

**Workshop on Globalizing Engineering Education:
Lessons Learned from African and USA Partnerships
Cape Town, South Africa
October 17-18, 2008**

Funded by the National Science Foundation
Organized by Ann Christy and Andy Ward, The Ohio State University

Project Description

Overview and Goals

The Workshop on Globalizing Engineering Education: Lessons Learned from African and USA Partnerships is proposed to be held October 17-18, 2008, in conjunction with the American Society for Engineering Education 7th Annual Global Colloquium on Engineering Education in Cape Town, South Africa, October 20-23 and the IFEEES Global Engineering Education Summit on October 19-20. The primary goals of the workshop are to: (1) identify effective learning models that incorporate a global dimension in engineering education; and (2) to identify what the infrastructure and resource requirements are to have a sustainable global dimension in engineering education.

This invitational workshop would bring together about 10 engineering faculty from around the U.S. to be joined by 8-10 African partners and 3-5 students (specifically, U.S. undergraduate and graduate students who have been involved in international engineering educational activities). The proposed approach in the workshop is to use the featured U.S. - African partnerships as models for evaluating how to globalize engineering education. Proposed workshop sessions are:

1. Global engineering educational models and case studies.
2. Why globalize engineering education – What are the benefits?
3. What are the benefits for our African partners?
4. The pros and cons of experiential, service, classroom, and distance learning.
5. Curriculum sustainability, infrastructure requirements, length of time involvement, and pitfalls.
6. Documenting the lessons learned.
7. Outcome assessment and evaluating the impact.
8. Collaboration and future directions.

Agenda

DAY ONE

Session 1 (0830-1000): Global engineering educational models

Greetings, introductions, and brief (5-10 minute) formal presentations by participating partnerships of their own models and case studies for doing global engineering education. Information presented in this session will then serve as common points of reference for the topics that are addressed in Sessions 2, 3, and 4. It is anticipated that at least 30 minutes will be available for participants to ask questions

[30-minute refreshment break]

Session 2 (1030-1200): Why globalize engineering education – What are the benefits?

Introductory set-up by the workshop coordinator and/or a short presentation by one of the other participants - including overview of models from Session 1. This will be followed by a 30-minute break out session for pre-selected groups of 5-6 persons to brainstorm and discuss the question. Each group will designated co-facilitators (that role will rotate among participants throughout the workshop) who will take notes, monitor time, and keep conversation flowing. The small groups will then return for a shared reporting session and discussion by the whole group. Each group will include representation from at least two USA-African engineering models (such as the OSU capstone design initiative in South Africa)

[60-minute lunch break]

Session 3 (1300-1430): What are the benefits for our African partners?

(Structure similar to Session 2): Introductory set-up by workshop coordinator and short presentations by a few of the African partners. The set-up might include an overview of benefits identified in Session 2, This will be followed by a 30-minute break out session for pre-selected groups of 5-6 persons to brainstorm and discuss the question. Each group will have designated co-facilitators (that role will rotate among participants throughout the workshop) who will take notes, monitor time, and keep conversation flowing. The small groups will then return for a shared reporting session and discussion by the whole group.

[30-minute refreshment break]

Session 4 (1500-1700): The pros and cons of experiential / service learning, classroom and distance learning methods

Introductory set-up by workshop coordinator, followed by 30-minute invited presentations by selected workshop participants (based on their expertise) on each of these three methods. A facilitated question and answer discussion period will be held at the conclusion of the three presentations.

DAY TWO

Session 5 (0830-1000): Curriculum sustainability, infrastructure requirements, length of time of involvement, and potential pitfalls

Introductory set-up by workshop coordinator including overview of Day 1, followed by a 30-minute break out session for four pre-selected groups to brainstorm and discuss one of the following topics: curriculum sustainability, infrastructure requirements, length of time of involvement, and potential pitfalls. Each group will have designated co-facilitators (that role will rotate among participants throughout the workshop) who will take notes, monitor time, and keep conversation flowing. The small groups will then return for a shared reporting session and discussion by the whole group.

[30-minute refreshment break]

Session 6 (1030-1200): Documenting the lessons learned

Introductory set-up by workshop coordinator, followed by time allotted for small group facilitators (and co-facilitators) to revise their notes and develop a summary of their group's lessons learned from the previous sessions. Every participant should be included in this session. The resultant summaries will become important sections of the workshop's final report to NSF and other subsequent publications.

[60-minute lunch break]

Session 7 (1300-1430): Outcomes assessment and evaluating impacts

Introductory set-up by workshop coordinator, followed by a 30-minute invited presentation by a selected workshop participant (based on expertise in outcome assessment tools). Participants will be led through the process of developing or enhancing their own outcomes assessment programs and then draft outlines appropriate for their own institutions. A facilitated question and answer discussion period will follow.

[30-minute refreshment break]

Session 8 (1500-1700): Collaboration and future directions

Introductory set-up by workshop coordinator, followed by brainstorming of the entire group on the following topics: planning inter-university collaborations among participants (education projects and grant proposals), planning publication development (encouraging participants to write individually or in collaboration on globalizing engineering education), and IFEEES/ASEE presentation preparation (sharing ideas and materials). Final wrap-up and adjourn.

