

AC 2010-1300: DEVELOPMENT OF A WOMEN IN ENGINEERING PROGRAM: FROM RESEARCH TO IMPLEMENTATION

Judith Cordes, Michigan State University

Judy Cordes has been working with women in engineering for over twenty years. Currently she is the Coordinator of the Women in Engineering Program at Michigan State University. She oversees recruitment and retention efforts for women engineering students and serves as the advisor for The Collegiate Section of the Society of Women Engineers. Judy also serves as an academic advisor for freshman engineering students.

Thomas Wolff, Michigan State University

Dr. Thomas F. Wolff is Associate Dean of Engineering for Undergraduate Studies at Michigan State University. In this capacity, he is responsible for all activities related to student services (academic administration, advising, career planning, women and diversity programs, etc.) and curricular issues. He is principal investigator on several NSF grants related to retention of engineering students. As a faculty member in civil engineering, he co-teaches a large introductory course in civil engineering. His research and consulting activities have focused on the safety and reliability of hydraulic structures, and he has participated as an expert in three different capacities regarding reviews of levee performance in Hurricane Katrina. He is a three-time recipient of his college's Withrow Award for Teaching Excellence, a recipient of the Chi Epsilon Regional Teaching Award, and a recipient of the U.S. Army Commander's Award medal for Public Service.

Development of a Women in Engineering Program: From Research to Implementation

Local and National Trends

The national focus to recruit more women and minorities into the field of Engineering is well documented. For women, Engineering is still considered a nontraditional career path, and for many women college students, a major they have not even considered. For over fifty years, those in engineering and higher education have been looking at this issue and trying to find ways to increase the number of women completing engineering degrees at the bachelors, masters and doctoral levels.

Even with the many efforts going on across the nation, the number of women pursuing engineering degrees is not increasing; and in some areas of engineering, the numbers are actually declining. For many years at Michigan State University (MSU), we saw a steady climb in the number of women engineering students, especially in disciplines like Chemical and Mechanical. Through the 1990s, we averaged 22% women engineering students, well above the 16% national average. However, in 2000 we saw the numbers begin to drop, as they did nationally.

Figure 1 compares first-year enrollments of women in engineering at xxx with those nationally, as reported by the Engineering Workforce Commission¹. While both percentages were dropping, through 2003, MSU remained above the national percentages in women enrollment, typically by one to two percentage points. Anecdotal information showed this may have been related to the the strong connection of the mechanical engineering major to the Michigan Auto industry, which employed significant numbers of both male and female parents in the state, and mechanical engineers were seen by Michigan families as stable and prestigious jobs. Hence, we had larger percentages of women than the national average in mechanical engineering, and generally similar numbers in other majors.

