

Final Report

## **Second ECEDHA/NSF Workshop on Globalization of Electrical and Computer Education: Implementation**

February 3-5, 2008  
Santa Clara, CA

Organized by

**The Electrical and Computer Department Heads Association (ECEDHA)  
The International Engineering Consortium (IEC)**

Sponsored by

**The National Science foundation**

### **Organizing Committee**

Dr. Kenneth Connor, Rensselaer Polytechnic Institute

Dr. Stephen Goodnick, Arizona State University

Dr. Kenneth Jenkins, Pennsylvania State University

Dr. Hossein Mousavinezhad, Idaho State University

Dr. Issa Batarseh, University of Central Florida

Dr. Mark Smith, Purdue University

Dr. Barry Sullivan, International Engineering Consortium

Ms. Melissa Swartz, International Engineering Consortium

Note: A post-workshop survey of globalization activities is currently being conducted at ECEDHA member organizations. When the post-workshop survey is completed the results will be posted on the ECEDHA website <<http://www.ecedha.org>> for public distribution.

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## **Executive Summary**

The recent decline in enrollments in computer engineering, electrical engineering, and computer science has been troubling both locally on university campuses and at the national level. Undoubtedly, prospective students have been influenced negatively by the publicity about out-sourcing, which peaked a few years ago, and the perceived threat of global job competition. While some universities are beginning to see a small rebound, the enrollment growth rate appears far from sufficient to sustain economic competitiveness in the high technology sector, particularly when compared with enrollments in China and India. This general concern over future competitiveness and workforce preparedness motivated an ECEDHA proposal to the National Science Foundation for a three-part workshop series to address the challenging issues associated with globalization.

The first workshop in the series was held at National Academy of Engineering, in Washington D. C., on November 14<sup>th</sup> and 15<sup>th</sup>, 2005. As a follow-up to the 2005 workshop, ECEDHA, in conjunction with the International Engineering Consortium (IEC), sponsored the sequel entitled “The Second Workshop on Globalization Effects on ECE Education for the Engineering Profession: Implementation.” It was held February 3 – 5, 2008 in Santa Clara, CA in conjunction with DesignCon 2008. The goal was to bring together experts from industry, academia, and government to learn about the implementation of educational programs and business practices to better enable ECE graduates to deal with globalization and engineering outsourcing, and to propose ways of overhauling engineering educational programs to deal effectively with these changes. Workshop invitees were Electrical and Computer Engineering Department Heads (or their representatives) and representatives from industry and government. The second workshop started with an update session to determine the state of affairs with regard to globalization of the ECE profession. Recent information on the current ECE job market was also gathered and presented.

In contrast to the first workshop, where a great deal of data was collected from industrial executives, the second workshop focused on practitioners with on-the-job engineering experiences. There was an attempt to accumulate information about

whether or not ECE-dominated companies are good places to work and what daily life is like for engineers working to develop small start-up companies. The workshop also addressed best practices and curricular development. In particular, there was an effort to collect information about the types of outreach activities in which ECE departments are currently engaged to address recruitment and retention of students and faculty in the face of globalization. Information on programmatic changes to improve global awareness and technical skills for global engineering was presented as well.

Five Keynote speakers were featured on the workshop program. James Melsa and Wayne Johnson delivered their Keynote addresses at the opening session of the workshop. Om Nalamasu and John Kent delivered their Keynote addresses in the afternoon session of the first day. Genevieve Bell was the featured speaker at the workshop dinner on Monday evening and Paul Penfield was the featured speaker at the breakout session on Tuesday morning. Videos of the Keynote addresses and featured speakers are available for downloading from the ECEDHA website at the following URL:

<http://www.ecedha.org/membership/workshop2008.asp>

As a follow-up activity a special panel session entitled “NSF/ECEDHA Workshop Revisited” was held at the 2008 National ECEDHA Meeting in San Diego, CA, on March 14-18, 2008. The panel included Dr. Khaled Ben Letaief from the Hong Kong University of Science and Technology and Dr. Robert Ayan from Cambridge Advisors located in Jordan. The participation of these international invited speakers added an excellent international perspective to the workshop review session.

## 1. Introduction

In response to significant interests in globalization, public policy, and engineering out-sourcing that emerged during the 2004 ECEDHA Annual Meeting, the Electrical and Computer Department Heads Association (ECEDHA) and the International Engineering Consortium (IEC) organized a workshop that was held at the Constitution Avenue location of the National Academy of Engineering, Washington D. C., on November 14<sup>th</sup> and 15<sup>th</sup>, 2005. Dr. William Wulf, President of the National Academy of Engineering (NAE), made the arrangements to hold the workshop at the NAE. It is hoped that this workshop will continue to stimulate further debate on globalization, public policy, and out-sourcing of engineering jobs, and the impact of this evolution on engineering employment opportunities in the United States [1,2,3]. Funds were provided through a grant from the National Science Foundation to provide partial travel support for invited workshop attendees and to cover basic administrative expenses for the organizers. All of the talks presented at the workshop were video taped and were posted along with the accompanying PowerPoint presentations on the ECEDHA website. The final workshop report [4] is available for download at:

< <http://www.ecedha.org/membership/meetings.asp#3> >.

There continues to be a growing need to educate engineering students for competitive careers in a global economy [5]. Educators need to carefully consider how to educate engineering students to prepare them for changes in the profession due to globalization and outsourcing. Educators also face the challenge of recruiting students into ECE programs in the face of negative publicity of out-sourcing, and the perceived undercutting of the value of an engineering degree in the United States due to global competition. Another challenge to educators is the retraining of engineering professionals in fields that have suffered from excessive out-sourcing. Addressing this challenge requires a new emphasis on continuing education in providing opportunities for engineers at all career levels to refresh and change the direction of their evolving careers.

A number of action items that resulted from presentations and breakout sessions at the 2005 workshop are summarized in the workshop final report [4]. These include:

## Recommendations to Prepare ECE Students for a Global Economy

- International Student Experiences
- Cultural Education
- Collaboration and Multidisciplinary Experiences
- Service and People Oriented Educational Experiences
- Enhanced Technology in Education

## Action Items for NSF

- International REU Programs
- Cooperative International Programs
- Benchmark Studies with Foreign Institutions
- Development of Model Curricula
- Making ECE Programs More Attractive - Workshop on attracting K-12 students to engineering

## Action Items for ECEDHA

- Follow-on programs on global engineering at 2006 and 2007 ECEDHA meetings
- Follow-on workshop organized jointly with NSF on best practices and curricular development for global education

## **ECEDHA/NSF 2008 Globalization Workshop Organization**

As a follow-up to the 2005 workshop The Electrical and Computer Engineering Department Heads Association (ECEDHA), in conjunction with the International Engineering Consortium (IEC), sponsored a second workshop entitled “The Second Workshop on Globalization Effects on ECE Education for the Engineering Profession: Implementation.” The second workshop in the three-workshop series was held on February 3 – 5, 2008 in Santa Clara, CA in conjunction with DesignCon 2008. The goal of the workshop was to bring together experts from industry, academia, and government to learn about the implementation of educational programs and business practices to better enable ECE graduates to deal with globalization and engineering outsourcing, and to propose ways of overhauling engineering educational programs to effectively deal with these changes. Workshop invitees were Electrical and Computer Engineering Department Heads (or their representatives) and representatives from industry and

government. Specifically, the organizational committee involved representatives from ECEDHA practicing engineers from companies that have a strong global footprint, and from government agencies. The second workshop started with an update session to determine where things currently stand with regard to globalization of the ECE profession. Tom Friedman has updated his book [6,7] and we are now in a position to gather more information on how companies are doing with outsourcing. Updated information on the current ECE job market was also gathered and presented.

During the first workshop a great deal of information was gathered from industrial executives. In contrast, one theme of the second workshop focused on practitioners with on-the-job engineering experiences. There was attempt to accumulate information about whether or not ECE-dominated companies are good places to work and what daily life is like for engineers working to develop small start-up companies.