Scientific justification, expected scientific results, mutual international benefits:

Engineering is increasingly becoming a globalized profession, including use of multi-national engineering design, technical service, and marketing teams. Engineering education in the U.S. has been slow to adapt to this changing reality, with estimates that fewer than 8% of engineering undergraduates participate in study abroad programs (Parkinson, 2007). The typical undergraduate engineering curriculum is already too full of required courses to allow most students to graduate in four-years. There is no room for more requirements and expectations, but the National Academy of Engineering (2004) predicted that, among other attributes, *“the engineer of 2020 will have to understand how to adapt solutions, in an ethical way, to the constraints of developing countries.”*

The Accreditation Board for Engineering and Technology (ABET) encourages educational programs to develop their own learning outcomes that are consistent with each individual program's educational objectives. However eleven outcomes (a-k) are required of all accredited U.S. engineering programs, including one that says programs must demonstrate that their students attain *“the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.”* (EAC, 2006). Engineering education researchers have studied this requirement of global competency, and recommended breaking it into three more measurable learning outcomes (Downey et al., 2006):

- “1. Students will demonstrate substantial knowledge of the similarities and differences among engineers and non-engineers from different countries.*
- 2. Students will demonstrate an ability to analyze how people's lives and experiences in other countries may shape or affect what they consider to be at stake in engineering work.*
- 3. Students will display a predisposition to treat co-workers from other countries as people who have both knowledge and value, may be likely to hold different perspectives than they do, and may be likely to bring these different perspectives to bear in processes of problem definition and problem solution.”*

Some U.S. engineering educators have instituted international engineering programs and experiences for their students, which can take many forms including dual degrees, exchange programs, extended field trips, extension activities, internships, mentored travel, partner sub-contracts, project based learning / service learning, and research abroad (Parkinson, 2007). With respect to African partnerships, some of the programs have linked U.S. engineering students with counterparts and projects in Benin (Silliman, 2007; 2008), Ghana (Swan et al., 2007), South Africa (Ward et al., 2007), and others.

Expected scientific results from the proposed workshop in South Africa include the identification and documentation of best practice models that incorporate a global dimension in engineering education. Mutual benefits will include educational benefits to the U.S. and African engineering students, professional development benefits to participating faculty, and tangible benefits to the communities or individuals being served by the student projects and problem-solving activities. Sustainable resource requirements will be explored, and strategies to address those resource needs will be developed. Research on learning outcomes assessment will be presented and workshop participants will be encouraged to develop or enhance their own outcomes assessment programs. As a result, multi-institutional outcomes data on globalizing engineering education will be gathered that can be shared between U.S. and African universities, continuing the learning process long after the workshop is adjourned in Cape Town.

Plans for dissemination of conclusions

The co-PIs are in conversation with organizers of the two co-located engineering education conferences, the American Society for Engineering Education's 7th Annual Global Colloquium on Engineering Education in Cape Town on October 20-23 and the IFEEES Global Engineering Education Summit on October 19-20. It is likely that we will be invited to present a summary of the results of this proposed workshop at one or both of those two events (see attached support letters from those two organizations). Shortly after returning to the U.S., a report will be prepared and submitted to NSF. Workshop findings will also be presented as a manuscript to be submitted for publication in the *Journal of Engineering Education* or the *International Journal of Engineering Education (IJEE)*. Co-PI Ann Christy has published in both of these journals, most recently in an IJEE invited special issue series on agricultural and biological engineering. If there is interest among the workshop participants, the co-PIs will approach IJEE with a proposal to co-edit a new special issue on globalizing engineering education that would feature invited peer-reviewed articles about the workshop results and case studies of US - Africa education programs written by workshop organizers and attendees.

Organization

The workshop will be organized by Andy Ward, Ann Christy, and Jessica D'Ambrosio. Andy and Ann will be Co-Chairs of this initiative. All three of us have extensive experience in conducting workshops and conferences. We have separately, and together, conducted various real-world educational projects. Ann provides leadership to the Capstone Engineering Design courses in our department and conducts research on educational methods. She is the undergraduate studies chair for the department and has won several teaching awards at local and national levels. Ann will be responsible for organizing the educational content of the workshop and will provide leadership to publishing and dissemination the results of the workshop. Ann will also participate in the workshop as the representative for our educational initiative in South Africa.

Three years ago Andy Ward established our innovative experiential learning initiative in South Africa. We have each participated in this initiative. In 2008, Andy won a Commendation Award from the International Soil and Water Conservation Society for a conference and series of workshops he organized with assistance from Jessica. Andy will provide oversight to the management of the grant, workshop invitations, and local arrangements in South Africa. He has relatives in the Cape Town area, makes annual visits to South Africa and has lived in South Africa. At the end of June, both Andy and Jessica will be in Cape Town and will visit the workshop hotel (Protea Sea Point), meet with the hotel's conference management team, and also meet with Duncan Fraser who is in charge of local arrangements for the IFEEES/ASEE activities and with two of the workshop participants, Marubini Manyage and Azeem Khan, who are at The University of Cape Town. Andy Ward will serve as the facilitator/moderator for the workshop.