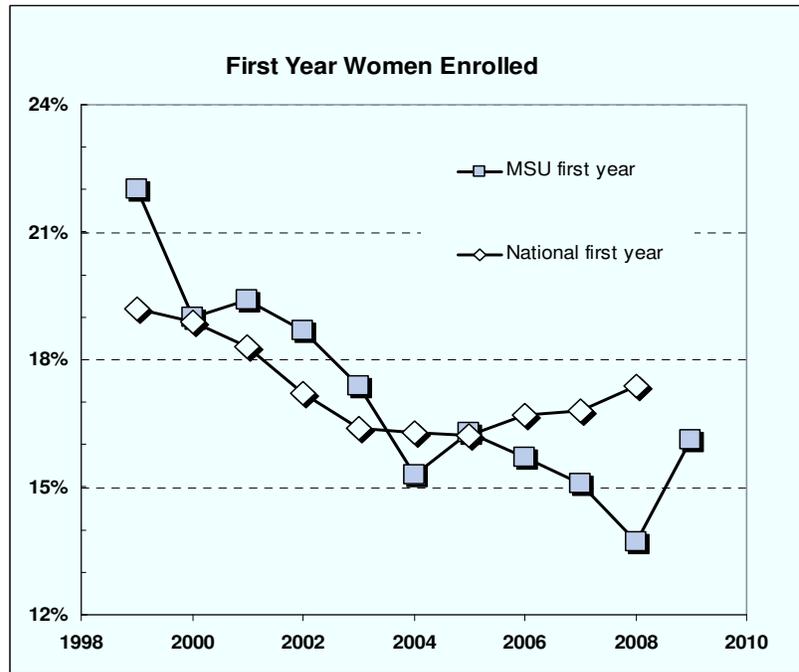


Figure 1. National and xxx First Year Enrollments

By 2004, we saw our percentages of first year women continue drop below the national average, and generally continue (discounting “noise” variations in the trends) through 2008. At the same

time, national percentages began to rise in 2006, causing xxx's numbers not only to fall, but to diverge from the national trend.

Figure 2 compares total enrollments of women in engineering at MSU with those nationally.

Like the national numbers, MSU's total women enrollment is typically a greater percentage than first year students, as some women "find" engineering after entering the university. It can be seen that MSU's percentages were greater than national percentages through 2002, ran similar from 2002 through 2006, but continued to drop when national percentages began to rise, showing a similar divergence from national trends. Clearly, things had changed and we needed to be doing more.

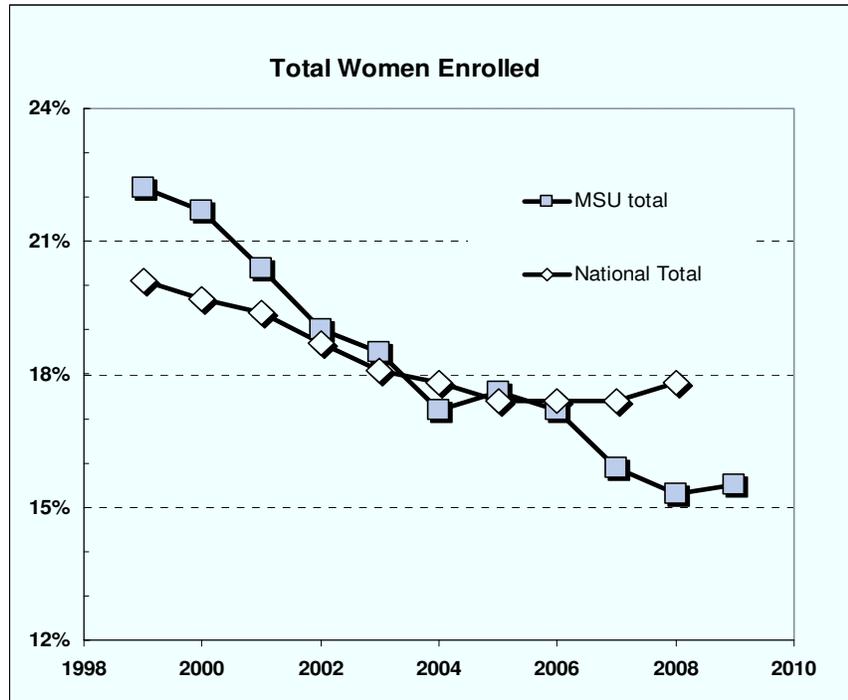


Figure 2. National and xxx Total Women Enrollments

At Michigan State, we have long had a very successful Society of Women Engineers section. This organization is one of the largest and most active organizations in the College of Engineering. When numbers were high, the college relied on SWE to do the significant recruitment and retention activities, which they did well. As the push came nationally for more women to obtain degrees in engineering, many schools started Women in Engineering Programs, working full time on the issues of recruiting and retaining these women. We continued to depend on our SWE collegiate section. However, as students, they had limited time and resources, were not able to solicit large amounts of donor funds, and of course, continuity became an issue with leadership turning over almost every year. Also, even though SWE had a strong membership, it typically only touched about twenty to twenty-five percent of our women students. By 2003-04, the trends presented in Figures 1 and 2 were becoming clear—with numbers heading below national averages, we knew we needed to do more in the areas of recruitment and retention.

