Megan Ida O'Connor, Milwaukee School of Engineering

Megan O'Connor is currently a Biomedical Engineering student at the Milwaukee School of Engineering. She looks forward to earning her BS degree in biomedical engineering in May of 2011 with a minor in technical communication. As a student, Megan is a member of Alpha Eta Mu Beta (AEMB), BMES, and SWE. In the fall of 2008, O'Connor assisted in the creation of a campus organization called Healthcare Without Borders (HWB), and has since participated as secretary, vp/engineering crew manager, and president. She intends on continuing her education in graduate school with a bioengineering focus on artificial organs.

Dr. Linda Young, MSOE School of Nursing

Faculty Advisor for Health Care Workers Without Borders since its inception. Nursing Professor at MSOE School of Nursing. PhD from University of Wisconsin - Madison in nursing and family.

John D. Gassert, Milwaukee School of Engineering

JOHN D. GASSERT, Ph.D., P.E. John D. Gassert is currently a Professor of Biomedical Engineering at the Milwaukee School of Engineering (MSOE) and an Adjunct Professor of Biophysics at the Medical College of Wisconsin. Gassert is a Registered Professional Engineer in the State of Wisconsin. He is currently the Chair of the Accreditation Activities Committee for BMES. He earned his Ph.D. in Biomedical Engineering from Marquette University in 1995. He earned his MS degree and BE degree in Electrical Engineering in 1974 and 1971 respectively, both from Marquette University. Gassert is an AIMBE Fellow, a Senior Member of the IEEE, and a member in BMES and Sigma Xi. He is an ABET EAC program evaluator for Biomedical Engineering. He has developed and taught courses at both the graduate and undergraduate level in Biomedical Engineering, Medical Informatics, Perfusion, Electrical Engineering, Computer Engineering, and Electrical Engineering Technology. Prior to arriving at MSOE, Gassert spent seventeen years in industry in positions as a design engineer, a clinical engineer and a consultant. As part of his 17 years in industry, he owned his own engineering design and consulting company for eight years. He continues to operate his consulting and design business on a part-time basis.
A World of Education: Healthcare Without Borders

Healthcare Without Borders (HWB) is a service organization visualized and mobilized by students of Milwaukee School of Engineering (MSOE) aiming to help underserved and underdeveloped areas of the world by providing health care related equipment and expertise. Moreover, the club was introduced to offer members the opportunity to travel to developing countries and share their abilities by building healthier communities on a global scale. As a team, members have created an environment where students can put their skills to use and challenge themselves to try new things, experience different cultures, and develop a new world view. With the experiences provided by HWB, students have the opportunity to explore even further than “beyond the classroom” and discover ways they can contribute to global welfare by applying their education to real world needs. HWB promotes goodwill and understanding between all areas of the world, and provides an equal opportunity to all those interested in making a difference in worldwide health care.

In 2008, a small gathering of four freshmen and sophomore biomedical engineers teamed together to start a new organization combining the service principles of Engineers Without
Borders (EWB) and the aptitude of healthcare majors. Under the new title of Healthcare Without Borders, they underwent many challenges searching for student representatives, university support, and funding opportunities. Faculty initiative was taken by biomedical engineering professor Dr. John Gassert and nursing professor Dr. Linda Young who together provided the first support and networking opportunities that allowed HWB to complete initial travel opportunities and project foundations. In February of 2009, students traveled to El Salvador to complete their first hospital and clinic assessment. Based upon the information gathered, the engineering crew returned in November of 2009 to remodel a clinic in preparation for a nursing student-led health service trip which took place February 2011. Since the organization’s birth, the scope has expanded to include Nicaragua, Guatemala, and even right at home in Milwaukee. Students are finding that there are abundant opportunities all around the world and at home where they can create a better world both for themselves and others.

Figure 1 and 2: Students working on the clinic remodeling in the El Salvador trip of 2009.

In comparison to similar programs, the grand uniqueness of HWB lies in the facts that it is not research based; it is built strictly on the motivation and leadership of the students; and it is a conglomerate of interdisciplinary participation. Some universities have classroom credit dedication, open research facilities, and thus research based project design. Due to a lack of such resources, HWB was created as an organization based outside of the classroom, and functions as a student life club. As such, the projects are planned and organized from the States, but overall it is more of a hands-on, travel based commitment. This design was not created by chance, for the students’ intentions were predicated on the strengths of similar developed programs; however, the design was tailored to meet the specific needs of the student body. Moreover, HWB is distinctive in the collection of undergraduate majors involved. True, the founding members were biomedical engineers, but their aim was to create a service solution that uses contributions from any discipline with an interest in healthcare. From a school with only engineering, nursing, and business majors, the initial concern was to form a bond between nursing and biomedical engineering students. This seemed a natural solution based on the common medical ground between the majors, but participation has since expanded to incorporate other engineering majors within the university.

