

Globally Diversifying the Workforce in Science and Engineering

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Abstract: To remain competitive in this global and technological world, academic institutions and corporations worldwide need to take serious steps to create a diverse, well-trained and multicultural workforce. To this end, the *Global Alliance in Science and Engineering for Diversifying the Workforce* was created to offer an opportunity to share best practices in education, industry, government and professional associations from different countries and provide technical assistance to groups looking for successful models. It also offers an opportunity for industry to continue influencing academic institutions to produce a diverse group of graduates. Further, it will create opportunities for new ways of thinking and new perspectives about science and engineering professions by the voices of people not traditionally targeted for science and engineering careers.

Key Words: Science, Engineering, Diversity, Diverse Groups, Best Practices, Collaboration, International, International Collaborations, Government, Business, Academic Institutions, Professional Associations

Introduction

Faced with a decrease of general interest in engineering careers and an increase in demand for engineers and scientists worldwide, companies and academic institutions from many countries are looking beyond the traditional pool of talent (largely men) and targeting the other half of the population – women. Several countries have mobilized their efforts to establish initiatives to increase the participation of women in science and engineering careers. Although some progress has been made, it is slow. In addition, few efforts have been made to exchange successful practices and strategies used in both the academic institutions and corporations among countries.

If we are going to continue to make progress in creating a more diverse workforce and recruiting the best and the brightest from diverse groups, we need to move beyond traditional approaches. To do this, we need to build upon the successes that recruitment and retention programs have brought us in the last couple of decades. At the same time, we need to identify incentives for academic institutions and corporations to effect change, and to create new ways of thinking about science and engineering (S&E) professions in

terms of the value added by the talents and skills of people from underrepresented groups.

1. Participation Rates In S&E, Demographic Shifts And Workforce Demand

Traditionally women have been underrepresented in engineering careers worldwide. In 1997 women were only 9% of all working engineers in the US. Despite this low figure, much progress has been made due to a national movement funded by the federal government, corporations and private foundations. Organizations such as WEPAN (Women in Engineering Programs & Advocates Network), AAAS (American Association for the Advancement of Science), and AWIS (Association of Women in Science) have been funded to develop and implement recruitment and retention programs for increasing the participation of women in science and engineering professions in the US. The results of these organizations' efforts have born fruit. According to a study conducted by the Engineering Workforce Commission (1995) of the American Association of Engineering Societies (AAES), the year of WEPAN's inception marked the start of an upward trend of women in engineering. Since that time, there has been a one-half percent increase annually. By contrast, in the eight years prior to the creation of WEPAN, the number of women in engineering stagnated and some decline was evident.

The US enrollment of women students in engineering curricula grew from less than 2% of engineering enrollments in the 1960s to more than 20% in 1997 (Engineering Manpower Commission, 1998). Similarly, baccalaureate engineering degrees conferred on women grew from less than 1% to more than 16% in the same time period (Engineering Manpower Commission, 1998). In 1997, women received 18.7% of the bachelor's degrees, 19% of the master's degrees and 12.2% of the doctorate degrees in engineering (Engineering Workforce Commission, 1998). There are also several areas of the related sciences where women are underrepresented. For example, in 1995 (most current figures available) women received 17.6% of the physics bachelor's degrees, 16% of the physics master's degrees and 13% of the physics doctorate degrees (Science Indicators, 1998).

At the same time it appears female participation in engineering is increasing, the total enrollment in engineering has been declining steadily at about 9% a year since the mid-1980's with a peak of 73,000 students in the mid-1980's to fewer than 60,000 in recent years. More significantly, the proportion of bachelor's degrees that go to engineering majors declined among all American students. In the mid-1980's more than eight percent of the total BS degrees in the US were in engineering. Currently, engineers make up just over five percent of the graduates (Campbell, 1997).

As overall enrollments and degrees granted are decreasing in the US as well as abroad, the demand for engineers and computer scientists is growing. During the past four years, actual engineering employment increased from 1,717,000 to 2,051,000, a growth of almost twenty percent (Campbell, 1997, pg. 7). Coupled with decreasing enrollments, demographic trends indicate that by the year 2000 sixty-eight percent of the new entrants into the US (Changing America, 1989) labor force will be women and minorities. For the US to remain competitive in a global technological society, it must take serious steps to create a diverse, well-trained and multicultural labor force.

