

# **AC 2007-1714: ADVANCING WOMEN IN ENGINEERING BY EMPOWERING STUDENT LEADERS TO PROMOTE THE RECRUITMENT AND RETENTION OF FEMALES IN ENGINEERING**

## **Helene Finger, California Polytechnic State University**

Helene Finger is the Director of the Women's Engineering Program in the College of Engineering at Cal Poly, San Luis Obispo. Her responsibilities include supervising staff and advising the student SWE section in the planning and implementation of programs for the recruitment and retention of women. She has also taught in the Civil and Environmental Engineering Department at Cal Poly since 1997 and is a registered professional engineer. In 2001 she was named a recipient of National Organization for Women Educational Equity Award.

## **Tracy Van Houten, University of Southern California**

Tracy Van Houten is the lead Systems Engineer for Jet Propulsion Laboratory's advanced concepts development team, Team X. She has a B.S. in Aerospace Engineering from Cal Poly and is currently working on a M.S. in Astronautics and Space Technology at the University of Southern California. She was the Cal Poly SWE President from 2002-2003, and has continued her SWE involvement as the Region Collegiate Representative Coordinator on the Collegiate Interest Committee.

## **Barbara Curry, California Polytechnic State University**

Barbara Curry has a B.S. in Mechanical Engineering from UC Santa Barbara, and a M.S. and Ph.D. in Economics and Operations Research from the Colorado School of Mines. Her research has primarily focused on retention of female engineering students, including her dissertation entitled, "Female Retention In Undergraduate Engineering Majors: The Effects Of Individual Characteristics, Career Characteristics, And Demand Discrimination".

## **Jennifer Harris, United Parcel Service**

Jennifer Harris graduated from Cal Poly in 2003, receiving a B.S. in Industrial Engineering and a M.S. in Engineering with a Specialization in Integrated Technology Management. She served for five years on the SWE Executive Council at Cal Poly including serving as President in 2001-2002. Ms. Harris is currently working at United Parcel Service in Los Angeles as an Industrial Engineering Supervisor, and she is the President of SWE-LA, Lt. Governor for the SWE Sonora Region, and the SWE National Scholarship Chair.

## **Malia Francisco, United Parcel Service**

Malia Francisco is a 2005 graduate of Cal Poly with a B.S. in Mechanical Engineering. She is currently working for Northrop Grumman Space Technology as a Launch Operations Systems Engineer. She has a six year career with SWE, the first five years spent working with the Cal Poly collegiate section where she served in various officer positions including President in 2004-05. Currently, she is the secretary for the SWE-LA section and on the SWE National Membership Committee.

## **Betsy Sale, United Parcel Service**

Betsy Sale recently graduated from Cal Poly with a B.S. in Civil Engineering. She was involved with SWE during her time at Cal Poly by serving in many positions including President in 2005-06. After graduation, she has continued her involvement in SWE by serving as Treasurer in the Central Coast Professional SWE Section. Ms. Sale now works as a Civil Engineer with Cannon Associates in San Luis Obispo.

# **Advancing Women in Engineering by Empowering Student Leaders to Promote the Recruitment and Retention of Females in Engineering**

## **Abstract**

Cal Poly San Luis Obispo's College of Engineering created a model for empowering women to excel by establishing the Society of Women Engineers student section as the implementing organization for women in engineering recruitment and retention activities. A Women's Engineering Program Director, who is supported by the Dean, provides strategic guidance to the approximately 45 SWE officers who oversee the development and completion of programming to encourage women to aspire, advance and achieve in engineering.

The outcome is an outstanding record of accomplishments that has continued to gain momentum through the years. Cal Poly SWE continues to improve upon prior successes and to expand efforts as the largest and most well-recognized professional organization on the Cal Poly campus and the largest and Most Outstanding Student Section in the nation for the last four years.

Studies of retention of Cal Poly female engineering students and alumnae have demonstrated the strength of this model. Cal Poly female engineering students are retained both at a higher rate than the national average and at a higher rate than male students on campus. This vitality of Cal Poly female engineering students and alumnae is derived mutually from the myriad of support activities that are being offered to attract and keep those students in the engineering pipeline and the empowerment of having students design and manage the events themselves. Further feeding this positive cycle is enhanced industry support, originating from the recognized value of interpersonal, managerial and leadership skills developed as a result of this organization.

Through the years, Cal Poly SWE has planned, implemented and improved their officer structure, programming and member recruitment activities in promotion of their mission. The best practices gleaned from the experiences of this flourishing section are discussed in this paper with the hope that they can be applied at other institutions to further inspire the next generation of engineers.

## **Introduction**

As in the words of Shirley Ann Jackson, president of Rensselaer Polytechnic Institute, "there is a quiet crisis in U.S. science and technology that we have to wake up to." The crisis that she is referring to is our nation's shrinking pool of scientists and engineers.<sup>1</sup> One of the four main recommendations cited in the report to congress dealing with this issue, *Rising Above the Gathering Storm, Energizing and Employing America for a Brighter Economic Future*,<sup>2</sup> involves a call to "develop, recruit, and retain the best and brightest students, scientists, and engineers". Unfortunately, one half of the best and brightest of our population are scarcely contributing to our engineering ranks, and their percentages of participation are declining.