It is difficult to quantify the group’s membership, because the number is quite fluid based on the group’s multifaceted activities and the hectic schedule of the MSOE student. However, within three years the group has expanded from four dedicated founders to about 25 active members. Moreover, within that same time period there have been over 50 student participants in HWB events. In truth, the most dedicated participation seems to arise from the students who have
Besides being a service opportunity, HWB was created with the goal of enhancing the students' knowledge and handling a wide range of infirmities. With this task, each student will augment the nursing students' service engineering but it is by no means limited to these students. A hospital assessment project consisting of an equipment inspection and working to repair broken apparatuses. This may be a parallel to the profession of a clinical engineer, albeit on a different plane of technology and imaging modality. On the whole, this HWB education is applicable to all realms of biomedical troubleshooting problems, and how human factors contribute to the success of a product in action.

Figure 3: Professor and students working together to build a defibrillator testing module.

With the help of the nursing students, who have become very familiar with the hospital environment and the physical details of their field of study, this objective is easily obtained with the nursing students' active participation in other missions. In total, 19 students traveled to foreign countries with the group or on other missions. In total, 19 students traveled under the title HWB, and these students are more likely to attend every HWB event. I was inspired by my travels abroad. I have come to learn that 'Third World' issues and diseases do not exist just overseas, but occur and affect people here in the US as well. There is so much we can accomplish and learn at home too, and HWB makes a stand to get students involved while still remaining a fun social group on top, states junior nursing student Kristine Radtke Norris.

As the group developed, members concluded that travel could not be the singular motivation factor of involvement and wide selections of home-based volunteer work, as well as, many opportunities to get involved on campus were uncovered. Within the community HWB students volunteered at several auctions to raise money with Hope for Haiti and Milwaukee’s women’s shelter. In 2009, students built defibrillator testing kits with a local company to be sent to Africa and Central America. Moreover, the engineering students repaired blood pressure cuffs for a Milwaukee homeless shelter in addition to the MSOE nursing lab. To inspire students, there have been numerous distinguished guest speakers talking about their medical service experiences in Africa, Israel, El Salvador, and China. Then, in order to share what was learned as an organization, two members presented at the 2010 Midwest Service Leaders Conference.
This leads into what may be seen as one of the limitations of the university education in biomedical engineering. Universities today have attained top of the line environments for “real world” engineering application laboratory and design processes. However, students find that despite having a solid education of applying theory to engineering ingenuity, there is little exposure to existing equipment. Sure, classes build a strong backbone of basic and complex principles on which we create designs from the ground up, but there is also value in seeing what is already out on the market and how current products fair with the human interaction. Armed with this knowledge and searching for a source of information on hospital assessments, the HWB team approached clinical engineering guru, Dr. Larry Fennigkoh. Under his guidance, a new elective course for the biomedical engineering curriculum was initiated, focusing on the benefits and limitations of hospital equipment including: physiological parameter monitoring systems, defibrillators, and electrosurgical units. A general outline for the course was brainstormed by students and moderated by Dr. Fennigkoh to develop an appropriate overview of what the students desired to become further acquainted with and what was physically available at MSOE. During the class student learned how a hospital functions, how to use equipment, and how human factors plays a role in product success or failure. In the end, it was determined that students do indeed take a great interest in exploring the equipment characterized by their major based on the high number of participants in the class. As it was the first time running, the course did not account for any graduation requirements; yet, 16 students added it onto already busy schedules just to learn more about where their career could take them. To appreciate this number further, remember that the senior biomedical engineer class at MSOE only includes 26 students. Moreover, reviews showed positive feedback from students who were glad to explore the role of hospitals on medical products already in use. Senior biomedical engineering student, AnnMarie Axarlis reflected on the course, “Even Dr. Fennigkoh’s lecture on electrical safety really brought together years of studying electrical circuits by placing it in the environment that can make the difference between life and death. It was inspiring to see how the electrical theory we learn about is applied in different medical settings.” Undoubtedly, the goal of any educational system is to expand the minds of students so that they are capable of developing critical design and analysis for their field of study. HWB has contributed to that goal by discovering what the students themselves would like to see included in their education and making that information accessible. More than anything, HWB is a student based community of dynamic learning, and perhaps the most intriguing lesson has been that the motivation for such groups must be fluid rather than a checklist of purposes. In that, we have discovered that the greatest difficulties of such an organization do not lie in the hard work and physical labor, the engineering design, or building motivation in an already busy populous of students. Although it was not one of the initial goals, communication has developed into one of the most important aspects of the edification HWB gives to students. What at first seemed like a confounding variable to the experiment, turned out to be a main educational constituent. Now, HWB has two main platforms of communication barriers: the first is located between North America and Central America, and the second is between nursing students and engineering students. Of course, the difficulty in communication between countries seems rather obvious considering the language barriers, the culture barriers, the education barriers, and the distance itself. HWB was prepared with fluent Spanish speakers, and still there was a lot of information lost between lingo differences in Central American countries. Yet, even if we were to natively speak the same language, cultural aspects play a large role in the understanding of both parties. What any North
American may see as a vital need, may not pose as a reasonable contender to the mind of someone with a different background. Thus, students have discovered the importance for both parties to build a solid foundation of initial goals that may be branched off of as the project is conducted. In truth, this takes a lot of time that American like to label as wasted, but it is a vital need within this type of work. There can be no doubt that if the people do not invest the same amount of interest in the project as the providers then the project will fail.

