Global Engineering Education Opportunities: A Survey of Selected ASEE SE Universities

Allen Greenwood [1], Mary C. Emplaincourt[2] and Tiffany Lampkin[3]

Abstract – In today's integrated global economy, engineering collaborations span the globe. Thus, a key part to engineering education is to prepare students to be effective engineers in the international arena. Opportunities need to be provided for students to travel, study, and work abroad for the purpose of deepening their understanding of other cultures and other ways of doing business. This paper presents a survey of study abroad programs sampled from universities in the ASEE SE region that provide global engineering education opportunities for engineering students. The documentation and characterization of existing programs provides a foundation for forums to discuss topics of mutual interest, better understanding the problems/risks and rewards associated with the programs, comparing alternative study/work abroad models, and developing collaboration among programs. The paper also outlines the study abroad programs at Mississippi State University and the strategic plan for increasing participation of engineering students in international programs.

Keywords: Global engineering education, Study abroad programs.

INTRODUCTION

The Bagley College of Engineering (BCoE) at Mississippi State University (MSU) is making a concerted effort to raise the global awareness of engineering students and get more students studying abroad. As we develop ways to broaden the international opportunities available to engineering students, we naturally look to other institutions to see what they are doing. The first part of the paper presents a website search sampling study abroad opportunities at universities in the ASEE SE region The remainder of this paper describes the current and planned international programs in the Bagley College of Engineering at Mississippi State University. We hope this discussion will provide an incentive and a model for other institutions to write about their programs and to make the information more readily available on the web.

SURVEY OF ASEE-SE MEMBER INSTITUTIONS

In November 2006 a website survey was conducted of ASEE member institutions in the SE region (Alabama, Mississippi, Georgia, Virginia, North Carolina, South Carolina, Florida, and Tennessee). Those universities are listed in Table 1, along with links to their engineering programs and the university's study abroad website.

The survey consisted of a keyword search of the college of engineering's website at each university. If the search provided information on study abroad opportunities, that information was summarized in a spreadsheet. If no study abroad information was found on the engineering website, another keyword search was conducted on the university's homepage. If engineering-related study abroad information was found on this search, then the information was summarized in a spreadsheet. The last column in Table 1 summarizes any study abroad programs found in the web searches. The programs that were found were further summarized in terms of the individual program objectives, location, eligibility requirements, duration, credit hours, costs, and administrator contact information. Due to space limitations, this information is not included in the paper, but is available from the authors.

As can be seen in the last column of Table 1, few engineering-related study abroad programs were found in the web search. Primarily, we found a series of semester programs at the University of Alabama, University of Tennessee,

Table 1. Selected ASEE regional institutions in web search

University Name	Engineering program link	Study abroad/international studies link	Location(s) of program(s)
Auburn University	http://www.eng.auburn.edu/	http://www.auburn.edu/academic/other/international_education/studyabroad/	Germany, England
University of Alabama	http://coeweb.eng.ua.edu/	http://international.ua.edu/overseas-study/semester/faqs.htm	(Exchange programs) Australia, Austria, Belgium, China, England, France, Germany, Japan, Korea, Netherlands, Scotland, Spain
University of Alabama at Birmingham	http://main.uab.edu/soeng/Templates/Home.aspx?durki=48390&pid=48390	http://www.studyabroadapp.uab.edu/overview.asp	not available
University of Alabama in Huntsville	http://www.eng.uah.edu/	http://www.uah.edu/colleges/liberal/global/index.php	(in development) Colgne, Germany
University of South Alabama	http://www.southalabama.edu/engineering/	http://www.southalabama.edu/intlprograms/studyabroad.html	not available
Jackson State University	http://www.jsums.edu/~sst/cset/engineering.htm	http://www.jsums.edu/internationalprogramsstudyabroad.htm	not available
Mississippi State University	http://www.engr.msstate.edu/	http://www.bagley.msstate.edu/international/index.php	Bristol, England and Europe
Christian Brothers University	http://www.cbu.edu/engineering/	http://www.cbu.edu/Academics/studyabroad/index.html	not available
Tennessee State University	http://www.tnstate.edu/interior.asp?ptid=1&mid=284	http://www.tnstate.edu/interior.asp?mid=862&ptid=1	not available
Tennessee Technological University	http://www.tntech. edu/engineering/	http://www.tntech.edu/international/study_abroad/program_options.html	not available
University of Memphis	http://www.engr.memphis.edu/	http://academics.memphis.edu/cips/abroad/default.shtml	Korea
University of Tennessee (Knoxville)	http://www.engr.utk.edu/	http://web.utk.edu/~globe/pao/programs/	Exchange programs: United Kingdom, China, Netherlands; Direct programs: Australia, United Kingdom, Mexico, New Zealand
University of Tennessee at Chattanooga	http://www.utc.edu/Academic/EngineeringAndComputerScience/	http://www.utc.edu/Academic/NationalStudentExchange/ise_other_accepted.php	not available
University of Tennessee at Martin	http://www.utm.edu/departments/ens/index.php	http://www.utm.edu/departments/globalstudies/sa_programs.php	not available