Female engineering students currently comprise 17.5% of undergraduate enrollment in engineering while six years ago this percentage was 19.8%.<sup>3</sup> Numerous studies have researched both the recruitment and retention components of this issue. One of the most recent retention studies has found that a vital factor in retaining undergraduate women in engineering majors is their use of support activities and resources.<sup>4</sup>

Based on this philosophy, Cal Poly San Luis Obispo's College of Engineering developed a model for empowering women to excel by establishing the Society of Women Engineers (SWE) student section as the implementing organization for women in engineering recruitment and retention activities. A Women's Engineering Program (WEP) Director, who is supported by the Dean and an Industry Advisory Board, provide strategic guidance to the approximately 35 SWE officers who oversee the development and completion of programming to encourage women to aspire, advance and achieve in engineering. The successful practices utilized in this organization are discussed in this paper with the hope that they can be applied at other institutions to further inspire the next generation of engineers.

## **Organizational Model**

In 1987, the newly appointed Dean of the College of Engineering, Dr. Peter Lee, resolved to address the dearth of female students graduating in engineering. Having limited funding to make advances in this area, the Dean decided to create a Women's Engineering Program Director position in conjunction with student leaders to drive the change. Through the years, the organizational structure has been evaluated and modified resulting in the current configuration.

### Society of Women Engineers

The majority of staffing for planning and implementing activities to increase enrollment and graduation rates of female engineers comes from student volunteers via the Cal Poly SWE Section. The mission of this organization is to recruit and retain women engineering students. A variety of events are hosted to encourage women to pursue engineering including numerous outreach events. Similarly, once women make the choice to study engineering, Cal Poly SWE offers opportunities for academic support, professional networking, and social interaction. This campus club has evolved to consist of a President who oversees an Executive Board which includes five Vice Presidents, a Secretary, and a Treasurer and over 400 members (see Figure 1).

Based on managerial models in industry, leadership cores were developed so that vice presidents supervised seven officers or less; with core areas being selected based on the Society's strategic plan and the Section's mission and vision. Each Vice President is responsible for the officers and activities in their core. This includes running bi-weekly core group meetings and insuring that all duties within her core are completed, either by motivating others to complete them or by doing them herself if required. Officer positions are filled utilizing a combination of election and appointment processes depending on the position. The majority of SWE officer positions are elected during the spring election meeting, where all SWE members are eligible to vote. For appointed positions, (identified in the position descriptions discussed later), interviews are conducted by the President and corresponding Vice President after officer elections have been held.