In 1999-2001, we had participated in a national, longitudinal study of women's experiences in undergraduate engineering programs called "The Women's Experience in College Engineering Project" (WECE) funded by NSF and the Alfred P. Sloan Foundation and conducted by Goodman Research Group, Inc. in Cambridge, MA.¹ Fifty-three institutions participated in this study, half with Women in Engineering programs and half without programs. 20,000 students

participated, completing a 30-40 minute survey. Questions included background information, information on K-12 education, background on parents, those who had the most influence and also gave most encouragement in regard to the participant pursuing engineering, and information on participants' current engineering major. Participants were asked at the beginning of the survey if they planned to stay or leave engineering. Some of the rest of the questions were asked only to stayers and some were asked only of leavers. Questions included information on how participants saw themselves compared to their male colleagues and their female colleagues, average engineering grades for the year, issues related participants self esteem, and future plans. Finally there was a section on support services and programs for engineering, and participants were asked to say which services they had used, frequency of use and these results were divided into stayers and leavers.

Each participating institution was given individual results which were compared to the national averages. We learned much about our students; however, one fact stood out significantly: *Women made use of programs which supported women in engineering. It was important to their confidence and success.*

Need for Change at Michigan State

Knowing that our numbers of women engineering students had fallen significantly and that women made use of programs which supported women in engineering, we knew we had to look more closely at our situation. During the 2003-04 school year, the SWE advisor (an academic advising professional) did a comparison study looking at schools we benchmark our efforts against, and the most popular "other" choices of our applicants. Each of these schools had full WIE Programs or at least a full time person working on recruitment and retention issues for women.

With the information we had learned from both the WECE Study and our own investigation of competing schools, we knew we needed to make some changes. We were losing ground in numbers and realized that women students were looking for "programs" that would assist them in their success. Although our SWE section was successful, it could not provide all the things our women students sought or needed to be successful. At this same time, new college leadership was supportive of the formation of a WIE Program.

Proposal and Early Development of Program

In late 2005 our SWE Advisor wrote a proposal to the Dean of Engineering asking for support of a Women in Engineering Program. The proposal rationale was built on the following points:

- The national need for more women engineering graduates
- Dropping numbers at our school, now crossing below national averages
- Documented results from the WECE study that women students favored having formal programs with a variety of program components
- The inability of a SWE chapter (student organization) and their part-time advisor to fully support recruitment and retention of women (paid assistance, preparing funding proposals, etc.)

These were strong, well supported reasons to begin a program that would both benefit the engineering profession and our institution. We were not just starting a program because everyone else had one or was starting one.

The proposal was approved in 2006, our SWE advisor was named Coordinator of the new program, and her advising duties were reassigned. Despite being “only” the SWE advisor, she also had many years of involvement in national Women in Engineering venues. However, in that same year, a voter initiative changed our state constitution to prohibit preferential treatment to women or minorities in college admissions, scholarships and related programs. We decided to hold the start of our program to understand the impact of this new policy. While waiting, our Coordinator worked on developing the details of our new Program through a series of activities. First, she visited two successful programs, Iowa State University² and The University of Texas at Austin³. Both programs had received national awards for their efforts, and were well known for their best practices. While visiting, she met with the other schools’ WIE/WISE Directors, Assistant Directors and Program Coordinators. She learned about how they developed the particulars of their programs, supporting materials they produced (brochures, web sites, etc.), their fund raising efforts, advisory boards, their relationships with their faculty and the other organizations that supported women in engineering, for example SWE.

