Evaluation of Civil Engineering Program at San Jose State University

by
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Introduction
I visited the San Jose State University campus on February 13 and 14, 2007. The visit was very productive. I met with:

1. The department chair Akthem Al-Manaseer;
2. Associate Vice President Robert Cooper, Associate Dean Ping Hsu, Associate Vice President Pam Stacks, and Dean Belle Wei;
3. Professor Rameshwar Singh
4. Professor Kurt McMullin
5. Professors Jan Botha and Steven Vukazich
6. Professor Udeme Ndon
7. A group of undergraduate students
8. A group of department lecturers (part-time faculty)
9. A group of graduate students

I was provided with a tour of the facilities and labs during the first day. The second day, I met with:

1. Department admin Ms. Ester Burton and the department technician Mr. Pat Joice (Same time)

Later in the second day, I had the exit interview which was attended by Chair Akthem Al-Manaseer, Professor Thalia Anagnos, Professor Jan Botha, Associate Vice President Robert Cooper, Associate Dean Ahmad Hambaba, Associate Dean Ping Hsu, Professor Kurt McMullin, Vice Provost William Nance, Professor Rameshwar Singh, Professor Steven Vukazich, and Dean Belle Wei. [I need names for the other two attendees]

This report is based on the site visit, self-study report, and other materials that were provided during my visit. The report covers: 1) Background and Overview, 2) Faculty, 3) Students, 4) Curriculum, 5) Resources, and 6) Concluding Remarks.

Background and Overview
The department of Civil and Environmental Engineering (CEE) has a curriculum that is comparable to other civil engineering programs. CEE offers a construction engineering/management specialty as part of the CEE department which is a unique feature of the program. The department is staffed with 5.5 full-time faculty (one faculty
is on the Faculty Early Retirement Program (FERP). Recently, Professor Janet Yates (construction engineering/management) accepted another position with another university.

The department has been experiencing a steady growth in the undergraduate student population in the last five years from 260 students in Fall 2000 to 510 students in Fall 2006 (Enrollment data provided by Chair Al-Manaseer). This growth is consistent with the growth trends in civil engineering programs nationwide (the National Department Heads Council meeting, 2006, organized by ASCE).

The general impression of the program is positive. The curriculum is comparable to other civil engineering programs. The total number of units for the undergraduate civil engineering degree is 135 semester units. The total number of units (for comparison) is 138 semester units at the department of Civil Engineering, California State University, Sacramento.

The department has two active faculty searches in geotechnical engineering and water resources engineering. The department has a vacant position in the construction engineering/management area.

Last fall the department of Civil and Environmental Engineering had the ABET accreditation visit. The review process identified four weaknesses: 1) a lack of formal review procedures for the program education objectives, 2) a lack of data-driven review and enhancement of the program education outcomes, 3) a shortage of full-time faculty members in certain areas of instruction, and 4) lack of evidence showing that students are meeting proficiency requirements.

**Faculty**
There are 5.5 full-time faculty members in the department with the following specialty:

- 3 faculty members in structural engineering
- 0.5 faculty members in water resources engineering (FERP faculty)
- 1 faculty member in environmental engineering
- 1 faculty member in transportation engineering

The distribution of faculty is not balanced relative to the areas of specialty in civil engineering. The department is in the process of filling two faculty positions - one in geotechnical engineering (vacant position since 2001) and the other is in water resources engineering (a replacement for the retiring faculty). This semester, the department is operating at 41% full-time faculty to 59% part-time faculty. This high ratio of part-time faculty consumes resources to manage the part-time faculty on the expense of planning, curriculum development, and assessment activities. When these two positions are filled the faculty ratio goes to about 61%. Ideally, the department should be at a 75% full-time faculty ratio.
The department faculty members are productive and pushed beyond their limit. The department cannot operate effectively nor can it sustain the program with the anticipated growth in the undergraduate student population with few full-time faculty members.