A second theme of the workshop was best practices and curricular development. There was an effort to gather information about the types of outreach activities in which ECE departments are currently engaged to address recruitment and retention of students and faculty in the face of globalization. Information on programmatic changes to improve global awareness and technical skills for global engineering was also presented. Opportunities to provide information electronically will be made available to those of our members who are not able to attend the workshop.

The workshop organizing committee consisted of Dr. Kenneth Connor, Chair of Electrical and Computer Engineering at Rensselaer Polytechnic Institute; Dr. Stephen Goodnick, Associate Vice Chancellor for Research at Arizona State University; Dr. Kenneth Jenkins, Head of Electrical Engineering at Pennsylvania State University; Dr. Hossein Mousavinezhad, Chair of the Department of Electrical Engineering at Idaho State University; Dr. Issa Batarseh, Head of Electrical and Computer Engineering at the University of Central Florida; Dr. Mark Smith, Head of Electrical Engineering at Purdue University; and Dr. Barry Sullivan and Ms. Melissa Swartz, both members of staff at the International Engineering Consortium. The workshop was organized through ECEDHA with administrative support from IEC as part of their long-standing administrative support of ECEDHA annual meetings and associated board meetings.

Attendees at the workshop were a combination of individuals from industry and

government invited by the workshop organizers, as well as delegates nominated by ECEDHA member institutions. Workshop attendees were selected based on their qualifications to contribute to a lively discussion/analysis of globalization and its effects on engineering education. Thus the attendees included both experts on globalization, engineering curriculum development, and continuing education.

### **Workshop Agenda**

The topics from which sessions were developed for the February 2008 workshop included but were not limited to the following:

- a) To start with an *update session* to determine where things currently stand with regard to globalization of the ECE profession. Updated information on the current ECE job market will also be gathered.
- b) To gather *information from working engineers* as to what their present jobs are like under the influence of globalization. There will be an attempt to accumulate information about whether or not ECE dominated companies are good places to work and what daily life is like for engineers working to develop small start-up companies.
- c) To highlight *outreach mechanisms and activities*. There will be an attempt to accumulate information about the types of outreach activities in which ECE Department are currently engaged. For example, such activities could build on the ECEDHA-related web site that is now maintained at Oregon State University.
- d) To *build on NAE themes* [8,9] that resonate with prospective students and their parents. (e.g. Engineering is essential to our health, happiness and safety).
- e) To dwell on how to *enhance the total ECE educational experience*. The question of how the ECE educational experience can be improved to attract and retain the best student body will be central to these discussions.
- f) To better understand the *forces that are luring students away from ECE* and toward Mechanical, Biomedical and Civil and Environmental programs. An effort will be made to better understand the factors that lead students in these directions and new strategies will be developed to attract more students to enroll in Electrical and Computer Engineering programs.

The 2008 workshop focused on the *implementation phase*, with its goal being to quantify the effects of globalization on the Electrical and Computer Engineering profession, to propose ECE curriculum revisions designed to prepare students for further changes in the future, and to deal with issues involving the recruiting and retention of undergraduate students, graduate students, and young faculty. The role of

ABET was re-examined, and the workshop considered ways to define changes needed in the ABET process to facilitate the creation of curricula that prepare students to deal effectively with globalization in their profession.

The workshop program opened with a Keynote address by Dr. James Melsa, Dean Emeritus of Iowa State University and current President of the American Society for Engineering Education. Dr. Melsa also has extensive industrial experience, having spent 11 years at Tellabs, Inc. where he served as Vice President of Strategic Planning and Advanced Technology, Vice President of Research and Development, and Vice President of Strategic Quality and Process Management. The first day of the workshop centered around two invited panels, one a panel of experts from industry and the second a panel of experts from academia. During the morning of the second day the attendees broke into discussion groups to address pre-assigned topics. Following the working meetings of the breakout groups all workshop attendees reconvened in a single meeting and breakout group representatives will reported their preliminary conclusions. Finally, breakout groups prepared brief reports on the most important lessons learned. These reports will be presented at the spring ECEDHA meeting in San Diego on March 14<sup>th</sup> – 18<sup>th</sup>, 2008, after which the final report for this workshop will be prepared for distribution to NSF and the ECEDHA membership, as well as to be posted on the ECEDHA webpage for public access.

In order that attendees came to the workshop prepared to actively participate in the workshop a survey of ECE Department Heads was conducted prior to the workshop in an attempt to compile information about innovative practices in which ECE departments are currently engaged to aid in recruitment and retention of students and faculty and to properly educate ECE students who will face the impact of globalization. This survey compiled inputs on key issues to be addressed at the workshop, and encouraged the inclusion of ideas, problems, and solutions from an input pool that was considerably larger than the group of individuals who attended the February 2008 workshop.

## **2. Summary of Keynote Addresses and Featured Speakers**

Five Keynote speakers were featured on the workshop program. James Melsa and Wayne Johnson delivered their Keynote addresses at the opening session of the workshop. Om Nalamasu and John Kent delivered their Keynote addresses in

the afternoon session of the first day. Genevieve Bell was the featured speaker at the workshop dinner on Monday evening and Paul Penfield was the featured speaker at the breakout session on Tuesday morning. Videos of the Keynote addresses and Featured Speakers and powerpoint presentations for some of the speakers can be downloaded from the ECEDHA website at the following URL:

<<http://www.ecedha.org/membership/workshop2008.asp>>

Summaries of the Keynote presentations given by James Melsa and Wayne Johson follow below.

**2.1 James Melsa**, Dean Emeritus, Iowa State University and ASEE 2007-2008 President, “Educating Engineers for a Global World”

Dr. James Melsa focused his presentation on five specific areas: 1) the historical background on the ASEE, 2) why globalization is important, 3) results of the ASEE Survey of Deans, 4) what is the ASEE doing with regard to globalization?, and 5) suggestions for future actions. Under the first item, he explained that the ASEE was founded in 1893 and currently has over 13,000 members, including 400 colleges of engineering and engineering technology, 700 global online members, and 100 corporations, professional organizations, and governmental agencies. One of the items that he highlighted as part of the ASEE mission statement is its commitment to “exercise worldwide leadership.”

Under the second item addressed, he emphasized that the ECE profession is “in search of global engineering excellence, a need that has been largely unaddressed in the United State until recently.” In his presentation he talked about the “economically flat world” within the context of “the engineer of 2020” and “ABET criteria 2000.”

In the context of the third item Dr. Melsa explained that the ASEE Survey of Deans solicited inputs from approximately 300 US engineering programs with a response of approximately 15%. The purpose of the survey was to better understand the state of international opportunities for engineering students and to quantify how engineering colleges are addressing globalization. The

presentation included a discussion of a number of different academic and industrial models that have been developed to address globalization.

Under the fourth item Dr. Melsa described a number of major ASEE initiatives in various areas of globalization. These included Global Colloquia, the International Federation of Engineering Education Societies (IFEES), Indo-US Collaboration for Engineering Education (IUCEE), an International Association for Continuing Engineering Education (IACEE), and Engineering for the Americas (EftA).

Finally under the fifth item Dr. Melsa summarized a number of suggestions that the ASEE has put forth to deal with issue so globalization. These included a recommendation to leverage your university's programs, to make your programs multi-faced, to investigate NSF support, to explore support from foreign government programs, and to "stop talking and do something!"