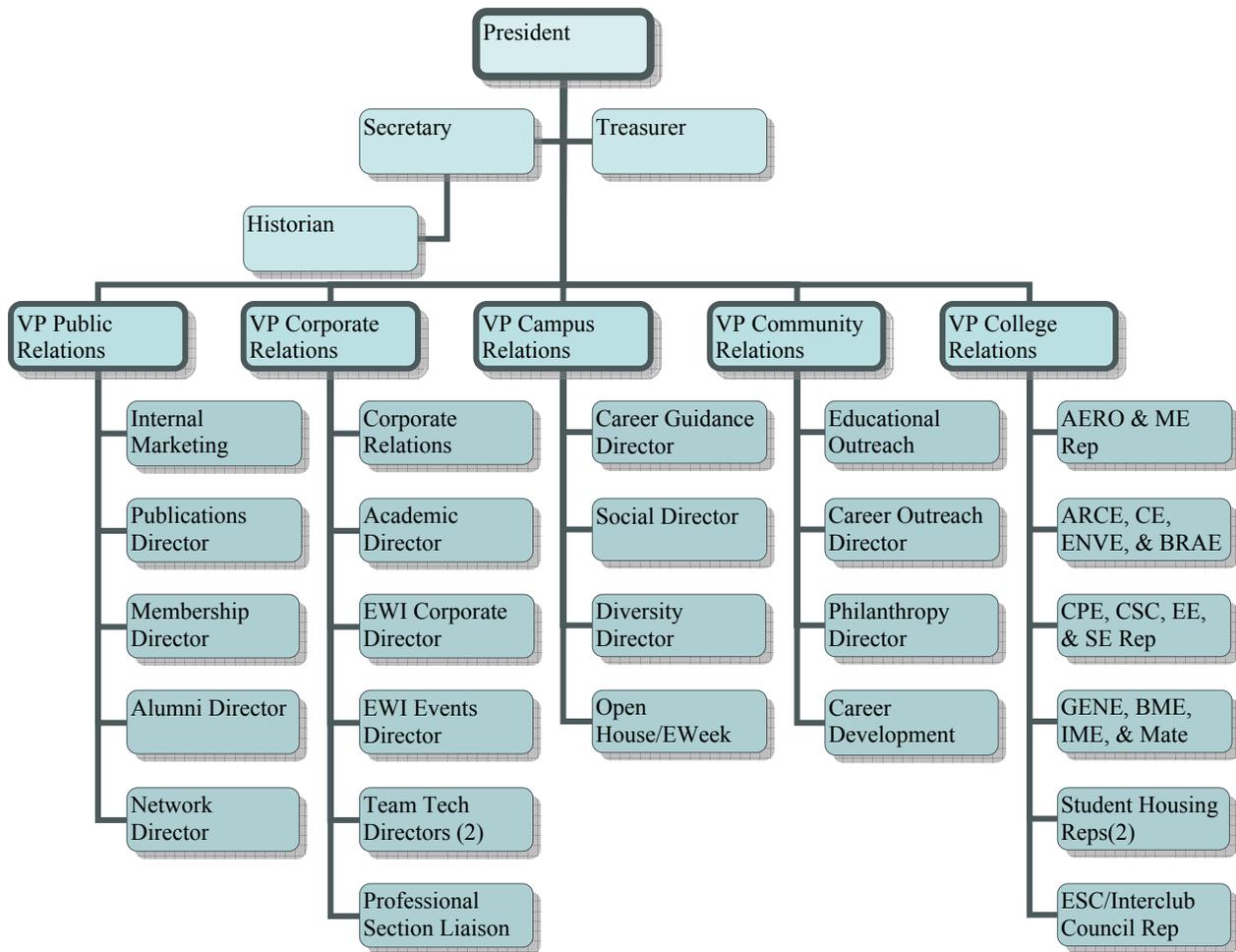


Figure 1  
Cal Poly SWE Organizational Chart

*Public Relations Core*

The Public Relations Core was established to expand the awareness of the engineering profession and of SWE/WEP activities. Along these lines, the Vice President of Public Relations is the point of contact for marketing engineering and SWE/WEP activities to the general public and to the university community. She is responsible for writing press releases for activities and awards, composing and distributing weekly e-mails to a member list, creating a membership brochure in the summer, and overseeing the following officers: Internal Marketing Director, Publications Director, Membership Director, Alumni Director, and Network Director.

The Internal Marketing Director designs and distributes all advertising materials including creating and posting bi-weekly meeting flyers, placing advertisements in the campus newspaper, and other advertising techniques.

The Publications Director designs, organizes, and distributes three student newsletters (August, December and March) that are sent to all female engineering students on campus, creates SWE bulletins for each general meeting, maintains the SWE bulletin boards on campus, and contributes to regional and national publications on behalf of Cal Poly SWE.

The Membership Director is responsible for organizing membership sign-ups at each meeting, providing members' e-mail addresses to the Network Director, providing membership lists to officers from national and local database, creating and distributing membership cards, and organizing all member recruitment efforts (information booths around campus, arranging SWE officers to speak at engineering intro. classes, etc.).

The Alumni Director maintains and updates the alumni database, plans alumni events, and assists with upgrading student members at the end of the year.

The Network Director updates and maintains the email aliases and updates and maintains the SWE webpage.

### *Corporate Relations Core*

The purpose of the Corporate Relations core is to develop and maintain industry networks. These relationships provide mentors and funding for all of the activities throughout the year. The Vice President of Corporate Relations is the primary contact for all communications with industry representatives. She supervises the officers that interact with corporate supporters, this group includes: Corporate Relations Director, Academic Director, Evening With Industry Directors, Team Tech Directors, and Professional Section Liaison.

The Corporate Relations Director position requires an application and interview. Responsibilities include arranging corporate speakers for all general meetings, contacting industry representatives to solicit general funds and sponsorship for SWE activities, maintaining the Corporate Database in Access (including obtaining current business cards from companies at career fairs), writing thank you notes to companies who support SWE, and compiling and transmitting the corporate brochure to all companies in the database during the summer.

The Academic Director contacts companies and individuals that are interested in sponsoring a SWE scholarship, creates and distributes scholarship applications to SWE members, oversees the selection of scholarship recipients, solicits nominations, selects, and distributes quarterly the "Most Active SWE Member" scholarship, solicits nominations and selects the "Most Supportive Professor" Award, maintains the test bank, and organizes study groups and peer tutoring for members.

There are two Evening with Industry (EWI) Director positions, the Events EWI Director and the Corporate EWI Director. Both positions also require applications and interviews. The Corporate EWI Director organizes events associated with the EWI banquet, including facilities and speaker, interviews, selects, and oversees committee heads, and runs committee meetings, mails invitations to faculty and Outstanding Women in Engineering nominees, obtains funding from

Associated Student Inc. co-sponsorship and the Dean, and maintains the budget for all expenses. The Corporate EWI Director contacts companies to sponsor tables at EWI and organizes the EWI sign-up meeting and company sign-up binder for students.

There are also usually two Team Tech Directors who are also selected via an application and interview process. They are responsible for finding a corporate partner, selecting the project and student team members, managing the scope, schedule and budget of a year long, multi-disciplinary project and presenting the project at the SWE National Conference

The last position in this core is the Professional Section Liaison. She is the contact between the SWE student section and the SWE Central Coast Professional Section. She organizes professional/student events and works with the professional section to organize events to reach out to the community to educate them about engineering possibilities/disciplines.

### *Campus Relations Core*

The Campus Relations Core's mission is to broaden students' horizons, "to stimulate individual growth and to encourage interaction among diverse groups so that we can leverage the values and experiences that each offers". This mission comes directly from the SWE national strategic plan which further calls "to embrace and promote the value and power of diversity." To connect students to the wider university community, the Vice President of Campus Relations supervises the Career Guidance Director, the Social Director, the Diversity Director and the Open House/Engineers Week (EWeek) Director.