Table 1. Selected ASEE regional institutions in web search (continued)

University Name		Study abroad/international studies link	Location(s) of program(s)
University of Virginia	http://www.seas.virginia.edu/	http://www.studyabroad.virginia.edu/index.cfm?FuseAction=Programs.ViewProgram&Program	Germany
Virginia Commonwealth University	http://www.egr.vcu.edu/	http://www.vcu.edu/oie/eao_ss/index.html	N/A
Old Dominion University	http://www.eng.odu.edu/index.php	http://www.odu.edu/ao/oip/studyabroad/	N/A
Virginia State University	N/A	http://www.vsu.edu/pages/3388.asp	N/A
Virginia Tech	http://www.eng.vt.edu/main/index.php	http://www.oired.vt.edu/Education/Study/Engineering.htm	N/A
Virginia Military Institute	http://www.vmi.edu/departments.asp?durki=2785	http://www.vmi.edu/show.asp?durki=1794	N/A
North Carolina A & T State University	http://www.eng.ncat.edu/	http://www.ncat.edu/~oip/home1.htm	N/A
North Carolina State University	http://www.engr.ncsu.edu/	http://studyabroad.ncsu.edu/	Ghana
Clemson University	http://www.ces.clemson.edu/	http://www.ces.clemson.edu/main/students/global/summer/trier.htm	Germany, Belgium, and England
Georgia Institute of Technology	http://www.coe.gatech.edu/	http://www.oie.gatech.edu/sa/	Australia, China, Singapore, England, and Spain
Georgia Southern University	http://cit.georgiasouthern.edu/	http://academics.georgiasouthern.edu/international/	N/A
University of Florida	http://www.eng.ufl.edu/	N/A	N/A
University of Miami	http://www6.miami.edu/engineering/	http://www6.miami.edu/UMH/CDA/UMH_Main/0,1770,6371-1;5680-2;5682-2;28920-2;51131-3,00.html	Vietnam
University of Central Florida	http://www.cecs.ucf.edu/	http://international.ucf.edu/index.cfm?oiscomm=studyabroad.ucfprograms	N/A

and University of Memphis, an evolving global studies minor-like program at the University of Alabama in Huntsville, and summer and intersession courses at Mississippi State University. Also, many of these programs do not appear to have an engineering focus. This lack of information means either that there are not many opportunities available to engineering students in the region or that the programs are not apparent from a web search. We suspect

it is the latter, since one thing that we learned from survey is that even though we offer a variety of programs, specifically targeted at engineering students, this information is not easily found on our website.

BACKGROUND FOR STUDY ABROAD PROGRAMS IN ENGINEERING AT MISSISSIPPI STATE UNIVERSITY

Like many other engineering programs, and most undergraduate education programs in the U.S., it is difficult to get engineering students at MSU to study abroad. The BCoE at MSU has traditionally provided two primary options for students to study abroad - one semester or academic year through the Global Engineering Education Exchange (Global E3) program or six weeks during the summer in Bristol, England. Typically less than ten students per year participate in these two programs. This represents only 0.6 percent of the College's 1700 undergraduate engineering students. While obviously a low participation rate, this is not uncommon. The Commission on the Abraham Lincoln Study Abroad Fellowship Program [1] reports that less than two percent of American university and college students study abroad. The Commission also reports that research and doctoral institutions account for 45 percent of U.S. students abroad, 108 institutions (out of 4200 American colleges and universities) account for 50 percent of all students abroad, and just 8 percent of American students abroad are engineering majors.

In order to enhance engineering education, the BCoE recently created the Center for Engineering Student Excellence (CESE). The Center's intent is to expose students to skills and experiences that cannot be taught in the classroom alone, and develop better leaders and communicators with an understanding of the impact engineers have globally in government and industry. Since a significant component of CESE is global awareness, the BCoE is striving to offer a variety of opportunities for engineering students to study abroad. Similarly, increasing the number of engineering students studying abroad is an important element in the BCoE's strategic plan.