Prior to the workshop, Jessica will assist the participants with logistical issues relating to travel and will be the primary liaison with Uniglobe Travel Designers who are the travel agent for OSU and The Ohio University Research Foundation who will manage the grant. She will also organize and prepare all of the workshop materials and prepare a website for the workshop. During the workshop, Jessica will be the liaison with the hotel, will prepare summary notes for each session, and will collate materials from each breakout group. Whenever, the opportunity arises, both Jessica and Andy will also participate in the workshop as regular participants.

The workshop is structured so that there is representation from about ten USA and Africa partnerships. These partnerships have ongoing educational activities that have American undergraduate and graduate students visiting Africa and conducting real-world engineering projects with their partners that are innovative, challenging, and incorporate to some extent scientific and research practices. Participants have been selected to represent: (1) a diverse range of educational models; (2) a wide geographical distribution within both the USA and Africa; (3) diversity in the career point of the participants and a diversity in the gender and ethnic background of the participants. The US participants are from 11 states, including 6 female faculty and students, and several different ethnic backgrounds. African participants will be from at least 5 countries (Benin, Kenya, Nigeria, Uganda, and South Africa). In addition, several of the participants from both continents have conducted projects in countries that are not represented such as Tanzania and Cameroon. All of the US participants have been selected and most have nominated African partners who will be invited to participate. There are currently 5 attending students (4 from the US including 3 females and 1 African student located in Cape Town). Participants from academia range from Students, Assistant Professors to Full Professors, Department Heads and Associate Deans. They all have impressive research and teaching track records and many indicators of excellence. Also, many have received grants from NSF within the past few years. We anticipate that a few additional African participants will be invited including a couple more students from South Africa. For example, Georgia Tech has a joint graduate program with the University of Pretoria. We have invited them to participate. Partnerships and participants were identified through discussion with the organizers of the ASEE and IFEEES activities, NSF personnel, discussions with our colleagues, and recommendations from other invited participants. We have structured the workshop to have 20-24 participants. A cap of 28 will be placed on the total number of attendees. We anticipate that, in addition to the core group of 20-24 people, one or more NSF, ASEE, IFEEES, or faculty and students from UCT might participate in some of the sessions. For example, Gerhard Salinger at NSF will be in South Africa and might be able to attend part of the workshop Also, Richard Felder will be holding a workshop in Cape Town, and we have invited him to participate as his schedule allows.

Provisional arrangements have been made to hold the workshop at the Protea Sea Point Hotel:

“The 3 star Protea Hotel Sea Point is situated between Main and Beach Roads in Sea Point, Cape Town. The Hotel is only minutes from the Victoria & Alfred Waterfront and the Cape Town International Convention Centre, 10 minutes from Clifton beach, 30 minutes from Cape Town International Airport and 5 minutes from Cape Town's central business district. The hotel offers a shuttle service to and from the CBD and Waterfront areas on a daily basis, at a surcharge.” www.proteahotels.com/protea-hotel-sea-point.html

Accommodations, all workshop activities, and group meals will be at the Protea Sea Point Hotel. The workshop is being held at the start of the peak tourist season for this popular location, so most hotels have few if any rooms available and room rates are very expensive. Quotations were obtained from three hotels and the Protea was the only one that satisfied our budget constraints. Andy has stayed in several Protea hotels and found their accommodation to be very good to excellent. They are a large chain that have many hotels located throughout Africa. A block of 20 rooms have been reserved for October 16-18 and a minimum of 5 rooms will be available prior to and after this time period. Two conference rooms (seating in a U for 20-30 people and several round tables for 6 people) have been reserved for both October 17 and 18. Having two rooms will allow us to divide into small discussion groups.

List of USA Participants

The following people from the United States have accepted an invitation to participate:

- 1 Ann Christy, Associate Professor, The Ohio State University (OSU), OH
- 2 Bethany Corcoran, Student, Stanford University, CA
- 3 Jessica D'Ambrosio, Student/Staff, OSU, OH
- 4 Lauren Fry, Student, Michigan Technological University, MI
- 5 Paul Golter, Student/Staff, Washington State University, WA
- 6 Garrick E. Louis, Associate Professor, University of Virginia, VA
- 7 James Momoh, Professor, Howard College, DC
- 8 Esther Obonyo, Assistant Professor, Rinker School of Building Construction
University of Florida, FL
- 9 Kurt Paterson, Professor and Director of D80 Center, Michigan Technological
University, MI
- 10 Maria Petrie, Professor and Associate Dean of Engineering - Academic &
International Affairs, Florida Atlantic University, FL
- 11 Roger Ruggles, Professor, Department of Civil and Environmental Engineering
Lafayette College, PA
- 12 Steve Silliman, Professor, Civil Engineering and Geological Sciences, Associate
Dean for Undergraduate Programs, College of Engineering University of Notre
Dame, IN
- 13 Andy Ward, Professor, OSU, OH
- 14 Bernard Van Wie, Professor, Washington State University, WA

South African partners of Pragasen Pillay (Professor, Clarkson University, NY and the University of Cape Town, SA) will participate in the workshop but Pragasen will probably not participate.