Other countries are facing the same issues. Most European countries have fewer females in the engineering workforce than the US; for example, Denmark (6.4% female engineers), Ireland (2% female engineers), and France (5% female engineers). However, it is very difficult to gather these figures because most countries do not collect or maintain this data by gender (Williams, 1998). A recent report (Come & Grosjean, 1996) published by the European Society of Engineering Educators (SEFI) assesses the low representation of female engineers in all European countries, as well as the decreasing interest in engineering careers in general, and makes a plea for a national mobilization of effort to change this trend.

The most active organization that is fostering the participation of women scientists and engineers in the international arena is the United Nations (UN) Commission on Science and Technology for Development (UNCSTD) Gender Advisory Board. This Board, supported by United Nations Development Fund for Women (UNIFEM), was established in 1994 to advise the UN organizations on gender, science, and technology issues including developing programs to encourage and support the participation of school-age girls in S&E and the recruitment of women in S&E into high level UN positions.

A 1997 survey indicated that at least 24 UN organizations are involved in gender, science and

technology activities. Among them are included: the Food and Agricultural Organization; International Atomic Agency; UN Conference on Trade and Development; Economic and Social Commission for Western Asia; UN Education, Scientific and Cultural Organization (UNESCO); United Nations Industrial Development Organization; World Bank; and the World Intellectual Property Organization.

Although individual countries have taken initiative to increase the participation of women in the engineering professions, there has not been a cohesive effort to share these strategies or offer technical assistance and training to other countries. Most notably, Great Britain, Denmark, Ireland, The Netherlands, Australia and Sweden demonstrated success with initiatives to increase the participation of women in the engineering professions in their own countries. There are examples of best practices and strategies worldwide that have been successful in diversifying the workforce; however, only a few efforts have been made to share these practices worldwide.

2. The Business Case For Diversifying The Workforce

Most companies have concluded that the key levers to productivity in the future are effective management of technology, organizational competence and intellectual capital. Kathy Sendall, Vice President of Engineering and Technology at Petro-Canada, contends that the attributes and skill sets for this era will come from a new cohort of engineers and leaders with markedly different skills and experience from those of the past. She says, "We need to look beyond our traditional pool of talent (largely men) in order to capture these new perspectives and build a stronger, more diverse, but nonetheless, synergistic workforce. As business and industry, we can no longer by-pass the talent available to us in 50% of our population" (Sendall, 1999).

Edgar S. Woolard, Jr. (Babco, 1995), past CEO of DuPont, believes that diversity is good for business, citing three major reasons:

1. "Fierce global competition - people of various cultures and nationalities are customers, competitors, employees and other stakeholders.
2. Enriched business decisions, new markets - teams with a mixture of gender, racial and ethnic backgrounds produce multidimensional and innovative decisions.
3. Recruiting advantage and talent - competition for the most qualified employees, including women and minorities,

is stiff. Diversity is an effective recruiting tool since the comfortable and supportive environment that can be developed attracts and retains talented people."

Gene Tucker (Babco, 1995, Pg. 16), Director of Equal Employment Opportunity and Workforce Diversity in Schering-Plough's Pharmaceutical Division, said, "In order to ensure that we are competitive with anyone in the global marketplace, we have to be sure that we're getting the best help we can. If you exclude any particular group, by gender, race, or religion, you would be excluding the person who's going to discover the next blockbuster product or someone who can contribute in another meaningful way in marketing, engineering, or elsewhere."

Yet, a recent Harris Poll shows that engineering remains a "stealth profession" among women and minorities (Harris Poll Shows, 1998). According to AAES Chair Martha Sloan, "As our nation's workforce continues to transition from one which is predominately male and Caucasian to one which will be majority female and African-American, Asian, and Hispanic, the price we pay in our society for engineers having worked in such obscurity may not be known for another generation." She also noted that "although women comprise 53.7% of the undergraduate student population, only 19.4% of the students enrolled in undergraduate engineering programs are female." Joseph Bordogna, Deputy Director of the National Science Foundation, responded, "Greater diversification of the engineering workforce and increased technological literacy must be achieved if our nation is to maintain its global leadership in engineering."

3. The Global Alliance For Diversifying The Science And Engineering Workforce

The Global Alliance for Diversifying the Science and Engineering Workforce is an association of organizations in partnership to diversify the global science and engineering workforce. Its purpose is to create a viable structure for collaboration among industry, higher education, government and professional associations worldwide. More than 30 countries, including members of the European Union, Africa, China, Australia, and Canada have indicated an interest in becoming partners. In recognition of the need to diversify the workforce globally, the AT&T Foundation and the Dow Chemical Company have contributed to the first phases of the Global Alliance development.