This year the BCoE celebrated its tenth year of involvement with study abroad programs. Part of the celebration included updating the BCoE website to list and explain the various opportunities that the college offers to better inform students about current and future study abroad opportunities. To find out more about the various programs go to www.bagley.msstate.edu, scroll own and click on Center for Engineering Student Excellence on the left side of the window. At the CESE site click on Study Abroad Programs. The direct link is: http://www.bagley.msstate.edu/international/index.php

Study Abroad through Global Engineering Education Exchange (GE3)

As mentioned above, traditionally, engineering students in the BCoE have the opportunity to study abroad through two programs. The first option is through Global E3, a consortium of leading universities around the world that provides opportunities for students at member institutions to receive academic credit for courses taken at an overseas institution. Global E3 is administered in the United States by the Institute of International Education (IIE) and consists of approximately 30 ABET-accredited American member universities and has more than 50 overseas members in 17 countries, including a consortium of western European universities and selected individual institutions in Asia, central and eastern Europe, and Latin America. Students in their junior year typically study one semester or a year abroad. Fellowships are available and the students select between English or foreign language instruction. Application is completed early in the prior semester of the one the student will be studying abroad.

Seven MSU engineering students have participated in this program since 2001 studying at Hong Kong University in Hong Kong, University College of Swansea in Wales, Monash University in Australia, Nanyang Technological University in Singapore, Institut National Polytechnique de Grenoble in France, and Tohoku University in Japan. Nine international students have studied in engineering disciplines at MSU through this program since 1999. MSU has hosted students from Institut National des Sciences Appliquées de Lyon, Ecole des Mines de Nantes, Institut Supérieure d'Electronique de Paris, Université Technologique de Troyes, EPF Ecoles d'Ingénieurs, Université de Technologie de Compiègne, and Institut National Polytechnique de Grenoble (INPG Ecole Nationale Supérieure de Mécanique et d'Aérotechnique.

The Burke Summer Study Abroad Program at the University of Bristol

The second option is a six-week summer program, in partnership with Clemson University, where students take two courses in four weeks at the University of Bristol; the remaining two weeks is for independent travel in Europe. Engineering Programs Abroad (EPA) located in London, England administers the program. The Dean of Engineering started this opportunity at MSU in 1997. Fred Burke, a MSU engineering alumnus, and his wife Sara Jean endowed the program in 2002.

The program is conducted in the second summer school session. A faculty advisor accompanies the group and the students live with host families while in Bristol. Typically, students are encouraged to participate in this program after their sophomore year when the calculus courses are completed. Students earn six hours of degree credit from two courses, History of Technology and a technical elective, either Computer-Aided Design and Manufacturing or Digital Signal Processing. The instructors at the University of Bristol assign the grades and forward them to MSU to be put on the students' transcripts. Continuing Education at MSU coordinates the grade transfers, handles the budget and other administrative activities.

The program's costs including MSU tuition averages $5500. This cost covers round trip transportation from MSU, coach & luggage handling in UK, Bristol fees (home stay with 2 meals), Shakespeare play at the Globe Theater in London, weekend excursions, site visits for the history paper, BritRail pass, MSU tuition and administrative fees, other meals, travel and entertainment in UK and the two-week independent travel. The endowment supports the accompanying MSU faculty person's costs (the program administrators in England locate a place for the faculty member to stay), competitive fellowships for students going on the trip, and prize money for competitions. Fellowships are awarded based on need, academic excellence, extracurricular activities, and potential to benefit from traveling and studying abroad.

Students are encouraged to participate in three competitions after the experience: a photograph contest, a story contest and a journal contest. Those who want to participate can submit a photograph taken during their travel, a story about an interesting event that happen to them, and/or a journal written about their experience. The monetary awards are 150, 100, and 50 dollars.

A total of 99 MSU students have participated in the Bristol program. The average number of students from MSU that have participated in the Bristol experience each year during the nine years that the program was conducted is eleven. The lowest participation was in 2003 and 2005 with five MSU students. The largest enrollment was in 1999 with sixteen MSU students. In 2004 the program was cancelled due to low enrollment at both MSU and Clemson, coupled with organizational and personnel issues at the University of Bristol.