Biographical Sketches for the USA Participants

Two-page NSF Curriculum Vitae for Ann Christy and Andy Ward are included in the proposal together with contact details for all the participants. Biographical sketches have not been included for the African partners as invitations to them will only be made when the grant is awarded.

Ann Christy, P.E., is an Associate Professor of Food, Agricultural, and Biological Engineering at the Ohio State University (OSU). She earned degrees in agricultural engineering, biomedical engineering, and environmental engineering and then worked for an environmental consulting firm for several years before entering academia. She teaches courses in bioenergy, biological engineering, waste management, environmental controls, statistics, and capstone design. Ann has been the chair of her department's undergraduate studies committee since 2000 and has won multiple teaching awards at the departmental, college, university, and national levels. Her research interests include microbial fuel cells, landfills, environmental fate and transport, and engineering education. In 2006, she co-founded OSU's capstone design initiative *Developing Sustainable Solutions for Impoverished Communities in South Africa: A Student Centered and Service Learning Capstone Design Experience*. Comments by students about their South African projects:

It was incredible to see how so many people in the informal townships did a great deal with such limited resources. It was very inspiring and made me have many thanks for the assets that we have and take for granted. I felt that our group did an enormous job with helping the Muzi Thusi

School's irrigation problems. Knowing that our six members will have a lasting effect on many school children and worker's lives gives a great deal of pride.(2007, OSU Student)

I couldn't have prepared myself enough for South Africa. What I saw and learned went well beyond the realm of text book education.(2006, OSU Student)

After visiting South Africa and seeing my actual capstone project being utilized in real life, I would change very little if I were to redo the project. When we visited the rural areas in Potshini – a Zulu community, I was amazed to see women hand tampering mud bricks into molds. I felt privileged to be able to help them make one of their bricks, something they have been making for hundreds of years. I wasn't sure how practical our hand tampered soil cores were until we visited this rural site. Without a strong stabilizer such as cement, the buildings do not last very long. We had a vague idea of how practical or useful our work would be. I am proud to say that our work could be a very important step in adding a component to a making mud bricks last longer. I am proud of last years' capstone project and cannot wait to see what next year's teams will do.” (2006, OSU Student)

Bethany Ann Corcoran, is pursuing a M.S. and PhD in Civil and Environmental Engineering, Atmosphere/Energy Program at Stanford University, CA. She is the recipient of both a National Science Foundation and a National Defense Science and Engineering Graduate Research Fellowship. In 2006, while an undergraduate student at The Ohio State University she was a Morris K. Udall Scholar. She is the recipient of numerous other awards and in 2006 was the R.C. Miller Outstanding Student in the Food Agricultural and Biological Engineering Department at The Ohio State University. In 2005, she attended the Czech Agricultural University for a summer. In 2006 she participated in the capstone design initiative *Developing Sustainable Solutions for Impoverished Communities in South Africa: A Student Centered and Service Learning Capstone Design Experience*. Bethany notes that:

“Before I participated in that initiative, I thought that engineering was the ultimate solution to the world's problems; develop a technology, and the rest will fall into place. However, after my study abroad trip to South Africa during the summer of 2006, I realized how unaware of reality I had been. Technology alone cannot improve the standard of living of the countless impoverished people in South Africa, or the rest of the world. I realized that the complex problems facing South Africa are limited by social, political, racial, economic, and environmental constraints. Most of all, I resolved that even small steps by university students can make a difference. My senior capstone team designed a sustainable and cost-effective process for producing cellulosic ethanol from sugarcane bagasse using rumen microbes; I learned volumes about biofuel production and the hurdles that still need to be overcome. Although this design project did not focus on impoverished communities, I still left my capstone experience with a broader sense of global problems and the perspective needed to solve them. These skills and knowledge have served me well during my interdisciplinary graduate studies at Stanford University, where I have been selected to work on an international biofuels project this summer to assess the regional sustainability of various biofuels in order to help political leaders make more well-informed and scientifically-sound decisions. It is with a global perspective that I believe today's engineering students can tackle the most serious issues facing our world. To me, energy and climate change are two such problems, with Africa being perhaps the most vulnerable of all continents to the consequences. My decision to focus my Masters and PhD studies to these topics has been strongly influenced by my South Africa capstone experience, and I look forward to my future contributions to these global issues.”

Jessica D'Ambrosio, Manager of the Ohio NEMO (**N**on-Point **E**ducation for **M**unicipal **O**fficials) in the FABLE Department, will assist in conference planning, implementation, evaluation and documentation. She also will assist in reviewing and developing content for the

conference and adapting materials for publication. Jessica has a Masters degree in Environmental Science and currently is pursuing a PhD in soil and water engineering with Andy as her advisor. In addition to her research on the concept of alternative designs for agricultural ditches and the geomorphology and ecology of stream systems she manages all grant-funded projects awarded to Andy Ward. Since 2003, Jessica has coordinated and been the proceedings editor for 2 national conferences (a 3rd is in progress); she has coordinated and been a co-instructor for 6 regional workshops; she has managed the development of a wide range of scientific and educational materials; and she has established and maintained three active websites that are interlinked. In summer 2008, Jessica will participate in a study abroad trip to South Africa (with Andy as a resident director) where she will be responsible for the oversight of implementation of student-led irrigation and water re-use design projects. As an outcome of this visit it is anticipated that one aspect of her doctoral research will be related to an ecological issue in South Africa.