The Career Guidance Director position was created to increase the diversity of the engineering population on campus by producing and extensively distributing print and audio/visual publications that define a new image of engineering.

The Social Director plans events that allow our officers, members and others throughout the university community to form and strengthen bonds with a diverse community. As shown in the Women's Experiences in College Engineering (WECE) study, connection to a community is a significant factor in the retention of female engineering students: "Our findings strongly indicate that participation in support activities is vital to many women undergraduates, who need to feel they are part of a larger community in engineering."

The Diversity Director is the liaison between SWE and the other minority in engineering clubs (SHPE, AISES, SBES). She is a participating member of these clubs and organizes cross-club diversity events (socials, outreach activities, etc.), and she plans events surrounding the history months (Women's History, Black History, Hispanic Heritage, etc.) including making and displaying multicultural exhibits for meetings.

Every spring, like many universities, Cal Poly hosts an Open House event to showcase the campus to prospective students and the community. This is an opportunity to leverage the efforts of the university in bringing 35,000 people on campus to introduce current as well as future students of all ages to engineering. The SWE Open House/EWeek Director is responsible for organizing both a booth with hands on activities and SWE's Passport to Engineering Program.

The passport program involves visiting engineering clubs and departments who have booths and/or lab displays to answer questions and collect a stamp. Completed passports are verified at the SWE booth then rewarded with a prize.

During the third week in February, universities throughout the world celebrate Engineers Week (EWeek) with numerous activities. Since Open House is not until mid April, it has been found that spearheading SWE's participation can be handled by the same officer who is in charge of Open House. She works closely with the Engineering Student Council and the SWE Engineering Outreach Director to assist in planning EWeek activities, as well as promoting SWE's participation throughout the week.

### *Community Relations Core*

The charge of the Community Relations Core is to recruit a diverse population to engineering by offering outreach activities to K-12 students, parents and counselors. This significant component of WEP/SWE mission is accomplished by the Education Outreach Director, the Career Outreach Director and the Philanthropy Director under the direction of the Vice President of Community Relations.

The Educational Outreach Director position, which also requires an application and interview, is responsible for sharing engineering with the K-8 community. The three main events organized by this officer have been spread out so that there is one per quarter and the Director is encouraged to select committee heads and develop committees for each event. In the fall, 100+ 6<sup>th</sup>-8<sup>th</sup> grade students are brought on campus for a day long, lab based engineering workshop. The Educational Outreach Director, in conjunction with her committee, manages all details for this event, including obtaining faculty and other engineering club support to staff the labs, and adherence to the project schedule and budget.

For EWeek, with the help of her committee, the Educational Outreach Director organizes hands-on introduction to engineering visits to 4<sup>th</sup> grade classrooms throughout the area. This involves selecting an engineering experiment for the children to conduct, procuring the material, coordinating with 4<sup>th</sup> grade teachers and training the presenters.

During spring quarter, the Educational Outreach Director oversees the Girl Scout engineering day committee in implementing this annual daylong workshop where Girl Scouts earn their engineering patch.

The Career Outreach Director, who is selected via an application and interview process, coordinates activities to encourage high school students to consider studying engineering. In addition to participating at career fairs and visiting classrooms, the Career Outreach Director organizes bi-annual high school shadow programs. Based on past successes and student input, this event has evolved to include an engineering focused campus tour, lunch with the Dean, attending classes with a SWE member and spending the night in the engineering dorm with a first or second year student. Based on post-event surveys, this event has not only been very successful at recruiting women to engineering, but also at retaining current engineering students.

Finally, the Career Development Director is tasked with advancing the professional and personal development and career opportunities of SWE members. She compiles and distributes the resume book and on-line resume site, informs members of company info sessions and Career Center activities, provides professional and personal development workshops, compiles and distributes the resume book/resume on-line, and makes business cards for members/officers.

### *College Relations Core*

The College Relations core provides the essential linkages to the College of Engineering faculty, students and administrators. The Vice President of College Relations directs the representatives from: each major (called Major Chairs), the Residence Hall and the Engineering Student Council, in communicating with their constituencies. She is responsible for interviewing, selecting, and supervising the Major Chairs (MCs), assisting with coordinating activities (industry tours, member/faculty socials, etc.), and working with the engineering residence hall administrators in developing programming to promote female student success.

The Major Chairs are the liaison between SWE and major related industry, faculty, and students. The fifteen majors offered on campus have been grouped into four industry related MC positions: Aerospace and Mechanical Engineering; Architectural Engineering, Civil Engineering, Bioresource and Agricultural Engineering, and Environmental Engineering; Computer Engineering, Computer Science, Electrical Engineering, and Software Engineering; General, Biomedical, Industrial, Manufacturing, and Materials Engineering. Each MC is responsible for organizing industry tours for their majors, communicating SWE opportunities (events, scholarships, etc.) and encouraging students from each major to join and participate in SWE.

There is both a Resident Advisor from the engineering residence hall and a freshman resident who serve as SWE officers and representatives on their hall council. They inform their respective organizations' officers and members of SWE events, and inform SWE officers and members of respective organizations' events. They also help plan and implement residence hall programming directed at retaining female engineering students.