## **2.2 Wayne Johnson**, Vice president, University Relations Worldwide, Hewlett Packard, "The Global Landscape: An Industry Perspective on Trends, Challenges, and Advances"

Mr. Wayne Johnson focused his presentation on five specific areas: 1) Student Achievement and Economic Impact – the role of education in global development, 2) Data from OECD Science, Technology and Industry Scoreboard 2007, 3) the U.S. Education Challenge, 4) Assessment and Impact, and 5) Challenges We Face. Under the first item Mr. Johnson discussed how the worldwide intellectual equilibrium is changing with respect to engineering graduates. He cited NRC Science and Engineering indicators showing that number of engineering graduates produced by China, India, Japan, and the United States in 2004 was 300,000, 200,000, 104,478, and 59,536, respectively. In response to the question of "what is going on around the world?" he explained that developing nations are making significant investments in S&T and innovation for economic development. He cited the example that Ireland's GDP per capita had risen in the last 15 years from less than 60% of the EU average to overtake UK's GDP in 2002. This was a result of direct foreign investment and a major commitment made by successive Irish governments to expanding

educational opportunities. The presentation included a description of aggressive economic investments made by the governments of China and Singapore.

In the second focus of his presentation Mr. Johnson presented data that showed “R&D intensity, 2005” figures for nations around the world, and for the evolution of gross domestic expenditures on R&D during the period 1995 – 2005. Data was also presented showing business-funded R&D in higher education and government sectors, shown as a percentage of R&D performed in these (combined) sectors. The data showed that the United States ranked 31st in the list containing the top 35 nations in this category.

With regard to the U.S. Education Challenge, Mr. Johnson stated that the world’s most valuable commodity – well-educated students – is getting harder to find. Two factors that make it hard for companies to adjust is the loyalty deterioration between employers and their employees, and a mismatch between what educational institutions are producing and what companies need. Education is the foundation of competitiveness, and educators must strive to be relevant to corporate and business needs and education must adapt as needs/skills change. The presentation then turned toward discussing two recently published books, the first that was “Is America Falling Off the Flat Earth?” by Norm Augustine, and the second “A whole New Mind” by Daniel Pink.

Under the item involving “Assessment and Impact” the presentation discussed how employers measure progress and described the transition of the engineering profession to outcomes-based assessment that has been reflected in educational institutions through Engineering Criteria 2000 (EC2000). Mr. Johnson expressed the opinion that since EC2000 was instituted Hewlett Packard and other industries have noticed improved abilities and capabilities of graduates. A final point made in this category was that educators must respond to current needs through the development of “Partnerships for the Future.”

The final portion of Mr. Johnson’s presentation focused on three major challenges that the ECE profession faces today. These include the “innovation”

challenge, the “disintermediation” of research challenge, and the “model” challenge. With regard to the “model” challenge, there will not be one single model for globalizing, but there will be many. Emerging models will be based on rapid growth in some regions and rapid contraction in others. In adapting to a globalized world there will be significant restructuring along the way as organizations and institutions attempt to deal with new forces while continuing to accomplish their mission.

### **2.3 Additional Featured speakers** (see website for videos and slides)

**Om Nalamasu**, Vice President, Advanced Technologies CTO, New Business and New Products Group, Applied Materials (Monday afternoon Keynote Speaker on industrial perspectives)

**John Kent**, VP Technology Development, AMI Semiconductor (Monday afternoon Keynote Speaker and industrial perspectives)

**Genevieve Bell**, Director, User Experience, INTEL (Featured Speaker at the workshop dinner on the interactions of technology and society)

**Paul Penfield**, Professor Emeritus, Massachusetts Institute of Technology, “Models for Engineering Education” (Tuesday morning Keynote Speaker on education)

## **3. Summary of Industrial Panel**

Globalization is being driven by industry, so we need to hear from them about their experiences. Each speaker talked about his/her global engineering experience. What is lacking in the skill set of graduates?

**Robert Aitken, ARM Fellow** – ARM designs microprocessors with 10 billion processors shipped. They are in 17 total countries with design in 7. The working environment is very different from traditional cubicle model. The Dilbert model engineer does not find a job in the US anymore. When he was at HP, the cultural difference he saw was between California and Colorado. When starting their Indian operation, the manager of it did not want to be the dumping place for stuff no one wanted to do in US. They needed to have the other operations competing. Everyone needs to be better than just in their ability to

apply engineering principles. That is expected. They are now looking for skill sets to deal with multiple geographies ... people skills, not just people management skills. They have to operate in different cultures. It turns out that US students are pretty well prepared to do this. US students experience one of the most diverse cultures anywhere in the world. We need to take advantages of internships. Engineers have to be willing to take on a new environment – a skill set that can be built up during the educational process. ARM is not that great about setting up international internships. All could do better at that. Need flexibility and adaptability. Need to be able to do different things. Need people who are really good at learning things so when something new needs to be done, they can do it. How do they assess whether students are good at learning things? Give them a problem they have not seen before. Are they methodical or guess or fake an answer? If the student says they look on the internet, this shows that they are thinking. They don't do this in the interview. Hence the result is that we need to help students better understand the interview process.

**Sergio Camerlo, Director, Engineering, Redback Networks** – Design teams are now spread out everywhere in the world. Resources are not collocated. When he worked at Cisco, he was in a vertically integrated group. If they needed more resources (additional bandwidth), they would hire what they needed. They had very minimal dependency on external resources. This was good to some extent, but could not scale forever. The amount of bandwidth hugely increased. A side effect of this was that when organizations grow bigger, they may become less agile. They are less able to respond to changes in the market. His second experience in a startup – small number of people, very agile, fresh ideas, changing hourly, resources willingly kept to a minimum. The need for skills and resources was satisfied by outside contractors, partners, etc. New issues – things needed to be documented better, project management and ability to communicate became much more important, clear definition of tasks was necessary. Today at Redback (part of Ericsson) some of the same situation exists. Some teams are pretty much everywhere. He deals with 5 design groups spread out all over North America. Vendors are everywhere. He deals with 3 continents, different time zones, different needs, etc. Using the information tools available now, where people are does

not matter. Being connected all the time, exchanging databases, ... He can get to fresh talent almost at his fingertips. He can find talent from universities anywhere, not just in the US. Hard skills are not difficult to come by these days. Engineers who are well educated/trained, who want to change and improve things, can come from anywhere. His real team is very small; his virtual team is large. More is getting produced in a shorter time at a lower cost. Students in our institutions need to be global leaders; they need soft skills in addition to science and math. They need to know about other cultures, how they live and interact with one another. They need respect for other cultures. Even our definition of right and wrong may not be correct. He discovered that it helps him a lot to know more than one language. Students need to have a zest for innovation (some amount of creativity). He is not convinced that this is only a gift. Engineers need to not be afraid to fail. There are immense opportunities to invent things that are greener and more environmentally sensitive. We need to do things better. School should foster a global awareness enriched by soft skills. We should instill enthusiasm and creativity and be able to deal with groups united only by the information highway. However, he is traveling more now because he needs to still be face to face. Will video conferencing ever be able to replace this? It will help improve communications, but it will never totally replace face-to-face communication. We will simply be demanding more which cannot be done with human contact. Should we require a language? Should there be recognition of language skills (certificate)?

**Terry Morris, HP Fellow** – Can university education do anything to improve globalization? Is it possible to address this academically? Globalization in electronics and computer engineering is in the same state engineering education was in 100 years ago at the beginning of the industrial revolution. Then the skill set was with self taught mechanics etc. Universities responded by coming up with the appropriate experience to educate engineers. There are obstacles to making this happen. He, of course, looks at things from the engineering management perspective. He has mission. Physics is the same in all cultures, but the values may differ, the process of design is not the same, education is not the same. In some cultures there is a lot of rote adherence to precept. Some put a large value on creativity. We need to consider more than just the US

interacting with other countries. All countries have interface problems. At the present, the main methodology is to value cross cultural experience. People build on their experiences, but what they have experienced can be taught. Regarding internship opportunities – some are 2 weeks long (call this a vacation), while some are 10-20 weeks (there is a big disparity on what people consider an internship). An issue he had coming from Texas to work with the groups in California and Colorado at HP, was that he could not communicate some things effectively to certain groups. One organization would only listen to someone from Stanford. His solution was to chose a book from a Stanford professor and spread it out over the company to find the common point. Time zones and languages are issues. Engineering skills are universal. They did a talent exercise to understand what they had. How to integrate the global aspect is the bigger challenge. Many people he asked do not believe these things can be addressed academically. What should students study if they are sent overseas? People should be immersed in a culture with a common set of goals. Hard skills may be best for this purpose.