Lauren Fry, is a doctoral candidate in environmental engineering at Michigan Technological University, with research in the area of water resources and sustainable sanitation in developing countries. As a doctoral student, she has been involved in forming Michigan Tech's D80 Center, and she is editing a field guide to be published by ASCE Press in Fall 2008: *Water Supply, Sanitation Systems, and Indoor Air Quality: A Field Guide to Engineering for Development Workers* (Eds: J.R. Mihelcic, L.M. Fry, E.A. Myre, B.D. Barkdoll, and L. Phillips). She is a graduate of the Master's International Program in Civil and Environmental Engineering at Michigan Tech, which combines coursework at Michigan Tech with two years of service as a water and sanitation engineer with the Peace Corps. She served in Cameroon, where she conducted spring improvement and latrine construction projects with the Ministry of Agriculture. Research conducted during this time has been published in her master's report as well as in the *Journal of Engineering for Sustainable Development*. She has also worked in the Office of Prevention, Pesticides, and Toxic Substances of the U.S. Environmental protection Agency as a Pollution Prevention/Environmental Justice Fellow. Lauren notes that:

"Working in Cameroon as a water and sanitation engineer with the Peace Corps through Michigan Tech's Master's International Program gave me professional experience in implementing appropriate technology and organizing community projects in a setting culturally and economically different from what I'm used to. The understanding gained from these experiences guided my work in environmental justice and pollution prevention at the U.S. EPA and now provides motivation and background for my current doctoral research relating to sustainable water and sanitation development. The experience of living among the 2.6 billion people worldwide without sanitation and the 1.1 billion people without clean water gave me a passion and focus for research that will impact sustainability of water resources in developing countries."

Paul Golter, Student/Staff, School of Chemical Engineering and Bioengineering, Washington State University. Paul Golter has spearheaded a lot of the efforts by Professor Bernard Van Wie in Nigeria. He has also worked with Bernard in preparing a major international proposal that will involve multiple universities in Nigeria. He has only just been invited, as Bernard is currently in Nigeria on a Fulbright Scholarship, and a biographical sketch was not received by the submission time for this proposal.

Garrick E. Louis is a Professor in the Department of Systems and Information Engineering, School of Engineering and Applied Science, University of Virginia. Garrick Louis' research goal is to assure safe, reliable, and affordable sanitation services to underserved communities worldwide. These services consist of drinking water, wastewater and sewage treatment, and solid waste management. The work develops methods for needs assessment, performance evaluation/gap analysis, and strategic resource allocation for sustainable sanitation service capacity assurance and disseminates examples of best practice in these methods. The work is pursued through a consortium of collaborators from the service industries, government agencies, grassroots organizations and funding agencies. It is supported by a NSF Grant.

James Momoh, Professor, Howard College. Director of Center for Energy Systems and Control (CESaC) research is directed to enhancing the efficiency and economics of power system operation through the application of expert knowledge systems and programs and power utilization analysis. CESaC research has been largely supported by grants from the National Science Foundation, Department of Energy, Bonneville Power Administration, the Department of Water and Power of the City of Los Angeles, and NASA (Lewis). CESaC is a member of the National Center for Research in Electrical Power Systems (PSERC), which also includes Cornell, California/Berkeley, University of Illinois/Urbana-Champaign and University of Wisconsin/Madison.

Esther Obonyo, is the principal investigator in a research project focusing on engineering sustainable building systems within the East African region. 5 students are going to be supported until 2011 through the NSF's International Research Experiences in East Africa. For 9 weeks each summer, the students will research sustainable construction within the East African context. The research will focus on sustainable construction elements like reclaiming and recycling water supply, thermal comfort for heating and cooling, and materials for the building envelope. At the end of the project, the students will use their research findings to design and construct a demonstration building unit for a local Tanzanian town.

Kurt Paterson, is the Director and Co-Founder, *D80 Center*, Michigan Technological University. He is also the Director of their Peace Corps Master's International Program in Civil and Environmental Engineering. He is the Chair of the International Division of the ASEE. Michigan Tech's D80 Center (development for the poorest 80%) creates education, research, and service opportunities for more than 200 students a year at Michigan Tech. Students have worked and learned in 30 economically developing nations, 11 in Africa. The primary African engineering program is the Peace Corp Master's International (MI) program in civil and environmental engineering. There have been nearly 75 students (from 13 undergraduate engineering disciplines) in this program over the past 10 years. The program requires two semesters of coursework followed by 27-months of Peace Corps service. During their time in Peace Corp, our MI students undertake numerous development projects, one serving as the basis for their master's thesis work. Research over the years has focused on applying engineering solutions to the Millennium Development Goals, notably potable water, sanitation, indoor air, food security, transportation, shelter and economic development, among other sustainability topics. At the undergraduate level, the new Pavlis Leadership Institute is combining appropriate technology development with entrepreneurship. The first technology to emerge is a fetal heart monitor that can be used in rural Africa with field-testing to be done this summer in Ghana. There is also a new program on appropriate technology development planned in Tanzania. The Center has a rigorous assessment strategy to determine the impacts of these programs to students, faculty, our university and the communities served.