As a long-term goal, the department should consider setting a minimum of two faculty members in each of the specialty areas of civil engineering (environmental, geotechnical, structural, transportation, and water resources). The department should also set a goal for two faculty members in construction engineering/management. Construction engineering/management is a unique feature of the civil engineering program and could be the visible area of specialty especially if the department considers making sustainable construction and design the theme for the construction specialty. The department has this opportunity now when it hires a replacement for the just vacated construction position. The Davidson endowed chair in construction should make this goal attainable.

This long-range goal should be set in the context of a long range planning process in conjunction with other activities such as recruitment and retention. One concern that some may have with setting such a long term goal is the cyclic nature of the enrollment in engineering disciplines. As the market place shifts so does the demand for certain disciplines which affects student enrollment patterns. However, there are several factors that indicate that there will be sustained demand for civil and infrastructure engineering for decades to come. Figure 1 shows the trends nationwide of the growth in the undergraduate population in civil engineering (Gibbons, The Year in Numbers, 2006, ASEE, can be found at http://www.asee.org/publications/profiles/upload/2005ProfileEng.pdf). Therefore, it is reasonable to develop a long range plan with this growth in mind.

The department relies on a large pool of part-time faculty members to fulfill its mission. I met with four part-time faculty members. It appears that these faculty members are motivated and interested in teaching. The students appreciate having some part-time faculty as instructors because they bring their practical experience to the class. However, the students also feel that some of the part-time faculty members are not available. As

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1 The factors that affect the increase demand for civil engineers include: 1) aging civil engineering population, 2) projected population growth in California, and 3) state of the infrastructure in California. The aging population of civil engineers, the demand to meet the projected growth in California, and the passage of bond measures in the last elections are all contributing factors to increased demand for civil engineers. According to the Department of Labor there are 237,000 civil engineers employed in the US (the highest number among other categories of engineering discipline) (http://www.bls.gov/oco/ocos027.htm/outlook). The workforce in the civil engineering area has been relatively stable. However, there will be a wave of expected retirements that creates openings for civil engineers (Work Force Summit, College of Engineering and Computer Science, California State University, Sacramento, January 25, 2007). The Governor’s office projects that there will be $500 billion demand for the infrastructure growth for the next two decades to accommodate the anticipate growth of 23% in California. The Public Policy Institute of California in its CA2025 projects about 20 to 30 percent growth in population by 2025. The American Society of Civil Engineers in its 2006 California Infrastructure Report Card gave the infrastructure a grade of C- and estimated that California needs to invest $37 billion annually in its infrastructure. All these factors indicate that the demand for civil engineers will continue for the foreseeable future.
the department establishes its long-term faculty hiring plan, this issue will be resolved because the department would have a manageable size of part-time faculty members.

![Figure 1. Trends in Degrees Awarded (BS and MS) and Undergraduate Enrollment in Civil Engineering (Gibbons, ASEE, 2006)](image1)

**Students**

The enrollment in CEE has been increasing steadily. In a system such as CSU, this growth is mostly a positive occurrence. In general there is a funding increase that is associated with the growth in enrollment. However, the time lag for the funding to catch up with the resource demands could be challenging to administrators, faculty, and students. It is expected that this growth in CEE enrollment will continue for the foreseeable future due to demand for civil engineering graduates as discussed earlier.

The students that were interviewed were very positive about the program. They indicated excellent support from the department and faculty for their academic and extra-curricular activities. The students appreciate the experience of the faculty in CEE.

Student advising for the undergraduate students initially was distributed among the faculty members in CEE. However, the department assigned the undergraduate advising to Professor Singh. This is an effective approach to advising student from budgetary point of view (effective use of resources) and providing consistency for student advising.

The graduate students that I met indicated their frustration with limited number of course offerings. They also found writing requirements are not clear to them. They were not able to articulate the requirements. With limited number of students (six students, one of them was present with the undergraduate students), it is not clear whether this is due to lack of advising or simply the students that I met were not clear on the requirements (the
information is available on the department’s website). Refer to the curriculum section for more recommendations regarding the writing requirement.