### Women's Engineering Program

The Women's Engineering Program staff consists of one engineering faculty member who is funded by the Dean for 50% release time to direct the program, and a student assistant, also funded by the Dean, who works 10 hours per week assisting mainly with administrative tasks involving the WEP Industry Advisory Board (IAB). Other than office space, all funding for WEP is derived from corporate sponsorship. The WEP Director reports directly to the Dean and provides strategic guidance and oversight to the SWE section who implements almost all recruitment and retention efforts. In addition the WEP Director compiles statistics on women in engineering, serves on the College of Engineering Council, facilitates IAB meetings, and manages the Outstanding Women in Engineering award program.

## Industry Advisory Board

The mission of the Industry Advisory Board (IAB) is to assist the WEP to increase and retain the number of women pursuing technical degrees and to help prepare them for successful technical careers. The IAB objectives are 1) to serve as a communication link between the WEP and industry, 2) to support the WEP in obtaining public and private funding for its programs and 3) to assist the WEP in developing and implementing its goals. The IAB consists of approximately 20 individuals having diverse backgrounds and a wide range of technical and professional interests. Members are from industry, consulting, and government agencies and hold positions ranging from Vice President to individual contributor. The regularly scheduled general meetings of the IAB are in the Fall and Spring of each year with committees meeting as needed throughout the year.

## **Strategic Principles**

### Leadership Development

Due to the size of the Cal Poly SWE section both in member numbers and in activities held annually; organization of the activities and the members is critical. One of the main tools for this organization is developing strong leaders within the section. The officer team and executive board gives the students a great opportunity to learn and practice extensive leadership skills that they then carry with them into the rest of the campus and later into the work place.

The entire officer team is given training at the three officer retreats during the year. The training is not limited to information about SWE and the section, but also includes leadership training and team building activities. Being a part of the officer team teaches members to have responsibilities outside of academics, to interact on a one to one basis with other members of the section and to manage their time and activities.

Another integral part of the officer retreats is strategic planning for the upcoming year of activities and the general goals of the section for the year. Teaching these leaders of the organization strategic planning not only benefits the section to have a well organized set of activities, but also gives the officers strategic planning skills that are not learned in quarter long classes.

The executive board is an especially integral part of the officer team, comprised of the president, five vice presidents, secretary, treasurer and section advisors. The vice president position offers leadership experience beyond that of typical officer positions, in that the vice presidents have responsibility for four to seven officers of similar areas of interest (i.e. corporate, outreach, publicity). Some of the vice president responsibilities include ensuring their officers are informed of upcoming activities and events in the section, accepting responsibility for the activities planned by their officers and providing critical distribution of responsibility so the president is not overwhelmed during the course of the year. The officer team and executive board are shown in the organizational chart in Figure 1.

Succession planning is a crucial part of the leadership development of the members and critical to the future success of the section. The first step in succession planning is bringing in younger

members to the SWE leadership. One strategy employed by Cal Poly SWE is to encourage younger members to become leaders in the section by offering less intimidating leadership positions that will easily transition into their life as a student or activities that they are already participating in. This participation is followed with verbal encouragements and recognition of their successful completion of leadership activities with awards such as “officer of the week”. The result is development of their confidence to pursue further leadership opportunities both in the section and in their life outside and beyond SWE. Some of the introductory leadership positions utilized by Cal Poly SWE are committee chairs and major chairs; these positions have limited responsibility over the course of the year and still provide the young officers a good exposure to leadership in SWE.

The next step in succession planning is identifying younger SWE members with potential for larger responsibilities and a future in more prominent leadership positions. Identifying early the future leaders and encouraging them to plan their Cal Poly SWE career with certain goals in mind, provides the section with a strong future. One of the vital parts of succession planning is utilizing past section presidents to encourage and inspire younger SWE members to consider expanding their leadership responsibilities within the Cal Poly section, within Regional and National SWE activities, within the university and beyond into their future profession.

Another arena to develop leadership within SWE is the annual National Team Tech competition. Team Tech is a year-long project that provides members with a technical arena outside of classrooms and labs for students to execute leadership and team interaction skills. Team Tech is entirely run by the students, they decide the schedule, deadlines, team assignments, project goals and project design. Advisors tend to provide more technical advice on engineering subjects beyond students experience and expertise, rather than oversight on project development and success. Team Tech is lead by a pair of team co-leads who oversee the project for its entirety, starting with deciding the sponsoring company and product, choosing the team members, overseeing the design process and schedule and finishing by delivering the technical competition presentation at National Conference the following fall. Team Tech members are provided a unique experience that simulates what they can expect as a professional in that there is an industry customer with requirements and expectations, there is a very specific and constrained schedule for the project and there tend to be several obstacles and challenges that exercise the students’ problem solving skills.

### Corporate Relations

Strong ties to industry prepare Cal Poly SWE students for success, both in school and in the workplace. SWE students benefit from several opportunities for interaction with industry representatives – developing their familiarity with the working world and increasing the skills needed to be young professionals.

Building and maintaining corporate partnerships takes a significant amount of effort. Over the years, Cal Poly SWE has developed a database of over 500 corporate contacts. Each year, a corporate packet is sent out to all of the industry contacts, outlining Cal Poly SWE’s goals and events for the year. This packet helps to garner financial support, keynote speakers, and

participants for events. The Cal Poly SWE Corporate Relations Director has the hefty job of maintaining these ties to industry.