All students who participate in the Bristol program are asked to assess the program in detail. The overall feedback from the students is very positive.

Intersession Study Abroad Opportunities

The philosophy behind offering traveling abroad opportunities between semesters is to attract students early in their engineering program, break any perceived barriers to studying abroad, whet their appetite for spending more time abroad, and ultimately to motivate them to engage in a longer study abroad experience. The first intersession course was offered during the winter break between 2005 and 2006. Future plans to expand the portfolio of study abroad opportunities during intercessions are through three intersession courses (over the next two years) during the break between spring and summer semesters (a three-week interval). Acceptance to these three-week trips is by consent of instructors via application with all students being in academic good standing.

"Engineering Practice in Europe" January 2006

This two-week field-study course in France was developed to fit into the university's new intersession – an extension of the winter break to include courses during a two-week period in early January of 2006 prior to the start of the Spring 2006 semester. The cost of the trip was $2000 plus tuition.

The objective of the course was to enhance engineering education by providing a hands-on introduction to engineering practice in an international setting by visiting companies and universities abroad. Field study visits to educational institutions, research laboratories, and production facilities were planned to provide direct exposure to key engineering technologies and dialogue with engineering and management professionals. These visits were also to provide the opportunity to examine cultural differences and better understand the global economy model that drives most enterprises.

Five companies (Airbus, Alstom Power Turbines, Eurocopter, Schneider Electric, United Parcel Service) and three universities (Institut National Polytechnique de Grenoble, Institut National Sciences Appliquées – Toulouse, EPF Ecoles d'Ingénieurs) in France were visited. Activities included research and readings on globalization and the eight organizations to be visited, structured field trips to research and production facilities, exposure to key engineering technologies, focused discussions with engineering and management professionals, documentation of observations and impressions.

Students received 3-semester hours of credit for the course. The undergraduate students received upper-division general engineering credit while the graduate students completed an extra assignment to receive graduate credit for the course. In some disciplines this course counted for degree credit as a technical or free elective.

The target enrollment was 15 to 20 students. Fourteen students (6 juniors, 6 seniors, 1 masters, and 1 Ph.D.) applied and all were accepted. The group was composed of 9 male and 5 female students; they were from 7 engineering disciplines, with 6 students from mechanical engineering. Two of the students were African-American. The 14 students were accompanied by two MSU engineering faculty.

There were four assignments that were equally weighted in the grading of the course. Three of these assignments were individual assignments and one involved pairs of students. The assignments included a book review, pre-trip preparation assignments, a company research project and a journal. The students were also required to read Thomas Friedman's *The World is Flat* [2] and complete a 3-5-page review of the book. The group assignment required pairs of students write a research paper and prepare an overview of the company or university to be used in briefing the other members of the class in the day or two preceding the visit to that site. The final assignment that the students completed was a journal in which they were asked to describe their feelings about the events of each day and the new experiences and people that they met. The graduate students were also required to read *The United States of Europe* [3] and write a book report in addition to the above assignments.

A set of assessment questions was developed to gather feedback from the students regarding the experience. An example of the quantitative feedback was as follows: Contribution to your engineering education -- mean rating of 80%: good to excellent; Contribution to your personal development -- mean rating of 100%: good to excellent; Overall course rating -- mean rating of 100%: good to excellent.

"European and American Interaction in Context" for Intersession, May 2007

The enrollment goal for the May 2007 Intersession is 15 students with two faculty members (one from the BCoE and one from the College of Arts and Sciences) accompanying the students. The students will be introduced to early and modern Western civilizations emphasizing in context interactions between the United States and selected European countries.

The European regions selected for the immersion are The Benelux Countries, also known as the "low countries", the Moselle Valley and the Middle Rhine Valley, and Paris, France (and its' environs) have full historical and cultural backgrounds that started with the conquest of Julius Caesar and connected with the New World (America). Today,

these countries have evolved into dynamic, industrial nations who have led modern Europe toward economic and political unity. Many of the sites that will be visited in the Netherlands, Belgium, Luxembourg, and Paris and all of the Middle Rhine Valley are on the United Nations Educational, Scientific and Cultural Organization (UNESCO) list of World Heritage Sites. Sites and regions are added to the UNESCO list of World Heritage Sites based on unique combinations of geological, historical, cultural, and industrial reasons. Additionally, students will visit selected production facilities.

The total tcost of the trip will be approximately $5,500 including tuition and the students will receive 3-semester hours of college credit. Travel within Europe will be by passenger vans and train.