These trips and discussions about best practices were very useful; however, there were other groups with whom it was important to talk to when developing the Program. Interviews were conducted with several faculty asking their opinions on the program, how it should be developed, and what it should provide. Many excellent suggestions were gathered from these interviews and used in the development of initiatives for the program. The other group that was interviewed was the current women engineering students. The Coordinator worked with the Director of Marketing for the college to develop an online survey which was sent to the students⁴. Those who completed the survey were given “bucks” which could be used at the on campus coffee shops. We had an excellent return rate of 44%. Ideas from both groups were used to develop the Program’s basic elements.

The primary faculty suggestions included

- Welcome letters to admitted students
- Promotion of engineering to women in other technical majors at the university
- Providing a resource room
- Current faculty and student presence at school career days and similar activities
- Engage more women in undergraduate research and point them to graduate school

The primary student suggestions included

- More contact with high school students
- More programs to educate high school students and teachers
- Recognizing the importance of student organization participation as providing both support systems and leadership opportunities

Armed with this information and her 20+ years of experience in Women in Engineering, the Coordinator began the process of developing a mission statement which connected to the College and University mission statements in areas related to diversity and the Land Grant philosophy. She then developed broad based goals for the program, quoted below.

- To **increase the pool of qualified women** who enter our Engineering College and assist in retaining these students in their chosen academic programs.
- To **assist women students in preparing for graduate programs in engineering and careers** in engineering.
- To **provide women students with resources and services** to enable their success in their academic and professional pursuits
- To facilitate **the development of leadership and career enhancing skills** and to offer mentoring and networking opportunities.
- To **work with other programs and units in the College of Engineering** to provide a positive environment for the success of our women engineering students
- To **introduce engineering as a career option to pre-college students.**

By this time, the university's approach to the state constitutional amendment had become clearer; the primary focus of the legislation was to ban college admissions and scholarship systems that explicitly favored certain groups through "point systems" or differential eligibility. Student support services, recruiting and retention activities could target specific populations so long as services were ultimately available to anyone who sought them. Hence, males are welcome to attend and fully participate in any Women in Engineering activities.

During this time frame, budgets and fund raising plans were also formulated. Our Coordinator worked with our development personnel to develop a fund raising strategy that would include both corporations and alumni. The program was introduced to both groups throughout the year. Following lessons learned earlier, the set up of our WIE program was somewhat unique, and was chosen to make it easier for corporations and alumni. We made WIE the umbrella organization providing funding flow to our two student organizations that assisted with recruitment and retention issues, our SWE section and our Women in Computing (WIC) section. Donations could be made to one group, the WIE Program, and split among three groups as designated. Support could be given through a Partners Program (levels of giving) or for specific events. This way, companies and alumni could support any of the programs without having to make separate donations. They could go through one person, the WIE Coordinator, to learn about programs and make donations. Going through different people to donate to or make connection with student groups like SWE and WIE/WISE Programs had been a complaint our Coordinator had heard from both corporations and WIE/WISE Directors. We hoped our organization would make it easier, and we have heard from several of our corporate sponsors that they like this set up much better. Fund raising is of course and ongoing project, and in this economy, a challenging one at best.

First Three Years

At this point, all the primary pieces were in place. In the fall of 2007, the Women in Engineering Program at Michigan State officially began operating. It was decided that the primary focus of

the program would be recruitment of new women engineering students and the retention in the first and second years. Multiple initiatives had been developed for both recruitment and retention; however, we knew that not all of them would start immediately, and we would need to decide which could be done based on finances and time constraints with just one person working on the program. Our Coordinator continued to serve as the SWE Advisor, a position she had held for almost twenty years, and she worked on forming a strong union with the Women in Computing section.

With the seed funding received from corporate partners, alumni, and a grant from our university's Inclusion Office, we were able to start several initiatives over the next three school years. Many of our initiatives depended on volunteers from our current women in engineering, and they came through in every instance. Many women who had never participated in an event connected to "women" were excited to volunteer their time. We found this new interest in volunteering very fascinating. As we began to look at why, and we as we talked with women students, we found that a number of them were interested in serving others through activities but were not interested in "joining an organization" WIE gave them this opportunity without having to make a long term commitment and in some cases, without being connected to a "women's organization." At the same time, interest in SWE and WIC remained strong. Clearly, students are each unique, and with different interests and preferences. The broader range of options was already beginning to bear fruit in the form of broader engagement.