**John Kent, VP Technology Development, AMI Semiconductor** – All of us carry identities (live in Idaho, Red Sox fan, etc.) Relating his experience in 1994 in Europe when he needed to do calibrations with Siemens (a partner), the solution was to carry wafers by taxi from France to Dresden. He was amazed that this could be done. In a second experience, he traveled 12 time zones, got in a taxi, followed a camel cart, and then met a peer who had the same manager. What does this mean for students? They need to belong to a global organization, which is something they learn in the work environment. There is a language that needs to be learned to help grow up in this environment. Addressing the workplace and the cost of education, it costs them \$130k per year per engineer. If the cost of educating an engineer seems high, consider the productivity. A world without borders means a world without clocks, which means that we have to pull work together across time zones. Working between countries ... we tend to have an offset at a given level. There are more advanced degrees in the European part of company. Other countries may have a distribution of education and compensation that does not necessarily make sense to managers. Technology enablers

such as collaboration workspaces are very important. (They use Lotus notes.) Everyone needs to work from the same script. Broadband communications do not substitute for face to face interaction. Internships and co-ops are absolutely necessary and more than worth the 5<sup>th</sup> year of school (his personal experience). Culturally one of the biggest issues is different management styles in different places. Some are top-down, some are team collaboration, etc. It is possible to seek global commonalities. Can always find interesting coincidences and building on them, unifying principles should be pursued. Visa issues can be a problem but also provide opportunities. They have more flexibility to place people in less attractive places in if a visa or green card is available as a benefit. Certain areas excel in certain tasks. It is possible to build on recognizing where the skills are to make an organization more effective. In AMI, they create and invest yearly in an engineering forum. They bring 300 engineers together in US or Europe, have a juried paper conference with internal proprietary info; this permits them to associate faces with ideas better. Engineers must build a sense of belonging to the global culture. What about continuing education for employees, do we have a role in this? They have been very selective in developing relationships with universities located near their sites. They encourage many of their engineers to get masters programs in business.

**Michael Resso, Business Development Manager, Agilent Technologies.** – He took Fields as a junior, which convinced him to go digital. There is an emerging technology called signal integrity, where high speed signals on pcb traces now become transmission lines. He did his degree in digital but he needed to learn the fundamental transmission line theory. The curriculum had a gap where students made a decision to go digital or microwave. There is a train crash coming because what is needed is a mix of technologies. Need to have the fundamental building blocks. Need to address gaps where most of the interesting new stuff comes from. The University of South Carolina has a curriculum in signal integrity, which has an exceptionally high placement with Intel. We should not make a choice between analog and digital. The different groups lose the ability to communicate with one another after the junior year, because we use different terminology in different sub disciplines. We need language commonality. At

HP/Agilent he did a lot of international business development. He could decide where best to introduce new products. The best place was Japan. Field engineers had a knowledge base there with the market and technology and if certain things were fixed the product would do well world wide. Language skills are important. Need to show a desire to learn about the local culture which helps develop relationships. Need some cultural experiences. There is a controversy between IQ and EQ (emotional quotient) ability to relate to others and utilize interpersonal skills. Engineering schools need to have admissions requirements for languages in high school. Hence we need to put more constraints on H&SS choices for our students.

All Panel Members Received the Following Questions

Question – **Should we push 5 years?** From an article in the Croatian World Network (CROWN [www.croatia.org/crown](http://www.croatia.org/crown) ) – He is looking for a master of global engineering program. Need a program that enables four key things in globalization. (1) Global competence needs to become a key qualification for engineering grads, (2) transnational mobility for engineering students, researchers and professionals needs to become a priority, (3) global engineering excellence depends critically on a mutual commitment to partnerships, especially those that link engineering education to professional experience, and (4) research on engineering in a global context is urgently needed. Global activities do not start at the lowest point in an engineer's career. Tailoring an MS program to global engineering may be the best way to do this. How do we stuff this into our course content? Can this be done by coursework or global internships? It will probably take both. We need a good academic rigorous analysis of skills required.

Penn State's EE Industrial Advisory Board did not like suggested tracks in the undergraduate program. They thought this was putting too much of the traditional pattern into the students' experience. The Dilbert engineer is becoming extinct. Maybe students could follow a course track for globalization. What is needed is people who are broadly skilled. Large companies need specialized skill sets and small companies need generalists.

**Women into EE** - How can we advise young women about the cultural issues? Different cultures clearly have different views toward women. The population of women remains the same in EE as it was decades ago. Some cultures restrict how far a woman can go. China is enabling. Many companies find it takes longer to integrate women into an engineering effort. It is important to educate the group on these issues, which takes a lot of work. The team and management have to be supportive. Support and encouragement are the two main things. All have seen outstanding contributions from women, so women students should not be discouraged. In US and Europe, things work the best.

**There is a lot of propaganda against globalization.** Everything today is good. For students the key is opportunity. This story is good to tell. Globalization is a slow process by which our economy has propagated around the world. More is being accomplished toward peace through globalization.

What is the differentiator for hiring an American rather than an Asian engineer? An example from software development -- they hired 5 in China rather than 1 in US. The reason it was successful was the system architect was in the US. Software people in US have to manage not write code. The desire to succeed has to be there. The ability to start something and create something is special in the US. The US centric view of globalization must be challenged – they sell their products everywhere. They need to do development in all countries to meet the needs of each market. What are the real reasons why companies do the hiring they do? We are not just hiring leaders, etc.

#### **4. Summary of Academic Panel**

Globalization has a major impact on ECE education since our graduates will be competing in the global marketplace with electrical/computer engineers and computing professionals receiving their bachelor's of science degrees in this important field of engineering & computing practically anywhere in the world. As mentioned in the book by Luc E. Weber, James J. Duderstadt, "The Globalization of Higher Education" [10], engineering schools in China, South Korea, India and other countries are investing in their higher education systems and are able to attract many students (including

international) to electrical/computer engineering and closely related fields. It is interesting that engineering accreditation issues and EC 2000 (engineering criteria) being implemented by ABET (Accreditation Board for Engineering and Technology, [www.abet.org](http://www.abet.org)) are being discussed by many engineering programs worldwide and there are currently several visits by ABET teams to these schools. Several US schools have strong programs for international exchange of faculty, students, study abroad and are allowing “international options” in their program of studies for electrical/computer engineering majors as well as other disciplines. The US has an historical advantage in engineering education, especially in the discipline of electrical/computer engineering as was discussed by one of the panelists. The academic panel of this workshop took place on Monday February 4, 2008 from 3:30 p.m. – 5:00 p.m. and was moderated by Dr. **James Melsa**, 2007-2008 ASEE president and former Dean of Iowa State University. The panelists included Drs. **Joseph Hughes** of Georgia Tech and President of IEEE Education Society, **Steven McLaughlin**, Vice Provost for International Initiatives of Georgia Tech, **Phillip Borrowman**, Chair of ABET International Activities Council (INTAC), and Paul Penfield of MIT (replacing Mr. Kevin Russ, Academic Relations Manager, USA Tata Consultancy Services who could not attend the meeting due to travel conflict.)

After introduction by Ken Jenkins, Jim Melsa introduced panel members who represent academia, professional societies (such as IEEE & ASEE), large universities with strong global component, accreditation organizations and viewpoints reflecting the historical perspectives of ECE education and research. Jim mentioned that as he indicated in his keynote speech earlier in the day, universities are engaging their faculty and students with respect to needed education so that our graduates are ready to compete in the global playing fields. Several universities include components in their curricula which will benefit students who will be working in companies with significant activities in other countries.