Each bi-weekly SWE membership meeting features an industry speaker. These presentations provide exposure to real-life engineering experience and a point of reality for the students to go beyond the engineering academics learned in the classroom. Topics are diverse in nature, to reach the various disciplines and experience levels of the SWE members. Past general meeting presentations range from resume and interview skills to panel discussions with engineers in the beginning of their careers, to the engineering of ice cream.

SWE also has close interaction with corporate partners through the Industry Advisory Board (IAB). The IAB was developed through a partnership between Cal Poly SWE and the Women's Engineering Program (WEP).

Members of the IAB provide good contacts for providing funding from their companies. Cal Poly SWE's strong ties to corporations garner approximately \$80,000 in corporate sponsorship including over \$40,000 in scholarships every year. The scholarships help recognize outstanding SWE members and aid in connecting these students with companies that may be interested in hiring them. The IAB members also help to seek out projects and corporate advisors for the annual Team Tech competition.

Another benefit to SWE's strong industry ties are the countless job opportunities that become available through SWE industry connections. Many companies recognize the outstanding leadership skills and well-roundness of Cal Poly SWE members, and therefore recruit specifically from SWE's membership via SWE-sponsored corporate info sessions.

The premier event for Cal Poly SWE members to interact with corporate partners is Evening With Industry (EWI). EWI brings together over 300 SWE members and more than 80 company representatives at a formal banquet, which includes a motivational keynote speaker and the presentation of scholarships and awards. This event allows the participants to practice their professionalism and ask candid questions about a company, while in an environment that is less formal than an interview and more personal than a career fair booth. Students will often sit at the same corporate table year after year, developing relationships with the company they want to work for (many times resulting in a job offer or at least a foot in the door for an interview). Other students will sit with a different company each year, gathering information about numerous companies and establishing a strong network for when they are ready to seek employment. Either way, several Cal Poly SWE alumni will testify that EWI was largely responsible for landing them their first job or internship.

### Alumni Involvement

As members of SWE at Cal Poly, students have the opportunity to lead, influence, effect, and change how engineering is perceived. These leadership opportunities experienced as students lay the groundwork for alumni. The knowledge and insight gained from serving as an officer of SWE, allow members to excel after graduation in work and as SWE professional leaders. Over the last several years, Cal Poly SWE officers have graduated and moved on to serve as SWE

National Committee Members, National Committee Chairs, Region Officers, Professional Section Officers. No other collegiate institution has provided such a pipeline of leaders in the last decade to SWE. Other Cal Poly SWE officers have been honored in Time magazine, nominated as emerging leaders in their industry, and promoted to levels of managements beyond expectations. Many of these accomplishments stem from their experience as leaders in SWE.

As students graduate from Cal Poly, they become part of the integral support group that enables Cal Poly SWE to continue flourishing. Even before graduation, Cal Poly SWE instills upon the graduating students the value and importance of remaining involved with SWE as a professional engineer. Cal Poly SWE offers a one of a kind upgrade program to its graduating seniors, by offering a one year complementary Professional Membership to SWE. This allows graduating seniors to experience the support network that SWE provides and remain involved as they make the leap from student to professional.

Upon graduation, SWE members are invited to remain involved with Cal Poly and requested to become members of the Cal Poly SWE alumni database. By becoming a member of the Cal Poly SWE Alumni database, they are offered the opportunity to return as a speaker for member meetings, corporate sponsor for Evening with Industry or Team Tech, guide for Shadow an Engineer, donor for scholarship, or consultant to the executive board. When alumni return to Cal Poly SWE as speakers or sponsors they have a special connection that allows them to relate to the students and give invaluable advice on how to prepare for the real world, how Cal Poly helps you succeed, what you really need to know about engineering, and current industry practices. Alumni not only provide educational lessons, but their presence allows the current students to meet practicing engineers and experience the tangible support they may need to continue with their engineering education.

One of the roles of Cal Poly SWE Alumni is to assist in succession planning for the student section. Since the actively involved SWE Alumni have experience with the expectations and demands upon SWE leaders, they provided guidance and mentorship to those who show promise in continuing the legacy of the Most Outstanding Student Section in the nation. By identifying the future leaders early in their SWE career, they receive the encouragement and guidance needed to prepare for their role as a SWE leader. By establishing this mentorship program, current and future leaders have multiple resources to seek direction and ask for assistance.

Cal Poly SWE Alumni also participate in the Strategic Planning of the student section. As the alumni venture into industry, they gain a different perspective on what SWE can provide, how SWE influences engineering students, and how to positively change the type of engineering programs and services offered by Cal Poly SWE. The Cal Poly SWE alumni meet twice a year to discuss what enhancements can be made to keep up with the varying needs of industry and how to positively affect the engineering experience for students. The dedication of the alumni helps shape and strengthens the quality and impact of what Cal Poly SWE strives to provide to engineering students.