First Year. The first year's focus was on connecting with admitted women students and developing materials necessary for the Program. We started a program called *Email Buddies* wherein current women students are matched with women who have been admitted to MSU and declared engineering as a major. Current students wrote to admitted students and shared their experiences at MSU. Most of the admitted students wrote back at least once, asking a variety of questions about engineering and the college. Every year, we have been fortunate to have an outstanding response from our current women engineering students and have had anywhere from 50-70 volunteers. This program has been very successful, and each year we have freshman who want to participate because they had such a positive experience in the program when they were admitted students. In fact, we have had several comment when volunteering that they had decided to attend Michigan State because of the Email Buddy Program. In fall and spring semesters, our Coordinator sponsored a program called *Make the Switch to Engineering*. She knew that many women students at MSU were in technical majors similar to engineering but had never considered engineering as a valid career choice. Although turn out was small, 10-15 students per session, 50%+ did switch to engineering after each program. So it was definitely worth the effort. In the summer, the Coordinator assisted with the Women in Engineering summer camp. This camp had been started by our Assistant to the Dean for Recruitment and K-12 Outreach, but would over time transition to the WIE Coordinator. With the assistance of our Engineering Marketing Director, the Coordinator also developed a WIE Brochure for corporations and alumni, started preliminary plans for a WIE Brochure for students, and put a Welcome Page on the web (the precursor for the web site).

Second Year. The second year's focus was on initiatives for first and second year students. The Coordinator was able to hire three student workers who each worked 10 hours per semester. We started two new programs, *Connecting to the College I and II* and *PALS* (Peer Assisted Leaders).

Connecting to the College I and II allowed first year and second year students to meet regularly (3-4 times a semester) to discuss important issues for their success, connect socially and academically, and find support in engineering. We had speakers or did social activities like game night, ice skating, or painting pots. Although these programs started out strongly, attendance dwindled as the year progressed. Students needed this particular support at the start of the school year, but after a while found other resources that engaged them in more preferred ways. At the end of the school year, participants were surveyed inquiring what they liked and didn't like about the program and if they felt it should continue. Although they enjoyed their time in program, most participants felt that they could make better use of other activities such as student organizations or peer mentoring programs. This program was not continued in the third year. Although it may be brought back, it will need to be re-worked before it will be successful.

The PALS program matched first year and second year students with upperclassmen. We attempted to match by majors, but where this was not possible (all participants were volunteers), we looked for related majors or other similarities between mentor and protégé. There were nineteen pairs, and during the school year, we only lost two freshmen, one that didn't return to school and one that changed majors, and two upperclassmen, one who graduated at semester and one who went on co-op. Participants all went through a short training and were given a manual on mentoring. The protégés' version was different than the mentors' version, although they did have some common pieces. Mentors and protégés were required to converse via a method of their choice once a week, and meet in person at least once a month. The WIE Coordinator kept in contact with all pairs through regular emails, suggesting ideas for conversation, and through events planned once a month such as a holiday party, ice skating, game nights and an end of the year celebration. At the end of the year, all participants were asked to take a survey. We had a 37% return rate. Overall, the comments were positive, and open ended questions gave us many ideas for the next year. These included

- Require communication between mentor and protégé at least weekly
- Always have an initial kick-off event where everyone can meet
- Always schedule programs well in advance to get them on individuals' calendars

Many of our first year protégés were very happy with the program and asked if they could be mentors the next year. Based on results from the survey, the most dissatisfied group were the second year protégés. They did not find the program as useful. Although they felt they still needed support in many ways, they did not find the protégé option as useful and thought the WIE program should look at other options for second year students.