Maria M. Larronod Petrie, Professor and Associate Dean of Engineering - Academic & International Affairs at Florida Atlantic University (FAU). Maria has published extensively and at FAU Maria has led sponsored research totaling \$2,720,000 in 22 grants. Grants within last 5 years include NSF funded projects on: (1) U.S. Mexico Workshop on Global Engineering Challenge for the Americas; and (2) An Industry-Academic Partnership for Students in STEM Disciplines. She is the Vice President of the International Federation of Engineering Education Societies (IFEES); the Executive Director of Latin American and Caribbean Consortium of Engineering Institutions (LACCEI); and (3) a member of both the Board of Women in Engineering Division and the Board of Minorities in Engineering Division, ASEE.

Roger Ruggles, Associate Professor and Department Head, the Department of Civil and Environmental Engineering, Lafayette College. In 2000-2001, he was a Fulbright Scholar, Makerere University, Kampala, Uganda. In 2006, Roger initiated an experiential learning project with Makerere University in Uganda. A group of five Lafayette students collecting data in Uganda on how agricultural intrusion is affecting local wetlands. The project was funded by NSF and built upon a visit, in 2004, to Uganda by Lafayette students where initial data was collected. The project is also part of Lafayette's EXCEL Scholars Program where students conduct research with faculty while earning a stipend. Many of the more than 160 students who participate each year in the EXCEL Program share their work through articles in academic journals and/or conference presentations.

Steve Silliman, Professor, Civil Engineering and Geological Sciences, and Associate Dean for Undergraduate Programs, College of Engineering University of Notre Dame. He is the recipient of many awards including the ASEE, Global Engineering and Engineering Technology Educator Award, 2006; and the ASEE, Outstanding Teaching Award, Illinois-Indiana Section, 2006. Recently he co-authored a manuscript on *International Collaborations and Incorporating the Social Sciences in Research in Hydrology and Hydrologic Engineering* (Silliman et al., 2008). He is the leader of service learning initiative in Benin. In 1997, the University of Notre Dame was invited to be part of a multifaceted, collaborative project focused on improvement, protection and management of critical groundwater resources in Benin, West Africa, with emphasis on: (i) enabling the population of Benin to develop sustainable water resources, (ii) development of water management infrastructure in Benin, and (iii) testing of methodologies for use in other developing nations.

- **Build Infrastructure for Development of Groundwater Resources** The first objective is to improve infrastructure in Benin related to development, protection, and management of groundwater: this includes improving the capabilities of Benin professionals, educating local populations regarding their water resources, developing collaborations among U.S. and Benin students, and pursuing technical/sociological advances.
- **Leverage Results for Broad Impact** The challenges addressed and techniques utilized in this program are chosen and assessed so as to provide solutions applicable both in Benin and, through publication and/or direct collaboration with other partners, in other regions of the developing world.
- **Technical / Sociological Strategy** Four strategies are employed: (i) augment technical expertise among Benin professionals and students, (ii) establish baselines on water use, water quality, and development / management practices, (iii) establish technical and sociological capacity within both government agencies and the local villages to monitor/manage water sources, and (iv) build international understanding among both

Beninese and U.S. students (K-12 through university level educational efforts) so as to increase understanding and future opportunities for international collaboration.

- Student Exposure Based on the educational mission of the University of Notre Dame, this program is designed to provide undergraduate and graduate students at Notre Dame with opportunities to experience life in Western Africa and to work hand-in-hand with peers from the national university, water professionals, and the local population in Benin.

As evidence of the impact to date on the Notre Dame students, the following brief quotes are provided:

- ✓ *I now realize that technical knowledge must be expressed in way that takes into careful consideration all those involved in order to yield the most beneficial solution. With this comes an understanding that strong leadership in engineering also means encouraging local ownership and responsibility rather than overbearing control.*
- ✓ *. . . this project has taught me about leading by example simply through doing. I have spoken with many other students who are amazed that I am working on this project.*
- ✓ *I think all of us here have risen to meet them (the challenges of working in Benin) as individuals with ever growing leadership and at the same time, one of the greatest foundations of teamwork I have ever experienced . . . The idea of a socially conscious leader has changed for me; I have seen the beauty and community that has arisen from uncompromised love and generosity in even the most challenging settings.*
- ✓ *I feel the experience will leave each one of us with a heightened social consciousness that will guide the paths we take and direct our actions. It will influence not only our priorities and interactions, but how we raise our children.*