One other important role that Cal Poly Alumni serve is Team Tech evaluators and practice judges. Team Tech is the most prestigious national competition for SWE. Every year, the Cal Poly SWE student section submits a Tech Team project addressing a real engineering problem, a

scientific problem solving approach, and an imaginative economic solution. The capstone portion of the project is a presentation given to a panel of professional engineers who evaluate the project, the team work, the problem solving process, the solution, and overall presentation. Before the final presentation Cal Poly alumni gather to evaluate the presentation and provide helpful guidance to the presenter. The multiple practice sessions allow for improvements and revisions. By critiquing the presenters and prepping them for the question period, they become more comfortable with the material and themselves. The alumni provide an invaluable opportunity for Team Tech to practice and improve their presentation as well as clarify any topics that may not be explained thoroughly to those unfamiliar with the project. The Cal Poly alumni involvement does not stop merely at the practice presentation, but they attend the final presentation that is used in the final judging of the project. The Cal Poly SWE alumni provide something not demonstrated by other universities, the commitment to help those behind them succeed.

### Partnerships

A key element to an engineering student's success is the support of their peers, the University faculty and staff, and industry professionals. Involvement with student organizations such as the Society of Women Engineers provides students opportunities for academic achievement, educational outreach, professional recruitment, and recognition for one's achievements. At Cal Poly, there are many student organizations with similar missions – to provide extracurricular opportunities for their members and to help guide them through the collegiate experience. In particular, the minorities in engineering societies have similar missions to recruit and retain minorities in engineering. Due to the similar nature of these student organizations, it is clear that it would be mutually beneficial to work together to achieve the same goals.

Through the years, SWE has strived to work together with the other minority engineering clubs on campus to join forces to provide the most effective methods of outreach, professional networking, and academic resources for the students. SWE now partners with the Society of Hispanic Professional Engineers (SHPE), the American Indian Science and Engineering Society (AISES), and the Society of Black Engineers and Scientists (SBES) to not only reach out to a larger community, but to allow our members to interact with other minority engineering students. This partnership extends beyond outreach events to include corporate networking, academic resources, and scholarship opportunities. We work together to provide a more expansive outreach network by providing more volunteers and a wider range of influence. We collaborate on professional events so that the opportunity to network with industry professional is extended to a wider range of students. Not only does this benefit the student members by providing them with more options, the corporate representatives appreciate the effort because their visits to campus reach a larger group of students.

The Dean of the College of Engineering is extremely supportive of the partnership that we established, and with his support, the four minority engineering societies at Cal Poly are piloting a student joint membership option – where members can join SWE and another minority engineering professional organization at a reduced rate.

In addition to partnering with other minority engineering clubs, Cal Poly SWE puts a great deal of energy into reaching out to all engineering students on campus. In order to remain up-to-date on current events and activities, and to ensure that the College is aware of SWE's efforts, we have established representative positions on the Engineering Student Council as well as representatives in charge of communication with each engineering department. These representative positions are not only critical to intra-campus communication; they strengthen SWE's ties within the College.

Engineering is an outstanding career for women, but many young girls are not exposed to engineering as a viable career choice. One of SWE's main priorities is to encourage young women to consider engineering as a potential career. We put a great deal of effort into our outreach events, and utilize the partnerships that we have developed with local schools and the community to reach out to children. We advertise our events at local schools by providing information to teachers who then pass it on to the students and their parents. We even visit classrooms to demonstrate to the youngsters that engineering can be exciting! Without the strong connections that we have made within the community and with the teachers, our outreach programs would simply not reach as many students.

### **Evidence of SWE's Positive Impact on Success of Females in Engineering**

Previous research has demonstrated institutional impact on retention<sup>5</sup>. Institutional impact surpassed most other well-known and observable factors in encouraging or discouraging female students<sup>5</sup>. These factors include GPA, preparatory high school courses, confidence, interest in engineering, teacher quality, expected wage and many more. Cal Poly's SWE section is a large, successful student section and may be the most representative institutional culture to female engineers.

One of the most visible measures of the extent of Cal Poly SWE's cultural dominance is the unusually high participation of Cal Poly students in SWE activities. For the last five years, Cal Poly SWE has been the largest and most active SWE section in the nation resulting in numerous awards. Cal Poly SWE membership is consistently over 400 members, while female undergraduate enrollment in the College of Engineering is around 645 students. For the last five consecutive years, Cal Poly SWE has won the #1 Large Outstanding Collegiate Section in the Nation award, something never demonstrated by another school in SWE's history. Cal Poly SWE has also placed in the top two for Team Tech six out of the last seven years. The myriad of other awards received by Cal Poly SWE include four awards for Best Large Student Membership Program, Best Collegiate Membership Recruitment Campaign, two awards for Student Membership Upgrade Program, Best Collegiate Section Website, two awards for Career Guidance Student A/V, and three awards for Multicultural.

As predicted by the presence of a positive institutional impact, Cal Poly's retention figures compare favorably to national averages with recent statistics showing Cal Poly exceeding the national average retention rate for female engineering students by over 30%.<sup>5,6</sup>

In 2006, a pilot national engineering alumni retention study was conducted by Harris Interactive for the Society of Women Engineers.<sup>7</sup> The purpose of this study was to address the dearth of

information available to the corporate community regarding issues related to retention of female engineers. Cal Poly was one of the 21 schools that participated in this study contacting 4000 randomly selected College of Engineering alumni from the set of alumni who graduated between 1985 and 2003 with an undergraduate or graduate degree. Alumni were equally divided by gender (i.e. 2000 female and 2000 male).