Joe Hughes mentioned his many roles in the academia and professional societies and how important it is to understand global nature of ECE education and research, As senior associate chair of one of the largest ECE departments in the country, he deals with many issues directly related to globalizations effects of students education and

faculty's involvement in many collaborative research and academic programs involving international partners. He is also a member of the IEEE's committee on engineering accreditation activities and pointed out the emphasis of ABET's a-k outcomes concerning the globalization and international marketplace issues that many of students graduating from these programs have to deal with. His other duties included serving as chair of the ASEE's ECE Division, he would point out three major points regarding globalization & ECE education: i) the role that IEEE Education Society can play in informing its members (about 3,000 ECE faculty) about the importance of globalization in educational programs offered by ECE departments; ii) challenges resulting from including components in courses and projects that ECE students have to complete so that they are ready to serve effectively as global engineers; iii) also roles played by other professional societies as well as government and funding agencies. There are many IEEE local chapters worldwide, as well as about 50% of education society members being from international schools that can help us in understanding complex global issues with regards to ECE education and research by using seminars, speaker exchanges and international IEEE, ASEE conferences. Globalization is here and it is real! While we all know about international students coming to US for engineering studies, we need to encourage US students to study abroad and complete their ECE degrees. Another factor is the lack of participation of US faculty attending education society meetings and becoming a member (if we just had all US ECE faculty as EdSoc members, the numbers will be greater than 3,000!). It is noted that conference participation by non-US members is high and growing. Some US faculty are not connected or interested in globalization issues. At the same time US faculty are not actively involved in industrial projects carried on by international companies. What is the main role of professional societies in encouraging faculty members to become more globally engaged?

Steve McLaughlin said he will use Georgia Tech as an example in his presentation and will be talking about internationalization of the (ECE) curriculum and research & development aspects of a global engineering education. There are several initiatives underway at his school. It is important that someone at the institutional level takes charge of international projects and programs. As we all know from Thomas Friedman's

recent book, world consists of individuals competing globally against individuals. From the US perspective it is important for us to know how we are addressing complex issues involved when educating our graduates not only for R&D positions in the country but with additional responsibility of competing at the international level with other engineers. From the students' perspective internship opportunities abroad are best way to get globally involved and educated, but this can have cost consequences. Here we can get help from our international industrial partners as appropriate. Some schools (including GT) have started international campuses with the mission of becoming a research university of the 21<sup>st</sup> century with a global emphasis. Again according to Friedman, research and education are pre-requisites for economic development and growth. Georgia Tech is very active at the international scene establishing four (4) campuses overseas: France, Ireland, Singapore and India (most recent.) We are also working on other initiatives and centers including those with University of Pretoria, Shanghai Jiaotong University, technical university of Munich/Polytechnic, and Peking University (PKU.) Our university's goal is to have 50% of our students having an international experience (presently we have 35%.) About 10% of students choose the international plan in their major curriculum. These include coursework, language competency and 26 weeks of study abroad. We are also encouraging education/research projects, internships, capstone courses with our international partners. These are all important for economic development of the countries involved. We have dual degree programs at BS/MS/Ph.D. level with the Middle Eastern countries. These and other related international projects are all initiated, developed lead by our faculty and administratively enhanced. Most of these projects are self-sustaining with some exceptions.

Phil Borrowman gave a brief report about historical involvement of ABET at the international scene. INTAC (international activities council) has been very active in recent accreditation visits taking place in several countries. These visits are part of non-domestic site visits of ABET and they usually start with MOUs, letters of intent and accords and/or agreements. There are several issues concerning international visits but both team chairs and PEVs (program evaluators) are becoming more familiar with these as the number of programs abroad seeking accreditation continues to grow. As we all know ABET started in 1932 with 23-24 member societies signing the initial

charter of the organization. There are four (4) commissions and INTAC responsible for carrying out the mission of ABET. Most accreditation activities offshore started after several countries signed the so-called Washington Accord (more information is available on ABET website, [www.abet.org](http://www.abet.org)). Before the establishment of INTAC and the international visits, we had the so-called substantial equivalency agreement (1993) and ABET board of directors in 2006 approved a transition plan to train PEVs for international visits. In fall 2007 there were visits by 2 commissions involving non-domestic accreditation. There are many programs involving 25 different institutions in 14 countries. Basically we now have NGRs (next general reviews) replacing the previously existing substantial equivalencies. Notice that ABET is using the official terminology of non-domestic accreditation (as compared with international.) As mentioned previously we now have Seoul, Washington, Sydney and Dublin Accords as well as several MOUs, LOIs with several countries including China (including Hong Kong), India, Ukraine, Vietnam, Peru, Germany, Taiwan, Germany, and South Africa. There are other organizations involved in this process including US Department of State (travel warnings) and the World Bank. There are some complex issues to deal with, knowledge of the criteria, policies & procedures manual. It is a true statement that ABET is a (the) world leader in accreditation.

Paul Penfield presented a few ideas regarding the development and history of the electrical and computer engineering education evolution. He mentioned that he had conversations with several faculty on these topics, both with those who agree as well as those who disagree. The most important problem we face regarding globalization issues is the faculty's involvement due to restrictions on their time and how much commitment they should make. They are not sure whether these efforts will be valued by their colleagues, especially when the time comes for tenure/promotion reviews. Is this an important activity in the eyes of department heads (chairs) and deans and higher university administration? Is there financial support for such activities? In the final analysis the local culture existing in every university will determine faculty involvement and support of the related programs. Large universities (e.g., his university, MIT's ECE Department has about 120 faculty) and small universities will react differently to the issues involving global ECE education. MIT has long term agreements with schools in

Japan, Singapore, joint venture with Cambridge University and others. There are 2+2 (twinning) programs. He then continued with an overview of historical development of ECE education in the United States. Most of these are summarized on the attached handout, Models for Engineering Education which basically covers the period from 1882 to present.

## 5. Summary of Breakout Sessions

### Report from Breakout Session A

**Question addressed:** What specific programs and mechanisms currently exist to prepare ECE graduates for careers in a globalized profession.

**Attendees:** Joe Huges (Chair), Hossein Mousavinezhad (scribe), Adel Ghandakly, Yaobin Chen, Tony Maciejewski, Ragu Balakrishnan, Issa Bartarseh, Gary May.

All participants reported that a variety of curricular options currently exist in their program offerings. The most common include study abroad (including engineering courses), student exchange programs, globalization lectures and options in seminars. Nobody reported a globalization curriculum requirement for all ECE majors. Co-curricular and extra-curricular activities include international internships (both undergraduate and graduate), volunteer organizations such as Engineers Without Borders, and one-time special programs in research and other scholarly activities.

Significant problems we identified include lack of interest of U.S. students compared to non-U.S. students, cost differentials, and low levels of participation. Additionally, there is lack of formal assessment including absence of clearly defined objectives and outcomes. The group identified two potential objectives: (1) training/skills to compete globally, and (2) awareness/appreciation of cultural differences. Possible outcomes that could be assessed are:

- Ability to communicate in another language
- Ability to understand technical materials written in other languages
- Ability to articulate differences in technical requirements or processes in different cultures, ability to reflect these differences in designs, and ability to work in a design team addressing these differences (including design process or style)

- Ability to make design choices that reflect local constraints and parameters such as components or labor cost, management style, regulations, social factors, etc.
- Ability to articulate issues related to intellectual property, ethics, etc. in multiple cultures.

The good news is that most universities appear to be engaged in some activities related to globalization. However, many of these activities may not be directly contributing to the achievement of the above outcomes and may not be formally assessed. Opportunities such as international internships and some study abroad programs appear to be most closely aligned with the above outcomes, but involve small fraction of ECE students. Suggestions for incorporating globalization elements that would benefit all students include use of relevant case studies and resources of global professional societies such as IEEE. Specific curricular requirement such as international design team might be highly valuable but difficult to implement.