Curriculum
The following areas are addressed in this section:

1. Undergraduate course offering
2. Graduate course offering
3. Undergraduate program assessment
4. Graduate assessment program
5. Graduate writing requirement
6. Other issues

The department’s curriculum is consistent with other civil engineering departments. The exception being that the department offers CE99 (Statics) as a 2-unit course. This is not consistent with most civil engineering programs. Community colleges offer the statics course as a 3-unit course. The department should consider converting CE99 to a 3-unit class. The statics course is one of the cornerstone courses in the civil engineering discipline. This course, in the view of many civil engineers (the evaluator included), is more important to CEE students than EE98 for example, which is offered as a 3-unit course.

The department also offers several courses with a 3-hour computation or design period (CE160, CE163, CE164, CE170, and CE192). Some other courses included a hands-on lab experience, which is essential in civil engineering curriculum. The department offers 11 labs/tutorial sessions in the required classes (based on the list of course descriptions provided by Chair Al-Manaseer). The elective classes include some additional labs/tutorial sessions. Just for comparison, at CSU Sacramento, the CE program includes eight labs (all hands-on) and there no labs associated with the elective courses. The department needs to evaluate the effectiveness of tutorial sessions in terms of student learning, workload, and budget. One possibility is to make the tutorial session a one-hour period and allow the students to work outside the class on their assignment.

The department offers Master’s degree in six areas of civil engineering: construction, environmental, geotechnical, structural, transportation, and water resources engineering. The department allows typically 6 to 9 units of elective courses and/or an approved minor area (6 to 9 units). The graduate students can graduate with Plan A (with a thesis) or Plan B (without a thesis). The department has organized its comprehensive exam that is given to students in each of the areas of specialty under plan B. This approach is useful in documenting the outcome assessment of the graduate program. The department allows overlapping some of the courses in the graduate program by setting elective courses and a minor area. This approach gives the department the ability to provide more course offerings in the graduate program.

The graduate students that I met indicated that they would be interested in more frequent offering of the graduate classes. The students would also like some of the classes offered
later in the day to accommodate their work schedule\(^2\). The students also mentioned that the graduate courses are too long, being scheduled for three-hour sessions. The timely replacement of the recently departed construction faculty member was a concern to the students.

In order to meet the CSU Graduate Writing Requirement (GWAR), the department embedded writing assignments and the assessment of the students’ writing competency into a number of its graduate courses. This approach resulted in shifting the burden of writing assessment to the faculty in CEE department. This action also resulted in introducing an inconsistency in the evaluation of writing competency due to variation among the faculty members that are evaluating the writing competency. This extra burden on faculty resulted in less available time for the course content. The department should consider being consistent with the college in meeting the writing requirement by asking students to take the ENGR 200W course. The consistency with the college requirement will be more effective use of resources; less burdensome on faculty; easier to implement; and easier to communicate to students.

The undergraduate assessment was identified as a weakness in two areas:

1. The lack of a formal review process for the Program Educational Objectives
2. The lack of data-driven review and enhancement of Program Educational Outcomes.

The department is moving in the right direction relative to assessment activities and it needs time to gather enough data to evaluate its program educational objectives and its outcomes. The department has no data gathering of employers for assessing program objectives in a formal way. The department may consider surveying employers by holding annual focus group meetings. The membership of the focus group should be targeted to different types of employers (e.g., state agency, local government, consulting engineering, design firms, etc.). The selection of employer should be prioritized based on employers that hire majority of the graduates of the program. The meeting can be held for two to three hours typically at the end of the semester (during finals week). The composition of the employer panel includes engineers with a range of experiences (from entry level (recent graduate) to management level. This process can provide the department information and data that can be used to evaluate the program educational objectives. The department should identify a facilitator outside the department who can run the meeting. Typically the facilitator is a person that is knowledgeable about employers and works with the Dean’s office. In Sacramento State, the facilitator is the Career Development Director in the Dean’s office. By getting a facilitator for the focus group, the faculty members and the department chair can participate fully in the discussion and can focus on the issues. A sample of questions that were used for the department of civil engineering at CSU Sacramento focus group meetings is shown in Attachment 1.