Bernard Van Wie, is a Professor in the Chemical Engineering Department at Washington State University. He has published widely and received several awards. In 2007, he was inducted into Washington State University Teaching Academy. He is a PI, co-PI, or faculty participant on \$2.8 M of teaching or training grants: 1) A Fulbright Scholar Lecturer/Research Award to Ahmadu Belo University in Nigeria; 2) an NSF CCLI Phase II grant to develop and disseminate Desktop Learning Modules and Cooperative, Hands-on, Active, Problem-based Learning at 6 institutions in the US and potentially 8 institutions in Nigeria; 3) two WSU teaching grants to transition a fluid mechanics and heat transfer course into a hands-on cooperative learning experience; 4) PI on NSF NER with a strong hands-on cooperative learning teaching component with a Native American charter high school; 5) co-PI on a \$478K USDA grant with the University of Idaho and Michigan State University to develop a new Biorefinery Process Analysis and Design course with hands-on components; 6) faculty trainer on WSU NIH PhD Training Program on Protein Biotechnology (now in its 18th year and 3rd renewal); and 4) Involved in summer high school and teacher camps: a) NSF Summer Teachers Institute focused on preparing high school and junior college teachers to lead their classes in hands-on learning exercises – from 2004 to 2007 he trained 8 teachers including two with minority status who serve in a Hispanic Serving Jr/Sr High School. He is a co-author of a recent publication on the *Design of Hands-on Learning Modules to Enhance Educational Motivation among Native High Schoolers* (Doty et al., 2007). He is highly interested in effective teaching, and he along with graduates and the WSU Center for Teaching, Learning, and Technology, are working on new learning pedagogy which combines some of the best learning strategies together in a single course.

Andy Ward, is a Professor in the Department of Food, Agricultural and Biological Engineering, The Ohio State University. Andy is a co-author of the text book Environmental Hydrology and has published more than 100 papers. Andy is a recipient of several awards including The USDA

Secretary's Award for Environmental Protection Honor Award and American Society of Engineering Education – Agricultural and Biological Engineering Division Excellence in Teaching Materials and Methods Award. He is an advocate for student center learning and in his courses he incorporates team work, solving real world problems, engineering and scientific judgment, and enhancing communication skills. Andy has nearly 30 years of international experience as a consultant and professor in the areas of watershed hydrology, stream geomorphology, reservoir sedimentation, modeling hydrologic systems, drainage, soil erosion, water quality, and the development and implementation of techniques to prevent or control adverse impacts of land use changes on water resources, streams and drainage networks. He has lived in several countries including Zambia, Zimbabwe and South Africa. He has worked as a consultant in South Africa, makes annual visits to relatives and in the past 3 years has conducted undergraduate engineering projects in South Africa. At The Ohio State University he spearheaded the establishment of the capstone design initiative *Developing Sustainable Solutions for Impoverished Communities in South Africa: A Student Centered and Service Learning Capstone Design Experience*. He has also organized workshops and conferences throughout the USA, Taiwan, and South Africa.

African Participants

African partner of Ann Christy and Andy Ward

Simon Lorentz
Assoc. Professor
School of Bioresources Engineering and Environmental Hydrology
University of KwaZulu-Natal,
Pietermaritzburg
Box X01, Scottsville South Africa
Phone: +27 33 2605701 FAX: +27 33 2605818 E-Mail: lorentz@ukzn.ac.za

African partner of Esther Obonyo

Dr. Alfred Omenya,
Eco-Build Africa
PO Box 22746 - 00100, GPO, Nairobi, Kenya
Tel: +254-(0)20-3004983, Cell. 254-(0)723-883-912, URL: www.ecobuild-africa.com

African partner of Kurt Paterson

Duncan Fraser, Professor, Department of Chemical Engineering
University of Cape Town
Private Bag Rondebosch 7701
South Africa
Office: 021 650 2515, Email: duncan.fraser@uct.ac.za

African partners or students of Prag Pillay

Marubini Manyage, graduate student, Department of Electrical Engineering
University of Cape Town, Private Bag, Rondebosch, 7701, South Africa
Office telephone: (021) 6502750
Office fax: (021) 6503465 (Reception), Email: maru@webmail.co.za

Azeem Khan, Lecturer, Machine and Drives, Power Engineering
Department of Electrical Engineering,
University of Cape Town, Private Bag, Rondebosch, 7701, South Africa
Office telephone: (021) 6505956
Office fax: (021) 6503465 (Reception), Email: akhan@ebe.uct.ac.za

African partner of Roger Ruggles

Lammeck Kajubi
Registered Professional Environmental Engineer, Uganda
Lecturer & Consultant of Environmental Engineering,
Makerere University
P.O. Box 7062, Kampala, Uganda
Email: kajubi@agric.mak.ac.ug

African Partners of Steve Silliman

Dr. Moussa Boukari, Professor of Geological Sciences,
Universite d'Abomey-Calavi,
Cotonou, Benin
E-mail: (mboukari@bj.refer.org)

African Partners of Bernard Van Wie

- a. Baba Abdul, PhD Student and Lecturer I, Ahmadu Bello University, Nigeria:
bababdul@yahoo.com; 011-234-803-206-0976.
- b. Emmanuel G., Shide, PhD Student and Lecturer I, ABU: 011-234-803-627-2998
- c. Dr. Abdulkarim S. Ahmed, Head of Chemical Engineering, Reader (Assoc. Prof.), ABU,
Asahmed2007@yahoo.com; 011-234-803-385-4025.
- d. Gutti Babagana, PhD Student & Lecturer I and Head of Department, Univ. of Maiduguri,
Nigeria: babaganagutti@yahoo.com; 011-234-802-419-8359 or 011-234-805-492-4977
or 011-234-803-462-6874