The methodology utilized in this study involved weighting completed surveys to American Society for Engineering Education (ASEE) 1998 to 2004 data. "Responses were weighted to be proportionate to the number of engineering undergraduate and graduate degrees awarded."<sup>7</sup> For Cal Poly this yielded 102 female and 70 male completed surveys. The resulting data for most of the questions was presented in categories of: Total sample, Total male, Total female, Total for school, School's male and School's female.

Overall, the survey respondents were approximately equally divided by graduation year; age ranges distribution for Cal Poly approximately mirrored the overall age range distribution. Although many of the responses to questions in this on-line survey were similar at Cal Poly compared to the total population, there are several notable differences.

The first area of observed differences in responses for Cal Poly females relate to education. When asked to rate their satisfaction with their engineering education, 64% of Cal Poly females respondents were very satisfied versus 57% of Cal Poly males, 53% of Total females and 54% of Total males.

The other Cal Poly female population differences concern employment and current circumstances. The first difference was in the percentage of respondents who were "ever employed in engineering or a comparable field". While 91% of Cal Poly females answered yes to this question, only 70% of total females answered yes with the male percentages being 60% and 69% for the Cal Poly and total populations respectively. Another notable dissimilarity was in annual base salaries. Although 29% of Cal Poly females earn at the high end of the salary range, \$100,000 or more, only 18% of Total females, 28% of Cal Poly males and 32% of Total males are in this category. The last difference relates specifically to SWE. Respondents were asked to identify which technical or professional societies they belonged to. Over twice the percentage of Cal Poly females were SWE members as the total female population (22% versus 10%).

As a follow up to this survey, some alumnae of Cal Poly SWE were asked to evaluate their experiences in SWE. Their responses included the following:

"SWE inspired me to be adventurous with my career... to take risks and challenge myself. SWE provided me with an outstanding forum for ideas exchange and allowed me to associate with other women who are facing the same challenges as me. I am still in contact with women whom I met through SWE who serve as mentors and provide advice and guidance as I start my engineering career."

"As 2005-06 Cal Poly SWE President, I was responsible for managing the officer team as well as serving as the liaison between Cal Poly SWE and the College of Engineering. I gained valuable experience in management, delegation, and budgeting. Without SWE, I would not have

developed these skills through my coursework. If my skills in project management are more developed than my peers at my company, I attribute it directly to the skills I obtained through my SWE presidency. My involvement with SWE truly rounded out my college education!”

“I can credit SWE with my success in my collegiate and professional career. Without SWE, I would have never completed my engineering degree much less my Masters in Engineering. Early in my collegiate career, SWE was my main motivation for remaining in engineering. After my first quarter in college I questioned whether, I had made the right choice by choosing engineering as a major. For me, SWE started out being my support group where I was able to meet other female students facing the same challenges.”

“As I grew, SWE's role in my career did as well. SWE encouraged me to get involved beyond my course work, to take a leadership role in the society and to help others facing the same challenges I did when I first started out. I went on to serve as the President of the SWE Section in college and was given an extraordinary opportunity not many people ever have the chance to experience. As the President, I managed forty officers and over four hundred members, served as the voice for female engineers to the College of Engineering, developed managerial and time management skills, improved my public speaking skills, and became a well rounded individual. My experiences in SWE gave me a distinct advantage over my classmates and co-workers that I credit to my years of involvement with SWE.

SWE was and will continue to be an integral part of my life and my development.”

“I never questioned whether I should or should not participate in Cal Poly SWE. In fact, I was signed up as a member before I ever set foot on campus my freshman year. I couldn't understand why anyone would not want to be a part of such a supportive organization that provided networking opportunities, potential for great leadership growth, and a social network of women who could really relate to the challenges in the engineering curriculum and culture. SWE proved to be all of these things for me. I took the opportunity to be a leader in SWE, moving up through the leadership ladder and becoming SWE President by my junior year at Cal Poly. There are very few college students who can say they successfully led a 500+ member organization, and this experience made me stand out in the crowd when it came time to look for an engineering job. Now, as a Systems Engineer for NASA's Jet Propulsion Laboratory, I attribute my success to the training and experiences I had in SWE. My public speaking skills and ability to make engineering exciting to the next generation of explorers (developed through SWE outreach events) have made my design team a permanent stop on the JPL tour. The leadership skills gained through SWE transitioned directly into my career, enabling me to be recognized and promoted at work. I now manage a group of 13 systems engineers, the majority being far more "educated" and experienced than me.”

## **Conclusion**

The result of the organizational model implemented at Cal Poly, reliance on students to promote the recruitment and retention of females to engineering, has been a positive effect on female success in engineering both during and after college. The empowerment of students in this managerial configuration has made Cal Poly SWE the largest professional club on campus and

consequently a dominating factor in defining the institutional environment for all female engineering students including those who actively participate in SWE as well as those who don't. The retention of Cal Poly female engineering students at a greater rate than not only the national average for female engineering students, but greater than the average rate for male students at Cal Poly is also aligned with the WECE conclusion that women feeling a part of a larger engineering community is one of the dominant factors influencing retention.

The strategic principles of leadership development, corporate relations, alumni involvement and partnerships are the foundation on which the Cal Poly model was constructed. And student led implementation supported by strategic guidance is the structure that created the community necessary for inspiring the next generation of engineers.

## References

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