### **Report from Breakout Session B**

**Question addressed:** How can we best use ABET Processes to promote global awareness and preparation for working in a global economy.

**Attendees:** **Stephen Phillips (Chair)**, **Stephen Goodnick (scribe)**, Malgorzata Chrzanowska-Jeske, Cauligi Raghavendra, Ken Connor, Toma Hentea, Anthony Kuh, Hiro Mukai, Jiann-Shiou Yang, and Kang K. Yen

The group began by reviewing existing implicit and explicit ABET References to global awareness and preparation. Criteria 2 and 3 contain several implicit and at least one explicit reference to these topics:

*Criterion 2:* Program Educational Objectives: A program may choose to include global issues along with an associated assessment process (e.g., educate engineers to be competitive in a global environment).

*Criterion 3:* Program Outcomes and Assessment

**Outcome c):** an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

**Outcome d):** an ability to function on multi-disciplinary teams

**Outcome g):** an ability to communicate effectively

**Outcome h):** the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

**Outcome j):** a knowledge of contemporary issues

Changing ABET outcomes (a-k) themselves is probably not desirable due to the large administrative inertia of ABET. One might instead define measures that satisfy a-k that are strong in global content. It is also possible to add additional outcomes although this creates additional burden for the ABET review. For outcomes assessment a rubric can be useful. For global awareness rubrics might include the following:

High level of global awareness: Semester abroad

Moderately high level: Internship abroad

Average level: Mastery of a second (or third) language

Modest level: Senior design project with multinational team

Low level: Course with global content

While the ABET process has moved away from explicit bean-counting there is still a tendency to compartmentalize topics into distinct courses. A more effective approach to globalization is to thread concepts throughout the curriculum. In particular, in order to prepare students for an effective global experience, it is important to start the preparation early, preferably in the first year.

For long term educational goals it is helpful to consider specific measurable objectives. These may be measured in senior surveys, alumni surveys and industry surveys with specific questions about global experiences. Suggested measures of Global Experience (objectives) are:

- 1) After 5 years the number of graduates placed in positions abroad
- 2) After 5 years, the number of graduates working in global teams
- 3) After graduation, concrete evidence of participation in international conferences and workshops.

For outcomes during the program it is somewhat easier to provide direct measures.

Measures of Global Experience (outcomes):

- 1) Studied a second language
- 2) Take globally oriented course as part of social sciences

- 3) Study abroad
- 4) Humanitarian projects abroad (engineers without borders)
- 5) Internship abroad
- 6) International content technical courses
- 7) International design projects: multi-country teams
- 8) Cultural experiences between foreign faculty and students with US students
- 9) Bringing in foreign students.

It is generally agreed that in the global environment more emphasis is needed on communication skills. This has been recognized as a chronic weakness of engineering students.

Most programs currently have a significant number of faculty members and students who have international backgrounds. This appears to be an underutilized resource as few have been explicitly involved in global engagement outside of their specific research program.

While not specifically related to the ABET process, several barriers have been identified for study abroad programs. These include financial constraints of the students and institutions, provincial attitudes of students who don't see the value of study abroad and the lack of foreign language skills among US undergraduates.

### **Report from Breakout Session C**

**Question addressed:** What are the expectations for ECE Academic Programs in the year 2020?

**Attendees:** Thad Welch (Chair), Pali Singh (scribe), Ken Jenkins, Leonhard Bohmann, Arun Somarin, Avitar Singh, Nazmal Ula, Tom Ortmeyer

1. Maintain a core of fundamentals for the discipline.

There was discussion about what the discipline/core really is. Should biology be required as part of the core? How much emphasis should be on analog vs. digital, continuous vs. discrete? The core is a moving target so we must continually evaluate its contents.

2. Proven abilities to work in multidisciplinary teams.

We must facilitate involving other disciplines and more emphasis on working teams. It provides opportunities to participate and contribute in solving larger societal problems (e.g. energy, health, clean water, etc.).

3. Flexibility in students' self-design of the curriculum.

There is a diversity of ECE programs throughout the U.S. as well as a diversity of industrial opportunities for ECE graduates. Flexibility in curricular design allows students to adapt to their particular goals and interests.

4. More focus on self-learning as part of the life-long learning process.

ECE programs cannot teach everything in four years that students need for their life-long careers so they have to develop abilities of how to learn on their own. It is important for students to develop skills in self-motivation, creative scholarship, and being innovative.

5. Provide more opportunities for students to engage in external learning experiences.

Globalization can be achieved in many ways, including study in other U.S. universities, study internationally, and through working with a global organization through internships. The goal is to take the student out of their comfort zone and have them experience a higher level of global awareness. We also need to encourage the faculty to participate in activities that take them out of their comfort zone and bring them to a higher level of global awareness.

6. Broader range of courses should be available from other disciplines.

Innovations often come at the intersections of different disciplines, and since we do not know what exactly students will need in their future careers it is important that they get exposed to different disciplines. Many future innovations are likely to occur at the intersections of engineering, biology, chemistry, and materials. Future curricula need to provide enough flexibility that students can aim their careers toward many different professions.

7. More development of learning about other cultures.

Industrial participants at the workshop expressed a serious need for graduates to be better educated in soft skills (written and oral communication, cultural sensitivities, and language skills). Typical training of engineering students in other countries does not include a liberal arts component to the extent that U.S. students experience. ABET accreditation of international institutions could provide a way to cause this to change.

8. A broader range of programs should be available.

Examples of educational models presented by Paul Penfield covered many examples of alternative programs that provide many interesting possibilities. In many regards ECE curricula have already moved toward considering the Master degree to be the basic education for an engineering graduate to enter the workforce as a practicing engineer. The B.S. degree provides a basic engineering education for students to enter into other professions (law, business, medicine, etc.). The Ph.D. continues to provide the educational background for a student to go into a career of research or teaching.

9. More innovation and creativity incorporated into the curricula.

The curricula of 2020 will provide more opportunities for students to customize their educational experience to help them become better prepared for careers of their choice. Heavily prescribed curricula with rigid built-in requirements that assure that ABET criteria are met will become model of the past. More flexibility and creativity will be needed due to the fact that ECE graduates of 2020 will follow far more diverse career paths that lead to many of the other professions as well as preparing them for leadership roles in the U.S. democratic society.

10. Articulate that the discipline of ECE benefits society.

It is important for engineering educators to get the message out to prospective students as well as to society in general that engineering graduates have the capacity to improve the quality of life across many dimensions of society. As our society becomes more dependent on technology to sustain a high quality of life the engineer of 2020 will play a pivotal role in developing

renewable energy sources, in further developing worldwide communications, and improving the environment through innovative engineering solutions.

## **6. Final Recommendations**

### ***Recommended Action Items for NSF***

1. Establish international cooperative education programs
2. Establish international cooperative research programs
3. Enhance international REU programs
4. Initiate program for international interns
5. Establish international fellowship program for faculty visiting institutions abroad.

### ***Recommended Action Items for ECE Departments***

1. Seek support of globalization initiative from university higher administration
2. Establish first year experience for engineering students
3. Establish collaborations with “hub” institutions abroad, with emphasis on Europe, Asia, and South America.
4. Enhance international cooperative programs for undergraduate students, graduate students, and faculty.
5. Establish specific curriculum requirements to meet globalization objectives

### ***Recommended Follow-up Activities by ECEDHA***

1. Sponsorship of Third ECEDHA/NSF Workshop on Globalization: Assessment
2. Organization of special sessions at national ECEDHA meetings

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8. Engineering Research and America’s Future (NAE 2005): Committee to Assess the Capacity of the U.S. Engineering Enterprise.
9. *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter future* (NRC/COSEPUP, 2005).

# Appendices

# Appendix A

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are needed to see this picture.