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\(^2\) This related to the 100 level courses that the students take as part of their curriculum.
The department may also consider utilizing the StudentVoice software for the senior survey and other surveys. This software makes the data analysis more readily available once the survey is completed by the students. San Jose State campus has a license for the StudentVoice, www.studentvoice.com. The Civil Engineering Department at CSU Sacramento used the software for the senior survey. This software is also used by the transportation faculty to conduct surveys in the transportation engineering class.

The graduate program educational objectives are listed in the CEE self-study report:

1. Prepare students for their professional careers and licensure by strengthening their knowledge in their specialization (depth) and extending their skills and knowledge base (breadth).
2. Provide students advanced proficiencies for professional practice to enable them to advance in the licensing process and equip them for advancement in their career.
3. Improve students’ research skills and prepare them for further graduate study.
4. Provide students with experience and skills for multi-disciplinary and cross-CE disciplinary practice.

The graduate program outcomes were also listed in the CEE self-study report:

1. Students will be able to apply advanced theory and analysis for problem solving.
2. Students will be able to apply modern tools in doing computation, simulations, analysis, and design.
3. Students will be able to synthesize and integrate information in the engineering process.
4. Students will be able to work collaboratively.
5. Students will be able to communicate effectively.

The outcome assessment for the graduate program is based on graduate course assessment. Each year, the department evaluates two courses in two areas of the graduate program. The department sends the course content to practicing professionals in the field with prepared format to evaluate the course. The faculty members (in the area) then evaluate the review results and make adjustments, if needed. This process is very effective in maintaining the curriculum up-to-date with current practices and relevance to practicing engineers (the graduate student population). The department may consider employing some of the following tools.

1. Survey the incoming students relative to their background. Some of the information that can be collected include: a) percentage of entering students with PE licenses; b) percentage of students eligible to take PE but did not take the exam yet; c) percentage of students that work as full-time engineers; etc.
2. Survey graduating students Master’s program.
3. Survey graduates two and five years after graduation relative to program objectives. For example, how many of the graduates obtain their professional engineer license after graduation.
4. Survey employers (see comment for the undergraduate assessment about employer survey)

Some of these recommended instruments can be implemented easily (once the survey questionnaires are developed). The department should work with the institutional research office (or any appropriate unit) within the University to develop effective survey tools. The employer surveys can be conducted every other year or longer time period as appropriate for the department.

The department offers a one-unit course, CE 105 (Professional Design I), as a Co-op (internship) experience which is in line with ABET’s professional component requirement. This is an excellent opportunity for students to gain some real world and practical experience before they graduate. This class is taken during one of the last two semesters before students graduate. The department may want to consider introducing a course at the freshman level (Civil Engineering Seminar). This can be designed as a one-unit course with invited speakers from the professional community. This course can meet the following objectives:

1. Introduce the students to professional practice in civil engineering. This is an effort to integrate professional practice issues through the curriculum as required by ABET accreditation criteria.
2. Instill a sense of community among the freshman student population and provide an opportunity for the students to take classes from the Civil Engineering Department. Freshman students typically take classes in math and science and therefore they do not identify with the department.
3. Give the students an opportunity to work on their communication skills by requiring them to write weekly written assignments. Typically students write 8 to 10 one-page essays.
4. Improve freshman retention in Civil Engineering Department by offering them information and exciting them about the career opportunities that CE major offers.