Perhaps even more frustrating is the simple task of communicating between departments in our own university. This may seem trivial, for HWB members are generally very outgoing and good speakers, but until we were able to process the different communication styles, working together was difficult. Within the departments, tasks get done efficiently as these students communicate and process in a similar manner. As it would turn out, though, students in the nursing and engineering departments have been taught to process and accomplish responsibilities in contradictory styles. By no means does this indicate towards a superior method of understanding, but temporary struggles do rise out of the polarity between the linear consideration of the engineering mind and the wide eyed picture of the nursing mentality. In truth, part of the difference stems from the contrast in motivating factors between the groups. The engineers find easy participation and motivation but have more problems finding significant projects for all the students; whereas, the nursing students have abundant project opportunities but are seemingly missing copious student contribution. By being aware and respectful of these communicative differences, HWB has been able to move forward to accomplish goals as efficiently as possible while demonstrating the importance of diverse communication in the workplace.

In the end, it is most vital to an engineering education that the students develop the ability to communicate with both right and left brained customers. Engineers look to solve problems and are fully capable of developing solutions, but to make the endeavor worthwhile, one must first build up a thorough comprehension of the problem. Clearly, to accomplish this, the ability and patience to communicate both with people of different backgrounds and people with different thought processing patterns is of vital importance. HWB is truly a beneficial component to this aspect of education by providing both the exposure to such situations and the motivation to work through the difficulty in order to accomplish the final goal.

It cannot be doubted that starting a group such as this has its challenges, but it is entirely possible with a few enthusiastic students. Finding contacts to work with seems a daunting task, and that has not disappeared in HWB’s three year of existence. Yet, the best advice remains constant: take opportunities, show passion, and talk to everyone! HWB made its primary contacts in El Salvador through a local church and over time students found that the more enthusiasm they show and the more they talk about their organization, contacts start to pop up in the most unexpected places. There are so many people willing to get involved, but they will not know how until you start to communicate with them. Truly, HWB has learned that with an open mind and a strong will to try new things, an organization can accomplish more than even the founders could have considered.

There are several hopes for the future of HWB. Namely, that it will give students a new perspective on service projects and student leadership. HWB can teach both students and professionals that the world is a balanced place. To a shallow eye, it may seem like we have everything to give with a university education, access to top of the line hospitals, and an abundance of donations. But in reality, the HWB trips are based on a relationship between
equals. We travel to contribute what we can to the cause of our partners in exchange for stories, a glimpse into another culture, and a life changing experience. The worst possible mission is one that forces a project on an uninterested people. In such a case, the project will tumble as soon as the donators leave, because the people have not invested themselves in the idea and hold no self identification with its maintenance. HWB works to preserve the best communication possible to ensure that we are working with the people and not simply for them.

Math, science and critical thinking are all clearly vital aspects in the development of an “engineering” mind, but it takes much more to become a true erudite professional. One of the most important aspects in the learning experiences of HWB is that it brings students out of the realm of factual, impersonal engineering, and into the most crucial human experiences. No matter what aspect of engineering a student decides to follow in his/her education, communication and a clear understanding of the people within the scope of a project are infinitely more important than even the most creative engineering endeavors themselves. In the end, a project with no applicable audience is unprofitable and goes unused. All in all, HWB provides a unique opportunity for students to build skills, relationships, and connections in a manner that enhances an education indefinitely.

**Figure 4:** New found friends of Healthcare Without Borders and Cara Sucia, El Salvador.