# Appendix B

**Special Session  
2008 National ECEDHA Meeting  
San Diego, CA  
March 14 – 18, 2008**

< <http://www.ecedha.org/membership/program2008.asp> >

10:30 am - noon

NSF/ECEDHA Globalization Workshop Revisited

**Facilitator:**

- Ken Jenkins, Pennsylvania State University

**Panelists:**

- Industrial Panel, Ken Connor, Rensselaer Polytechnic Institute
- **Academic Panel**, Hossein Mousavinezhad, Idaho State University
- **Breakout Session A**, Keith Teague, Oklahoma State University
- **Breakout Session B**, Steve Phillips, Arizona State University
- **Breakout Session C**, Thad Welch, Boise State University
- **Invited Participant from Hong Kong**, Khaled Ben Letaief, Hong Kong University of Science and Technology
- **Invited Participant from Jordan**, Robert Ayan, Cambridge Advisors

# Appendix C

## Project Participants

**Name:** Jenkins, W. Kenneth  
**Contribution to Project:** Member of the Workshop Organizing Committee and Workshop Participant

**Name:** Connor, Kenneth  
**Contribution to Project:** Member of the Workshop Organizing Committee and Workshop Participant

**Name:** Sullivan, Barry  
**Contribution to Project:** Member of the Workshop Organizing Committee and Workshop Participant

**Name:** Smith, Mark  
**Contribution to Project:** Member of the Workshop Organizing Committee and Workshop Participant

**Name:** Mousavinezhad, Seyed  
**Contribution to Project:** Member of the Workshop Organizing Committee and Workshop Participant

**Name:** Batarseh, Issa  
**Contribution to Project:** Member of the Workshop Organizing Committee and Workshop Participant

**Name:** Goodnick, Steve  
**Contribution to Project:** Member of Workshop Organizing Committee and Workshop Participant

**Name:** Bohmann, Leonard  
**Contribution to Project:** Workshop Participant

**Name:** Chrzanowska-Jeske, Malgorzata  
**Contribution to Project:** Workshop Participant

**Name:** Ghandakly, Adel  
**Contribution to Project:** Workshop Participant

**Name:** Kuh, Anthony  
**Contribution to Project:** Workshop Participant

**Name:** May, Gary  
**Contribution to Project:** Workshop Participant

**Name:** Ortmeyer, Thomas  
**Contribution to Project:** Workshop Participant

**Name:** Raghavend, Cauligi  
**Contribution to Project:** Workshop Participant

**Name:** Saleh, Res  
**Contribution to Project:** Workshop Participant

**Name:** Singh, Avtar  
**Contribution to Project:** Workshop Participant

**Name:** Singh, Pritpal  
**Contribution to Project:** Workshop Participant

**Name:** Somani, Arun  
**Contribution to Project:** Workshop Participant

**Name:** Teague, Keith  
**Contribution to Project:** Workshop Participant

**Name:** Ula, Nazmul  
**Contribution to Project:** Workshop Participant

**Name:** Welch, Thad  
**Contribution to Project:** Workshop Participant

**Name:** Wendt, Amy  
**Contribution to Project:** Workshop Participant

**Name:** Yang, Jian-Shiou  
**Contribution to Project:** Workshop Participant

**Name:** Mukai, Hiro  
**Contribution to Project:** Workshop Participant

**Name:** Hentea, Toma  
**Contribution to Project:** Workshop Participant

**Name:** Alam, Mohammed  
**Contribution to Project:** Workshop Participant

**Name:** Yen, Kang  
**Contribution to Project:** Workshop Participant

**Name:** Balakrishnan, Ragu  
**Contribution to Project:** Workshop Participant

**Name:** Chen, Yaobin  
**Contribution to Project:** Workshop Participant

**Name:** Melsa, James  
**Contribution to Project:** Keynote Speaker

**Name:** McLaughlin, Steve  
**Contribution to Project:** Panelist for the Academic Panel

**Name:** Hughes, Joseph  
**Contribution to Project:** Panelist for the Academic Panel

**Name:** Borrowman, Phillip  
**Contribution to Project:** Panelist for the Academic Panel

**Name:** Dudnikov, George  
**Contribution to Project:** Keynote Speaker

**Name:** Aiken, Robert  
**Contribution to Project:** Panelist for the Industrial Panel

**Name:** Kent, John  
**Contribution to Project:**  
Keynote Speaker and Panelist for the Industrial Panel

**Name:** Morris, Terry  
**Contribution to Project:**  
Panelist for the Industrial Panel

**Name:** Resso, Michael  
**Contribution to Project:**  
Panelist for the Industrial Panel

**Name:** Camerlo, Sergio  
**Contribution to Project:** Panelist for the Industrial Panel

**Name:** Nalamasu, Om  
**Contribution to Project:** Keynote Speaker

**Name:** Bell, Genevieve  
**Contribution to Project:** After Dinner Speaker

**Name:** Kiener, Andy  
**Contribution to Project:** Administrative Support

**Name:** Janowiak, John  
**Contribution to Project:** Administrative Support

**Name:** Pappas, John  
**Contribution to Project:** Administrative Support

**Name:** Plummer, Roger  
**Contribution to Project:** Administrative Support

**Name:** Swartz, Melissa  
**Contribution to Project:** Clerical and Administrative Support

**Name:** Johnson, Wayne  
**Contribution to Project:** Keynote Speaker

**Name:** Kunkel, Joachim  
**Contribution to Project:** DesignCon Keynote Luncheon Speaker

**Name:** Russ, Kevin  
**Contribution to Project:** Panelist for Academic Panel

**Name:** Penfield, Paul  
**Contribution to Project:** Keynote Speaker

## **Appendix D: ECEDHA Globalization Pre-workshop Survey Results**

### **1. Please provide your name, department, and institution.**

<b>#</b>	<b>Response</b>
1	Adel A. Ghandakly, ECE Department, California State University, Chico
1	Brian Gilchrist, EECS Dept, Univ of Michigan
1	Brian Johnson, Dept. of Electrical and Computer Engineering, University of Idaho
1	Chaouki Abdallah, ECE, University of New Mexico
1	Clif Pollock, ECE, Cornell
1	Dan Ewert ECE North Dakota State Univ
1	Darren Dawson, ECE, Clemson University
1	David Lilja, ECE, University of Minnesota
1	David Scott, EE Department, Northern Arizona University
1	Dr. Vladimir A Labay, Department of Electrical and Computer Engineering, Gonzaga University
1	Ed Schlesinger, Electrical and Computer Engineering, Carnegie Mellon University
1	Erik Cheever, Engineering, Swarthmore College
1	Fred Looft, WPI ECE dept.
1	Gary May, ECE, Georgia Tech
1	Iowa State University - ECE, Arun Somani
1	J. Van der Spiegel, ESE, Univ of Pennsylvania
1	John Ventura, ECE, Christian Brothers University
1	Ken Connor, ECSE, RPI
1	Ken Jenkins, Electrical Engineering, Penn State university
1	Mark E. Law, ECE, University of Florida
1	Nazmul Ula, Electrical Engineering and Computer Science, Loyola Marymount University
1	Paul Devgan, ECE, Tennessee State
1	Richard R. Schultz, Department of Electrical Engineering, University of North Dakota
1	Rob Maher, Electrical and Computer Engineering, Montana State University
1	Salomón Oldak, ECE, Cal Poly Pomona
1	Sam SanGregory, Engineering, Cedarville University
1	Sarah Rajala, Electrical and Computer Engineering, Mississippi State University
1	Saroj Biswas, Electrical Engineering, Temple University
1	Stanford - EE, Bruce Wooley
1	Stephen Horan, ECE, NMSU
1	Stephen M. Phillips, EE, Arizona State University
1	Stephen Parke, ECE, TTU

