points below those of the on-campus section; ENGR 230 showed an even greater disparity. However, Fall 2013 grade reports show that there has been an improvement in success rates and a narrowing of the gap. Success in the hybrid section of ENGR 215 increased to 67% (compared with 70% for the traditional section); success in the hybrid section of ENGR 230 increase to 63% (compared with 69% for the traditional section).

C. Program Efficiency Indicators. Do we deliver programs efficiently given our resources?

Summarize trends in program efficiency as indicated in the **Student Success and Core Program Indicators** (LOAD, Full-time and Part-time

FTEF, etc.)

The reported LOAD for 2012-13 is 520, an increase from 476 in 2011-12 and approaching the college average of 533.

Enrollment in the entry-level engineering courses (ENGR 100 and 210) continues to increase and each of these courses was expanded to a single lecture with double lab format in 2013-2014. However, low enrollment in advanced engineering courses continues to be a concern. Program LOAD would be lower if on-campus and hybrid sections of ENGR 215 and ENGR 230 were not cross-listed; essentially, the hybrid sections are being taught at no charge to the college.

Due to the small number of engineering courses offered, LOAD values change when faculty carry load in the Math Resource Center (as was the case in spring 2011) or the Integrated Science Center (as was the case in spring 2012) in addition to the load associated with lecture and lab. The program FTEF directly associated with lecture and lab has remained constant at 1.72 for close to a decade (hybrid offerings are cross-listed and do not increase FTEF) through spring 2013. Using this value as the divisor in the LOAD calculation gives adjusted LOAD values of 458 for 2010-11, 505 for 2011-12, and 526 for 2012-13. The adjusted value for 2012-13 is close to the college average and is high for a program in which many courses have advanced math and physics courses as prerequisites.

3. Career Technical Education

D. Additional Career Technical Education Data - CTE programs only. (This information is required by California Ed. Code 78016.)

1. Review the program's **Gainful Employment Disclosure Data**, **External Community**, and other institutional research or labor market data as applicable. Explain how the program meets a documented labor market demand without unnecessary duplication of other training programs in the area. Summarize student outcomes in terms of degrees, certificates, and employment. Identify areas of accomplishment and areas of concern.

2. Review and update the program's Advisory Committee information. Provide the date of most recent advisory committee meeting.

4. Additional Factors

Discuss additional factors as applicable that impact the program, including changes in student populations, state-wide initiatives, transfer requirements, advisory committee recommendations, legal mandates, workforce development and employment opportunities, community needs. See **Institutional Research** as needed.

Demand: The Bureau of Labor Statistics projections for 2012-2022 show employment increase in the 5-8% range for most of the traditional engineering disciplines, below the 10.8% projected average for all occupations. The projected increases for civil engineering, 20%, and environmental engineering, 15%, are above the projected average. The projected increase for biomedical engineering, 27%, is significantly higher than the projected average, but – due to the small base – the projected increase in the number of jobs in the field, 5,200, is lower than that for mechanical engineering, 11,600 [Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2012-13 Edition*; links to specific disciplines at **http://www.bls.gov/ooh/architecture-and-engineering/home.htm**]. There has been an increase in the number of transfer schools offering programs in bioengineering and biomedical engineering and an increase in the number of our students seeking to transfer in these majors.

Students who transfer and complete a B.S. degree in engineering continue to find high-paying jobs that make visible contributions to society. Given the regional emphasis on STEM fields and the increased inclusion of engineering in the Next General Science Standards [**http://www.nextgenscience.org**], it is likely that interest in engineering will remain strong. However, for the large fraction of students who arrive at CSM in need of remedial math, it may be difficult to persevere through a course of study that requires completion of precalculus and then 2 ½ to 3 years of additional study prior to transfer.

Transfer requirements: The move away from a common lower division engineering core curriculum has continued. The divergence across majors can be seen in the work of the engineering FDRG, which has just (as of March 25) posted for vetting drafts of three Model Transfer Curricula – one for civil/mechanical/aerospace/manufacturing engineering, another for electrical engineering, and a third for

computer engineering. The divergence of requirements across transfer schools has increased as well; most significant for CSM's program are changes at U.C. Berkeley, which no longer offers a course comparable to ENGR 230. The lack of coherence in lower division programs at transfer schools means that each engineering course is required by fewer programs than in the past.