During the second year, we once again sponsored the Email Buddy Program, which had excellent response from both current women engineering students and admitted women engineering students. In addition, the Coordinator partnered with our recruiting coordinator and attended several college fairs, talking to women about the benefits of studying engineering and attending xxx. She met with visiting prospective women students and their families, and introduced them to the WIE Program. During the summer, she was the Co-Director of the summer Women in Engineering Summer Camp which hosted 25 women students going into their second, third and fourth years of high school. Finally, the brochure for students and their

families was taken from development stage to final copy. It is now used in all recruitment activities.

Third Year. The third year has been a year of growth but also reflection. The Coordinator was able to hire a student worker who works five hours per week and assists in both planning and implementation of programs, emails to participants, and upkeep of the web site. We have been looking at initiatives that have been successful, and how to make them better, initiatives that might be successful with some revamping, initiatives that should not be repeated, and of course many new initiatives.

In year three, we again have our PALS Program, however, it has been renamed *WIE Connect*. We have eighteen pairs, but this year only first year students are matched with returning students. As this paper is being written, and Fall 2010 admitted women are identified, Email Buddies is getting under way as well. Each year, admitted women students have received a congratulations letter from the WIE Coordinator. This year, we have added a new component; we are also sending a letter to each student's family. From the WECE study, we learned that families have the greatest influence on what a woman student will study and where she will attend college, so we want to make connections with our future students' families.

We also started a new program called *WIE Preview*. This program happens the night before our Preview Day (our fall College Open House). Prospective women students are invited to come to campus the evening before and are matched with a current woman engineering student. They "experience" campus life and stay over night with their host, and then attend Preview Day the next day. For our first attempt, we had a small turnout. We had twelve college students and five high school students who attended the event. Although we did not do a formal survey, we did receive thank you notes from all of our prospective students, and all five have applied to xxxx to study engineering.

One of the greatest and most important accomplishments of the third year was the completion of our WIE web site. Having a web site makes it much easier to deliver information to women engineering students, corporate supporters, alumni, families, and prospective students. The web site will continually be evaluated and updated as necessary.

Throughout the development and implementation of the WIE Program, the connection to our two student organizations, SWE and Women in Computing has grown even stronger. Both organizations have taken on new projects and initiatives with the assistance of WIE. WIE has been able to support both groups financially with special programs, and both groups have started new initiatives to support WIE's mission and goals. For example, SWE sends a post card to all admitted women students which works hand in hand with the letters sent by WIE and the Email Buddy program. The numbers of women in the computing majors are small at xxxx, so all the women are invested in their student group and make sure that any prospective women who are interested in computing majors are connected with a current women student either through our Email Buddy Program or the WIE Preview Event. The direct connection between our three groups makes the Women in Engineering Program much stronger!

Assessment is an important part of our WIE Program. We have much anecdotal evidence, but it is also important to do surveys and track participants to see how well our Program is working. We need to expand this effort, doing more frequent surveys to understand our students' (likely changing) needs. We also need to institute a better tracking program to see how our students move through the entire process from prospective students who come to a SWE Girl Scout Day to women who graduate with an engineering degree.

The Future of the Program

There are also several initiatives on the horizon. WIE Programs must always be fluid, using what works, discarding what doesn't, and continually attempting to track the rapidly changing components of young adult culture.

Recruitment. In the area of recruitment, we hope to start an on-line newsletter for prospective students (although others can sign up if they wish) which will come out once or twice a semester with information on Michigan State engineering and upcoming events. We are considering localized welcome receptions, going to different areas in-state and out of state where we host receptions for admitted students. We feel it is important to reach out to people where they live. The Women in Engineering summer camp curriculum will be revamped and will focus more on topics rather than majors. We believe participants will respond more positively to this approach, and more might see engineering as a viable career option. We also want to implement a spring semester program for high school women called *Engineering is Great at Michigan State* which will allow them to come to campus for a day and learn about engineering (again through topic areas) from current students, faculty and professional engineers. Role models are very important!