Plans for anticipated new collaborative activities

By bringing together 20 to 28 faculty and students with ongoing and well respected U.S.-African partnering programs in engineering education, the proposed workshop will provide the opportunity for new collaborations to be formed. One of the goals of the workshop is to identify the infrastructure and resource requirements to have a sustainable global dimension in engineering education. The next step after such identification of needs is brainstorming how to meet those needs, then planning a series of multi-university grant writing activities that can help secure the financial and material resources required. In the early process of communicating with workshop invitees, funding ideas have already been initiated and shared. One suggestion was to propose building small indigenous research centers (e.g., Zulu kraals) in rural African villages that could serve as local residences and provide fixed locations for ongoing engineering student projects that could be designed, constructed, and monitored over time by nearby African students and visiting U.S. students.

Participant Contact Details

1. Ann Christy, Associate Professor, OSU, OH
Food, Agricultural, and Biological Engineering Department
The Ohio State University
590 Woody Hayes Drive
Columbus, OH 43210
Phone: 614-292-3171, Fax: 614.292.9448, E-mail: christy.14@osu.edu
2. Bethany Corcoran, Student, Civil and Environmental Engineering
Civil and Environmental Engineering
Stanford University, Stanford, CA
Cellphone: 614 657-1619 bethany.corcoran@gmail.com
3. Jessica D'Ambrosio, Student and NEMO Program Manager, OSU, OH
Food, Agricultural, and Biological Engineering Department
The Ohio State University
590 Woody Hayes Drive
Columbus, OH 43210
Phone: 614.688.4438 Fax: 614.292.9448
E-mail: dambrosio.9@osu.edu Website: <http://streams.osu.edu>
4. Lauren Fry, Student, Michigan Technological University, MI
Department of Civil and Environmental Engineering
Houghton, Michigan 49931-1295 USA
lmfry@mtu.edu
5. Paul Golter, Student/Staff,
School of Chemical Engineering and Bioengineering
Washington State University
Pullman, WA 99164-2710 USA
pgolter@wsu.edu
6. Garrick E. Louis, Associate Professor, University of Virginia, VA
Department of Systems and Information Engineering
School of Engineering and Applied Science
University of Virginia , 151 Engineer's Way, P.O. Box 400747
Charlottesville, VA 22904
Office: *Olsson 102A* Phone: 434-982-2742 Email: gel7f@virginia.edu
7. James Momoh, Professor, Howard College, DC
Department of Electrical & Computer Engineering
2400 Sixth St, NW Washington, DC, 20059
(202) 806-5350, jm@scs.howard.edu
8. Esther Obonyo, Assistant Professor
Rinker School of Building Construction
University of Florida
329 Rinker Hall
Gainesville, FL 32611
Phone: (352)273-1161, E-mail: obonyo@ufl.edu, Web: estherobonyo@hotmail.com

9. Prof. Kurtis G. Paterson
Michigan Technological University
Department of Civil and Environmental Engineering
Houghton, Michigan 49931-1295 USA
Telephone: 001-906-487-3495
Facsimile: 001-906-487-2943
Email: paterson@mtu.edu Website: <http://bigmac.cee.mtu.edu>
10. Maria M. Larronod Petrie
Florida Atlantic University
777 Glades Road, SE-308, Boca Raton, FL 33431-0991
Office: 561 297-3899, Cell 561 313-2296, FAX: 561 297-1111
Email: petrie@fau.edu Website: <http://www.cse.fau.edu/~maria>
11. Professor Roger Ruggles
Department of Civil and Environmental Engineering
Lafayette College
Easton, PA 18042-1775
Phone: (610) 330-5442 FAX: (610) 330-5059 E-mail: rugglesr@lafayette.edu
12. Professor Stephen E. Silliman
Department of Civil Engineering and Geological Sciences
Associate Dean for Undergraduate Programs, College of Engineering
Mailing Address: 156 Fitzpatrick Hall
University of Notre Dame, Notre Dame, IN 46556 USA
Phone: (574) 631-5332 Fax: (574) 631-9236 Silliman.1@nd.edu
13. Professor Andy Ward
Food, Agricultural, and Biological Engineering Department
The Ohio State University
590 Woody Hayes Drive
Columbus, OH 43210
14. Professor Bernard Van Wie
School of Chemical Engineering and Bioengineering
PO Box 642710
Washington State University
Pullman, WA 99164-2710 USA
E-mail: bvanwie@che.wsu.edu, Phone: 509-335-4103
15. Pragasen Pillay, Professor and Jean Smith Newell Distinguished Professor
Department of Electrical and Computer Engineering
Clarkson University
Box 5720, 146 CAMP
Potsdam, NY 13699-5720 U.S.A
Telephone: 315-268-6509
FAX: 315-268-7600
E-mail: pillayp@clarkson.edu
<http://people.clarkson.edu/~pillayp/>