Facilities: The program currently uses one of the Electronics program's labs for ENGR 260 and makes use of software funded primarily through the Drafting program for ENGR 210. Changes to these arrangements would impact engineering course offerings.

Competition: The strong foundation provided by CSM's math and physics programs continues to result in students who are well prepared for engineering courses. However, our sister colleges to the north and south both have active MESA programs. Incoming students interested in math, science, and engineering may be drawn to Skyline or Cañada for the added support provided by MESA and the high visibility of STEM majors. In addition, Skyline College, which does not currently have an engineering program, has begun to discuss offering at least the entry-level engineering courses.

5. Planning

A. Results of Program Plans and Actions

Describe results, including measurable outcomes, from plans and actions in recent program reviews.

Limited progress was made on 2013 plans due to the full-time engineering faculty member's involvement in the 2013 Self Evaluation process through Fall 2013.

2013 Plan 1: Investigating peer support for engineering courses
No progress has been made on this plan.

2013 Plan 2: Facilitating engineering transfer success through creative course delivery
This plan is partially complete. The full time faculty member is aware of online and local offerings of the engineering courses that are not offered at CSM and makes this information available to students during advising sessions. For example, UC Berkeley has expanded its summer offerings to include several of the specialized courses that prompted this plan; additional courses are available in an online format through other California Community Colleges (e.g. Strength of Materials I and II at Cuesta College, Dynamics at Canada College). However, this information has not yet been posted in a form that is easy to update and readily available to students and counselors. Dissemination is incorporated in 2014 Plan 2.

B. Program Vision

What is the program's *vision* for sustaining and improving student learning and success over the next three years? Make connections to the **College Mission and Diversity Statements**, **Institutional Priorities, 2008-2013**, and other **Institutional Program Planning** as appropriate. Address discussion in the Student Learning and Program Data section: SLO assessment results and trends in student success indicators.
[**Note**: Specific plans to be implemented in the next year should be entered in C of the Planning section.
CTE programs must address changes in the context of completion and employment rates, anticipated labor demand, and any overlap with similar programs in the area as noted in D1 and D2 of the Career Technical Education section.]

The engineering program's vision is to continue to provide to students the engineering coursework and support needed to successfully transfer to the variety of engineering majors available at CSU, UC, and private universities. The vision supports the college's mission of providing a comprehensive curriculum and Institutional Priority 3: Promote Relevant, High-quality Program and Services.

The introduction of a programing and electromechanical design component to ENGR 100, the engineering club's purchase of a 3-D printer and its use in ENGR 210, and the imminent arrival new materials testing equipment have helped modernize and generate enthusiasm for the program. To improve student success, the program will consider the addition of a design project to ENGR 260; increase the use of software tools in all courses; investigate support strategies such as tutoring and supplemental instruction; and develop closer ties with transfer schools and industry. With the completion of accreditation responsibilities (finally!), the full-time faculty member will be able to devote more time to activities that support the program outside the classroom, including the engineering club, industry interaction, articulation with transfer programs, and outreach to local high schools.

Given the extensive math and physics prerequisite chain for advanced engineering courses, the fact that a large percentage of CSM students place into remedial math courses, and the divergence in transfer requirements, enrollment in advanced courses is likely to remain low. The program will need to coordinate with other community colleges in the region and across the state to allow students to complete increasingly specialized transfer requirements.

Students benefit from taking classes with several engineering instructors. To provide continuity and retain talented adjunct faculty, the full-time faculty member may need to pick up load in mathematics or elsewhere.

1. To guide future faculty and staff development initiatives, describe the professional activities that would be most effective in carrying out the program's vision to improve student learning and success.

Professional enrichment activities that are most needed are 1) activities that address the use of peer support in small programs, 2) activities that address learning styles and strategies to support specific student populations (prompted by low success rates in engineering courses for students who identify as Filipino), and 3) activities that support effective use of hybrid, online, and other non-traditional delivery models.

2. To guide future collaboration across student services, learning support centers, and instructional programs, describe the interactions that would help the program to improve student success.

The continued interaction with student services provided through the full-time instructor's role as faculty advisor is critical to promoting student success. In addition, it would be helpful to work with learning center staff on approaches to peer support for advanced classes. Students typically transfer the year that they complete these courses, so there are few "peers" available on campus to serve as tutors.