1 Thad B. Welch, ECE, Boise State University

1 Thomas Ortmeier, ECE Department, Clarkson University

1 Tim Grotjohn, ECE, Michigan State University

1 Toma Hentea, ECE, Purdue Calumet

1 Tony Maciejewski, ECE, Colorado State University

1 UCCS, ECE- Kalkur

1 University of Central FL, EECS, Batarseh

1 Vladimir Mitan - Electrical Engineering Department - University at Buffalo

**2. Is there attention being given to globalization issues by your faculty?**

Yes  77.5% (31)

No  22.5% (9)

**TOTAL  100.0% 40 (40)**

**3. Is there attention being given to globalization issues by your department administration?**

Yes  82.5% (33)

No  17.5% (7)

**TOTAL  100.0% 40 (40)**

**4. Is there attention being given to globalization issues by your college administration?**

Yes  87.5% (35)

No  12.5% (5)

**TOTAL  100.0% 40 (40)**

**5. Is there attention being given to globalization issues by your upper administration?**

Yes  85.0% (34)

No  15.0% (6)

**TOTAL  100.0% 40 (40)**

**6. Please comment on other levels/forms of sensitivity and concern at your institution with regard to educating ECE students to work in a globalized profession.**

# **Response**

1 about half of our students complete a significant project at one of 20 sites around the world

1 At the college and university level, international partnership is being pursued.

1 Community is very sensitive to this as many local high-tech companies have downsized due to offshoring, e.g., HP and Advanced Energy

1 General focus on multidisciplinary work; expanded institutional ties to several foreign institutions.

1 Globalization is one of the important issues that is being addressed in the 2008 - 2013 EE Departmental Strategic Plan. The Dean of Engineering has appointed one of the Assistant Deans to try to develop new programs and mechanisms for the College of Engineering to enhance opportunities for international student experiences.

1 High concern about globalization at the university, college and dept levels. Variable

- level of concern among faculty
- 1 international experience
- 1 Medium
- 1 Much activity at all levels, research, student exchange, graduate student dual degrees, etc.
- 1 No activity so far
- 1 No Concerns
- 1 No other levels are addressing the issue
- 1 no room to add new course or materials in the curriculum, lack of understanding the need for globalized profession
- 1 No structured program
- 1 None
- 1 none in particular
- 1 Our alumni are strongly stressing education and international exchange programs.
- 1 Our primary concern at the department level is the impression that this is unnecessarily hurting enrollment in ECE. There is also concern across campus that we prepare students appropriately for the globalized workplace.
- 1 Students
- 1 The school administration (i.e. me) is trying to ensure that our program remains attractive and strong, so US students will still want to get EE educations. I worry that the fear of off-shoring coupled with a weak curriculum could be fatal. We need to be even better as we now compete globally for students.
- 1 The university and college have increased attention on globalization and international experiences for students for several years. There has been an effort to increase the number of international students at the undergraduate level, the number and breadth of exchange programs, and increase the number of partnerships with international academic institutions.
- 1 The University has an international student exchange program and also has programs for faculty international travel.
- 1 This is a major topic of discussion at all levels here.
- 1 We are a small department in a state university, making funding a concern.
- 1 We have an international plan that allows students to gain global experience and indicate it on their degrees.

**7. Are there current activities addressing globalization by means of student exchange programs?**

Yes	 85.0%	(34)
No	 15.0%	(6)
<b>TOTAL</b>	 <b>100.0%</b>	<b>40 (40)</b>

**8. Are there current activities addressing globalization by means of international internships?**

Yes	 52.5%	(21)
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No	47.5%	(19)
<b>TOTAL</b>	<b>100.0%</b>	<b>40 (40)</b>

**9. Are there current activities addressing globalization by means of special summer programs?**

Yes	50.0%	(20)
No	50.0%	(20)
<b>TOTAL</b>	<b>100.0%</b>	<b>40 (40)</b>

**10. Are there current activities addressing globalization by means of international partnerships?**

Yes	80.0%	(32)
No	20.0%	(8)
<b>TOTAL</b>	<b>100.0%</b>	<b>40 (40)</b>

**11. What other programs or mechanisms are currently being used at your institution to better prepare ECE graduates to work in a globalized profession?**

#	Response
1	All of these programs exist at BSU, but few if any ECE students participate in them
1	An international research collaboration between faculty
1	Capstone Design
1	Capstone design modules.
1	Change in course descriptions.
1	Exchange of faculty, joint degrees, special projects
1	FIPSE Grant for Exchange Program in Engineering
1	International campuses.
1	International Certificate Program, International sabbaticals
1	International visiting professors
1	Joint Ph.D. programs
1	More MOUs with international universities and research institutes that address all of the questions in this survey.
2	None
1	none in particular
1	not specific to EE, but take a look at: <a href="http://www.wpi.edu/Academics/GPP/index.html">http://www.wpi.edu/Academics/GPP/index.html</a>
1	Not too much; professional awareness opportunities mostly
1	Partnership with international universities.
1	Research
1	semester and year long international programs
1	The college has tried to set up joint degrees with schools elsewhere. It has had very little impact.
1	University has international student exchange program and we have had students

from European countries attend our university. We also had some students but very few. ECE does not at present have any exchange program although we have a number of foreign students.

1 We have some strong international student experiences by virtue of the SPIRT Rocket Program (Penn State students working with Norwegian students on instrumentation packages to be launched on rockets in ranges in Northern Norway). We also have some activities centered around our EPICS (Engineering Projects in Community Service) projects.

1 We send a team of engineering students to Liberia to do engineering work for a Christian Hospital and its associated campus infrastructure each summer

**12. Are you planning new curricular changes to better prepare ECE graduates to work in a globalized profession?**

Yes	42.5%	(17)
No	57.5%	(23)
<b>TOTAL</b>	<b> 100.0%</b>	<b>40 (40)</b>

**13. Are you planning graduate student exchanges to better prepare ECE graduates to work in a globalized profession?**

Yes	57.5%	(23)
No	42.5%	(17)
<b>TOTAL</b>	<b> 100.0%</b>	<b>40 (40)</b>

**14. Are you planning international research collaborations to better prepare ECE graduates to work in a globalized profession?**

Yes	67.5%	(27)
No	32.5%	(13)
<b>TOTAL</b>	<b> 100.0%</b>	<b>40 (40)</b>

**15. Are you planning exchanges through distance learning to better prepare ECE graduates to work in a globalized profession?**

Yes	60.0%	(24)
No	40.0%	(16)
<b>TOTAL</b>	<b> 100.0%</b>	<b>40 (40)</b>

**16. What are the other future plans at your institution to better prepare ECE graduates to work in a globalized profession?**

#

**Response**

1 A new CPE instructional site is being set up in Dubai. It will be possible for students in East Lansing, MI to spend 1 or 2 semesters in Dubai taking MSU courses. It is also anticipated that Dubai based students could spend 1 or 2 semesters in East Lansing, MI. This program starts Aug. 2008.

1 Again all of these programs exist at BSU, but few if any ECE students participate in them

1 Attempting to identify companies willing to provide internships at their non-US locations.

- 1 Continue to build partnerships with industry, universities, remote campuses, etc.
- 1 ECE plans to collaborate with international universities through program development and student exchange.
- 1 Joint proposals, joint research projects, joint senior design projects
- 1 My main concern is not new programs or mechanisms but determining how to get more of our US students to participate. Despite all the publicity and concern, few of our US students have an international experience outside the US.
- 1 no others
- 2 None
- 1 None at this time
- 1 none in particular
- 1 Note: we are strictly an undergraduate school - I will not be able to attend the workshop in February but will be at the annual meeting in March. Globalization for ECE students is a personal interest for me.
- 1 One of our immediate goals is to establish partnering relationships with several foreign institutions so we can begin to develop various levels of exchange programs.
- 1 Partnership with international institute for group and dual degree program
- 1 Required international experience for all undergraduates
- 1 We would like to see more opportunities for global internships and visiting short-courses in other countries (summer)

## **Appendix E**

### Post Workshop Survey Results

(Survey in process)