The Global Alliance is particularly committed to increasing the participation of women worldwide and considers other areas of diversity, such as social groups, ethnicity, age, discipline,

languages, and cultures. Membership is based on organizational units or entities and dedication to diversifying the workforce. The goals of the Global Alliance are to:

- Establish worldwide collaborations with higher-education institutions, corporations and governments for the purposes of diversifying the workforce globally.
- Facilitate the development of long-term, sustainable infrastructures in science and engineering with a diversified workforce globally.

A series of working sessions have been held internationally to explore the feasibility of establishing a Global Alliance for Diversifying the Workforce in Science and Engineering. These are summarized below.

- A Working Session was held in April 1998 to begin to strategically address the global need for broader participation of women in the science and engineering professions. The specific objectives for this first meeting were to: identify appropriate programs and activities that meet the needs of individual countries; identify creative strategies for effecting systemic change; identify collaborative organizations; identify other countries to invite; and identify specific types of collaborative projects. The participants of the WEPAN/AAAS/AWIS Working Session concluded that there was a critical need to learn more about successful recruitment and retention strategies. The primary outcome of this meeting was a call to establish a global alliance of organizations, identify best practices in industry and education from different countries, and develop a plan to sustain the Global Alliance.
- An Inaugural Planning Conference for Diversifying the Workforce in S&E was held in January 1999 in conjunction with the 1999 Annual AAAS Meeting in Anaheim, California. The purpose of this meeting was to more formally shape the direction and the future activities of the Global Alliance and to explore different organizational structures. Professionals representing private foundations, educational institutions, professional associations, industry and government worldwide were invited.
- The Rector of the Danish Technical University in Denmark hosted a two-day Global Alliance working session in February 1999 with representatives from industry, education and professional associations. With eight countries represented, the focus was on further clarification of the meaning of diversity; an in-depth discussion of the potential services of the Global Alliance; a proposal for the Alliance to have a

presence at conferences already scheduled; and a discussion about the organizational structure of the Alliance. The outcomes of the meeting included specific action steps for each organization to further explore the possibilities of participation and the scheduling of another meeting in Denmark at the end of September 1999.

- A presentation on the Global Alliance was made in Aachen, Germany also in February 1999 at the Aachen Technical University where presidents, deans and chairs of departments in engineering were present. A very enthusiastic audience expressed its interest in the Alliance and in increasing the participation of women students and faculty. The University is particularly interested in technical assistance and training. The Global Alliance is a collaborative subsidiary of AAAS, the American Association for the Advancement of Science. Both WEPAN – Women in Engineering Programs & Advocates Network – and AWIS, Association for Women in Science are partners. In its initial development stages, the Secretariat is located at two sites: the University of Washington in Seattle, Washington and the AAAS offices in Washington, DC. In the future, the Secretariat will have several international and regional offices. In addition, it will have a virtual location with a virtual address and global linkages with higher education, corporations and government worldwide.

A. Targeted Membership and Strategies

The target members of the Global Alliance will include: corporations, colleges and universities, governments worldwide and professional associations. The specific strategies that will be used to promote and to maintain the Global Alliance will include but not be limited to:

- Maintaining networks of academic institutions, corporations and governments worldwide that are working toward diversifying the workforce.
- Identifying and sharing best practices for diversifying the workforce in educational institutions, corporations and government.
- Brokering relationships with US and international organizations in higher education, corporations and government, and connecting regional and international groups that share these interests.
- Conducting research, e.g., identification of country-specific barriers to balancing the workforce.
- Developing common formats, standards and criteria for data collection.

- Dissemination of research, best practices, and model programs for diversifying the workforce.
- Holding two preconference meetings or working sessions in conjunction with the American Association for the Advancement of Science (AAAS) and Women in Engineering Programs & Advocates Network (WEPAN).
- Conducting pre- or post-conference forums and working sessions worldwide in conjunction with international organizations.
- Developing training materials and curriculum for recruitment and retention strategies.
- Facilitating exchange programs and opportunities for short-term mentoring.
- Conduct training and technical assistance in establishing mentoring programs and providing training for mentors and mentees.
- Conversion and licensing of curriculum and training materials for country or region-specific use.
- Offering training seminars on strategies for diversifying the workforce.
- Providing a cadre of experts, who are acknowledged leaders in diversifying the workforce; who have familiarity with different cultures, who conduct organization specific needs assessments, and offer other customized services and technical assistance.