3. To guide the **Institutional Planning Budget Committee** (IPBC) in long-range planning, identify any major changes in resource needs anticipated during the next three years. Examples: faculty retirements, equipment obsolescence, space allocation.

See the Resource Requests section below to enter itemized resource requests for next year.
Leave sections blank if no major changes are anticipated.

Faculty

To retain strong adjunct faculty, the full-time faculty member may need to pick up load in mathematics or elsewhere.

Equipment and Technology

Instructional Materials

Increased use of group design projects in several classes will lead to a modest increase in the instructional materials and supplies funds needed to support the program.

Classified Staff

Facilities

C. Program Plans and Actions to Improve Student Success

Prioritize the plans to be carried out next year to sustain and improve student success. Briefly describe each plan and how it supports the **Institutional Priorities, 2008-2013**. For each plan, list actions and measurable outcomes. (Plans may extend beyond a single year.)

Plan 1

Title:
2014 Plan 1: Peer support for engineering courses (carry over from 2013)

Description
To improve success and retention, the program will investigate the implementation of support strategies such as individual tutoring, small group tutoring, and supplemental instruction. No additional resources are required for this plan.

Action(s)	Completion Date	Measurable Outcome(s)
Engineering faculty will meet with learning center staff and with programs using supplemental instruction to determine whether peer support is likely to be feasible for engineering courses.	Fall 2014	A “peer support plan” will be developed outlining appropriate strategies and the resources required for implementation.
Proposals will be developed to request any supplemental funding needed to implement peer support plan.	Spring 2015	Proposal for supplemental funding will be submitted.

Plan 2

Title:
2014 Plan 2: Engineering transfer planning support

Description
Review engineering articulation agreements and submit additional articulation requests as appropriate. Update the engineering transfer guide to reflect changes in transfer requirements and the availability of specialized courses through distance education. No additional resources are required for this plan.

Action(s)	Completion Date	Measurable Outcome(s)
Review engineering articulation agreements and submit additional requests as appropriate	Spring 2014	Gaps in articulation identified; list of gaps and supporting information provide to articulation officer.
Update engineering transfer guide	Fall 2014	Updated transfer guide is posted on

		engineering website and distributed to counselors.

6. Resource Requests

Itemized Resource Requests

List the resources needed for ongoing program operation.

Faculty

NOTE: To make a faculty position request, complete **Full-time Faculty Position Request Form, AY 2013-2014** and email to your Dean. This request is separate from the program review.

Full-time faculty requests	Number of positions

Equipment and Technology

Description	Cost

Instructional Material

Description	Cost
Replacement for worn/torn Arduino components in ENGR 100 (increased cost due to second lab section)	$300
MATLAB license renewal for ENGR 215 (increased cost due to additional toolboxes for use in ENGR 215, ENGR 260, ENGR 270)	$400
Annual contribution to Bus/Tech division's renewal of licenses for Solidworks and AutoCAD for ENGR 210	$500
Expand number of Solidworks licenses from 30 to 45 to support increased enrollment in ENGR 210 and to reach threshold at which students are provided with free access to software for their personal computers.	$1000
Purchase additional objects for mechanical dissection projects in ENGR 100 and ENGR 210	$400
Replace worn/torn electrical components in ENGR 260 (larger cost due to introduction of individual, rather than "partner" labs in Sp 2014)	$300
Tension and impact specimens for ENGR 270	$300
Polishing and mounting supplies for heat treated specimens in ENGR 270	$300

Classified Staff

Description	Cost

Facilities

For immediate or routine facilities requests, submit a CSM Facility Project Request Form.

Description	Cost

7. Program Maintenance

A. Course Outline Updates

Review the **course outline update record**. List the courses that will be updated in the next academic year. For each course that will be updated, provide a faculty contact and the planned submission month. See the **Committee on Instruction website** for **course submission instructions**. Contact your division's **COI representatives** if you have questions about submission deadlines.

Career and Technical Education courses must be updated every two years.

Courses to be updated	Faculty contact	Submission month
No courses require updating (ENGR 240 was banked last year). If engineering C-IDs and model curricula are approves, changes may be needed in some courses.	Laura Demsetz	

B. Website Review

Review the program's website(s) annually and update as needed.

Faculty contact(s)	Date of next review/update
Laura Demsetz	June 2014

C. SLO Assessment Contacts

Faculty contact(s)	Date of next review/update
Laura Demsetz	June 2014