Students will be required to read selected readings prior in preparation of the trip, keep a daily log with comments while traveling, write a paper comparing, contrasting and synthesizing the travel abroad experience based on the daily log, and write a research on a topic of their choice (related to the trip). Students for their research papers will select topics that must include descriptions and critiques of creative human efforts and ideas reflected in art, architecture, religion, history, technology, and politics; address ambiguity in analyzing material and arrive at conclusions that are independent and reasonable; respond to ethical and moral dilemmas that will be made apparent as they are exposed to religious, political, technological, racial, historical and cultural issues.

"Engineering in Classical and Medieval Times for Intersession, May 2008

This trip is designed for engineering and architecture students to travel in Italy and France in order to study the design and construction of classical structures. Again a BCoE faculty member and a faculty member from the School of Architecture will accompany the students.

"Engineering Practice in Asia" for Intersession, May 2008

Field trips to universities, production facilities, and research laboratories are planned in Japan and South Korea. The structure of the course will be similar to the intersession course to France in January 2006. Two BCoE faculty will accompany the students.

Potential Opportunities for MSU Engineering Students

Through our partnership with Clemson University, BCoE students can participate in Clemson's summer program in environmental science and international studies in Trier, Germany. Through a recent agreement, BCoE students have the opportunity to spend a summer studying at Kyungpook National University in Korea. MSU is also working with the Hessen Universities Consortium to identify possible exchange opportunities between the two institutions. The BCoE is also investigating the creation of a certificate program for engineers that is directed towards international issues and would have a study abroad component.

Other International Opportunities for MSU Students

MSU offers the following two programs to all students interested in studying abroad:

International Studies Abroad (ISA) (www.studiesabroad.com) offers to students study abroad programs in Spain, Italy, France, England, Mexico, Costa Rica, Argentina, Chile, Peru, and the Dominican Republic. Each academic program is designed to help students gain a cultural understanding and personal independence that can only be achieved by living and studying in another country. The Office of the Provost at MSU administers ISA opportunities for MSU students.

The Center for Study Abroad (CCSA) (http://www.ccsa.cc/) is a higher education consortium of 26 colleges and universities form Alabama, Illinois, Indiana, Kentucky, Mississippi, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and Texas. The program is headquartered at Northern Kentucky University in Highland Heights, Kentucky. Study abroad opportunities through this program are located in Australia, Belize, Canada, England, Ghana, Hong Kong, India, Ireland, Jamaica and Scotland. The MSU Honors Program administers the CCSA opportunities fro MSU students.

CONCLUSIONS

The initial research presented in this paper shows an apparent lack of opportunities in the region for engineering students to study abroad. However, this may not be a lack of opportunities, but poor external dissemination of information on the opportunities. Hopefully, this paper will foster better communication among institutions and possible collaboration on study abroad programs.

The paper also provides an overview the various programs that are currently offered by the Bagley College of Engineering at Mississippi State University and plans for future programs.

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Allen G. Greenwood

Allen G. Greenwood, P.E., is a Professor of Industrial and Systems Engineering at Mississippi State University and International Programs Coordinator for the James Worth Bagley College of Engineering. He holds a bachelors and masters degree in industrial engineering from North Carolina State University and the University of Tennessee, respectively, and a Ph.D. in management science with minors in industrial engineering and statistics from Virginia Tech. Dr. Greenwood teaches courses in systems simulation, project management, enterprise systems engineering, and engineering administration. His research efforts are focused on the design and analysis of production and project systems and the application of simulation-optimization technologies to improve organizational performance.

Mary C. Emplaincourt

Mary C. Emplaincourt is an Instructor of Mechanical Engineering at Mississippi State University. She is the undergraduate program coordinator for the department and is the Assistant Director of the Mississippi State University Industrial Assessment Center. She holds a B.A. in political science, history, and mathematics from The University of Alabama, a M.A. in history from The University of Alabama, and a M.S. in industrial engineering from Mississippi State University. Ms. Emplaincourt was the faculty advisor in the summer of 1999 accompanying engineering students in the six-weeks study abroad program to Bristol, England. She will be the instructor of record taking engineering students on the travel abroad program to Europe in the "Maymester" 2007.

Tiffany Lampkin

Tiffany Lampkin is a currently working toward a master's degree in industrial engineering at Mississippi State University. She completed her bachelor's degree in industrial engineering at Mississippi State University in 2004.