B. Membership Services

The services offered to members of the Global Alliance will include:

- Access to the Global Alliance website
- Inclusion on the Global Alliance listserv
- Directory of Global Alliance membership institutions
- Links to international women's groups and other related organizations
- Current statistical data and analyses
- Conferences, often held in conjunction with member organization's annual conferences, including AAAS and WEPAN annual conference.
- Small forums held worldwide on topical issues
- Discounts on Global Alliance products and services
- Access to best practices in education, corporations, and government
- Biannual Publication Series

The Global Alliance website will be available to the membership. Part of the site will be free and a portion will only be accessible with a password and will include a fee. The website will be

licensed and provide advertising as a source of revenue. It will include:

About Global Alliance activities: This would include an overall description of the Global Alliance, its mission, goals, annual objectives, strategic plan, Advisory Board members, accomplishments and planned activities.

Global Alliance Members: This would include abbreviated profiles of partnering organizations. A brief description of their goals and objectives and then a direct link to their websites would be available. It will be designed to be accessible by country, region, and state; by sector; and by type of programs, activities and affiliations offered.

Professional engineering & science associations

Media

Industry

Governmental agencies

Non-Governmental Organizations (NGO's)

Educational institutions

Community groups

Engineering accreditation agencies and boards

Women and minorities in science and engineering organizations

APEC

Intergovernmental Agencies

Best Practices in Diversifying the Workforce: This separate menu would include the *Best Practices* identified through research and evaluation. It would be designed to be easily accessible by country, region, sector, type of program, and other variables.

Events Calendar of Partnering Institutions: This would focus on worldwide events, conferences and activities that are going on to diversify the workforce in different countries. It would provide a calendar of events, brief summary of the event, a link to a website if available and information on targeted audience.

Global Alliance Events Calendar: This menu pull down will be accessible by different events that are happening or will happen and will focus on the objectives of the event, the participants, the outcomes, and the next steps.

Academic and Workforce Statistics and Trends: This menu would include statistics on enrollment, degrees granted and participation in the workforce by country and region. Gathering this information will require significant research, since most countries other than the US and Canada do not have regular and reliable reporting of their statistics by gender.

Chat Room for Current Global Issues: This capability would be designed to post current topics of events, and announce a time (globally) that a

discussion will occur. Specific topics would be chosen by the participating institutions, initiated in most cases by specific partnering institutions, and facilitated by one institution that agrees to summarize the conversation and topics for those who were not able to participate.

Links to Related International Sites and

Bibliography of Research: This would include annotated descriptions of different programs and sites that may not be part of the partnerships for one reason or another but are related. It would also include links to information regarding international research that is relevant to the issue of diversifying the workforce, with attention to issues of women in science & engineering. It will also include a comprehensive bibliography of research.

Newsclips and Feature Articles: This section will include current activities worldwide that have been in the news. It will also include feature articles of interest.

C. Developing Advisory Board

The Developing Advisory Board is composed of executive level and highly visible individuals representing higher education, industry and government. Its primary functions are to provide guidance in strategic planning and sustainability and making connections to potential new partner organizations. Its current members are: Dr. William Wulf, President, National Academy of Engineering; Dr. Shirley Malcom, Head, Human Resources & Education Directorate, AAAS, and Dr. Hans Peter Jensen, President, Danish Technical University. Several other invitations to corporate and higher education executives worldwide are now being issued.

D. Source of Funds and Sustainability

In the beginning stages of the Global Alliance, seed funding in the form of grants from federal, private and corporate sources worldwide will be sought. After the Alliance has passed its initial start up phase, it will continue to seek funding for special projects, but it will also use other strategies, such as fees for services, fees for products, licensing agreements for curriculum and software and membership fees.

4. SUMMARY

If we are going to continue to make progress in creating a more diverse and global workforce and continue to recruit the best and the brightest of these diverse groups, we need to begin to move beyond

traditional approaches, and to begin to think about a new paradigm which offers the opportunity to make true systemic change worldwide. To do this, we need to build upon the successes that recruitment and retention programs have brought us in the last couple of decades; and, through collaboration and cooperation, create a diverse workforce that will add value and strength to this global technological economy.

The Global Alliance in Science and Engineering for Diversifying the Workforce offers an opportunity to share best practices in education, industry and professional associations from different countries and provide technical assistance to groups looking for successful models. It also offers an opportunity for industry to continue its influence on academic institutions to produce a diverse group of graduates. Further, it will create opportunities for new ways of thinking and new perspectives about science and engineering professions by the voices of people not traditionally targeted for science and engineering careers.

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BIOGRAPHY

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