Retention. In the area of retention, we have several ideas in development. MSU has many initiatives for first-year engineering students which help them to stay engaged and learn about engineering early in their academic career. However, there is very little for second year students, and this year is critical to our students' success. So we are considering a class targeted to sophomore women engineering students. This course will cover resources and skills necessary for academic and professional success and keep them moving forward at a time when many of them might be contemplating leaving engineering. We also want to start an on-line newsletter for our current women engineering students that would come out once a month with news and information to help them succeed and get the most out of their time at Michigan State. Finally, we are looking at ways we can help our transfer students. Although they are a small group, we believe they get lost in the shuffle and would benefit from targeted initiatives.

Alumni Relations. The last area under development is an expanded use of our alumni base. Since our WIE Coordinator has been the SWE advisor for over twenty years, many of our alumni have an established relationship with her. We need to tap into this population in both our recruitment and retention efforts and our fund raising efforts.

Summary and Conclusions

The Women in Engineering Program at MSU had been an idea on the horizon for many years. It is now growing steadily and will continue to develop over time. This paper and presentation are about our process, but may not be the way other institutions have or will come to have an official program. We are not saying that a Women in Engineering Program or Women in Engineering and Science Program is even appropriate for every engineering program. We feel it is important to have support from the top down--if you do not have this support, you will not be successful. We also feel it is important, if possible, to let your Coordinator/Director work on the Program at least three-quarter time, but if possible full time. It is important to have a concrete mission and goals in mind that connect with your College and University mission and goals, and then to plan all initiatives to meet your mission and goals. Dream big with a whole list of possible initiatives, but start slowly and keep adding new initiatives each year. Don't overwhelm yourself, and get rid of the ones that don't work! Ask the participants; they will tell you. Assessment is crucial. Don't forget to include all interested parties in your planning and use your resources, both on your campus and fellow colleagues around the country. Best practices can be found in so many places, and they are great resources as you start to plan!

Acknowledgements

Our Program would not have happened if it were not for the Best Practices and ideas gathered from several sources which we would like to acknowledge:

- The Women in Engineering Program and staff at Purdue University⁶
- The Program for Women in Science and Engineering and staff at Iowa State University⁷
- The Women in Engineering Program and staff at Ohio State University⁸
- The Women in Engineering Program and staff at The University of Texas at Austin⁹
- Society of Women Engineers (SWE)¹⁰
- Women in Engineering ProActive Network (WEPAN)¹¹

In addition, Ms. Lynda White, Director of Marketing at the MSU College of Engineering had significant responsibilities in developing our surveys, and Ms. Wendy Booth, information and statistical analyst at the college, has developed much of the enrollment trend data.

References

1. Engineering Workforce Commission (annually), *Engineering and Technology Enrollments*, EWC of the American Association of Engineering Societies, Elkridge, MD.
2. Goodman Research Group, Inc. (2002), *Final Report of The Women's Experiences in College Engineering (WECE) Project*, Cambridge, MA
3. Communication with personnel from Iowa State University, The Program for Women in Science and Engineering.
4. Communication with personnel from The University of Texas at Austin, The Women in Engineering Program.
5. College of Engineering, Research on Women studying in MSU College of Engineering, May 2007
6. College of Engineering Women in Engineering Program, Mission and Goals Statement, 2007.
7. Communication with personnel from Purdue University, Women in Engineering Program.
8. Communication with personnel from Iowa State University, The Program for Women in Science and Engineering.
9. Communication with personnel from The Ohio State University, The Women in Engineering Program.
10. Communication with personnel from The University of Texas at Austin, The Women in Engineering Program.
11. Communication with personnel from The Society of Women Engineers (SWE).

12. Communication with personnel from The Women in Engineering ProActive Network (WEPAN).