Developing an additional class should be planned in the context of evaluating the overall curriculum in CEE subjects to the university constraints, resources, accreditation, and department goals and objectives. At Sacramento State, the faculty members made the following changes to its curriculum:

1. Made Steel Design class an elective course.
2. Reduced the Structural Analysis and the Water Resources classes by one unit (from 4-unit to 3-unit class).
3. Created a new course “Civil Engineering Practice” as a required class.
4. Added a one-unit lab for transportation. Transportation was the only area that did not have a hands-on lab.
5. Created a one-unit course “Civil Engineering Seminar” for freshman students.

The objectives of the above mentioned changes were to: 1) balance the five areas in civil engineering (four units in each area – three units for lectures plus one unit for a hands on
lab, 2) introduce professional component through the curriculum, and 3) not increase the total number of units in the curriculum.

**Resources**
The department labs are comparable to CSU labs. The investment on lab equipment appears to be good (about $400 K in the last few years). The computer lab update is underway (Chair Al-Manaseer). The students commented on the desperate need for upgrading the computer lab.

The clerical support is short in the department due to the vacancy of the half position of an admin position. The department search for this admin position is well underway. Meanwhile, the workload is shifted to the department’s full-time admin and a student assistant.

The tech support is reduced to one position from 1.5 positions. The students are satisfied with the tech support. The department may need to evaluate if it needs to restore the half-time position.

The department enjoys the support of the Davidson Endowed Chair. The department should capitalize on this in terms of building a strong construction engineering/management area. The growth of high tech is dependent on the infrastructure and availability of resources. Sustainable design and construction is an area that fits well in the Silicon Valley.

**Concluding Remarks**
The campus visit was an excellent learning experience and provided an opportunity to meet new colleagues. The following is a summary of my recommendations:

1. The department needs to fill the three vacant positions. The department should develop a long-range plan for hiring two faculty members in each area of the six areas.
2. The department needs to consider making the statics course (CE99) a three-unit course. This is an essential course in civil engineering.
3. The department should evaluate the tutorial sessions that are associated with some classes versus the hands-on labs.
4. The department is well underway in its assessment of the undergraduate program. The department may consider including an employer survey component to its assessment activities.
5. The department should consider using StudentVoice software for its survey tools. As it was mentioned previously that San Jose State has a license for StudentVoice.
6. The department should consider developing and incorporating some survey tools for the graduate assessment in addition to its current assessment activities. These survey instruments include: 1) surveying the incoming graduate students, 2) surveying graduating Master’s degree students, 3) surveying graduated students after two and five years, and 4) surveying employers of the graduate students.
7. The department should make the graduate writing requirement consistent with the college by requiring ENGR200W instead of the current requirement that is embedded in some of the graduate classes.

8. The department may consider developing a one-unit Civil Engineering Seminar targeted to freshman students to expose students to professional practice in civil engineering through presentations given by professional engineers.

9. The department should consider the opportunity to develop the endowed chair for establishing a sustainable construction and design component that could be a model program in California and can serve the Silicon Valley needs in particular. The department has a great advantage with the endowed fund.
Attachment 1

Employer Focus Group
Department of Civil Engineering
California State University, Sacramento

1. What CSUS learning experiences were most valuable to you in your career?

2. What knowledge and skills that you acquired during your education have you used most?

3. What knowledge do you use the least?

4. What do you wish you had learned in school but did not?

5. What are the emerging and expanding fields in civil engineering?

6. What critical skills and knowledge will civil engineers need for the future?

7. For managers: What are the strengths and what are the weaknesses of our graduates of the CE program?
Attachment 2

A summary of the comments that I heard during my visit is presented below. I did not highlight the comments in terms of recommendation or any action because the comments were related to decisions within the college or subject to constraints that are beyond the college. These comments are not ordered in any manner.

1. Some of the labs need to be updated and renovated.
2. Space is very limited.
3. Students need bigger space for their activities and projects.
4. Admin positions need a raise. The workload doubled.
5. Class size and SFR are increasing.
6. Faculty development funds needed to send them to training.
7. Some electives are not offered frequently enough.
8. PA system is needed for large classrooms.
9. Not enough graduate classes offered to graduate in a reasonable time.