Internationalizing Our Engineers: 
A Strategic Focus on Sustainability in Brazil

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Motivation Summary:

- Globalization – the world is really “flat.”
- Significantly freer and faster movement of:
  - Goods
  - Services
  - Information
  - Ideas
  - Money
  - People (a lot of people!)
- Rapid growth in technology, especially information technology
- Competitive pressure: outsourcing and downsizing
Commoditization of engineering talent and a need for U.S. engineers who:

- Understand in a global context (ABET):
  - Engineering solutions
  - Economic, political and societal factors
  - Contemporary issues including the environment and sustainability

- Beyond ABET
  - Understand the importance of entrepreneurship, innovation, and lifelong learning
  - Are able to work with colleagues in other countries
  - Can become world citizens!
The First Challenge:

- Only 2.4% of eligible students enrolled in a US engineering or computer science program participate in an international education experience*

* Calculated by combining information from IIE Open Doors and the ASEE Profiles of Engineering.
The Second Challenge

Educate graduate engineers who:

- Can readily incorporate sustainability into engineering designs
- Appreciate the ways in which sustainable design varies internationally, and
- Can effectively operate in an international context
Our Overall Objective

To provide engineering students with an explicit international focus through:

Creative coursework at the University of Pittsburgh

Field experiences that build upon that coursework.
Our Assets

- University Center for International Studies (UCIS)
- Department of Education National Resource Centers:
  - Center for Latin American Studies (CLAS)
  - Asian Studies Center (ASC)
  - Center for Russian & East European Studies (CREES)
  - Center for Western European Studies (CWES) and European Studies Center
  - International Business Center (CIBER)
Brazil: Our Objectives

- Create curricula and research that emphasize multi-disciplinary team-based design
- Enable students to learn a common framework for sustainable design
- Approach sustainability globally – a focus on Brazil

Iguaçu Falls - Brazil
Achieving the Vision

- Nucleate strong research programs, innovative curricular advances, and broad outreach initiatives.
- Forge partnerships: University (national and international), Industry, Foundation, and Government.
Partnership UNICAMP / University of Pittsburgh

Innovative approach to engineering / design education and product development

Multiple disciplines
(various engineering + architecture backgrounds)

Multiple agents
(Collaborative design & research)

Sustainability

Multiple contexts
(Learning from different realities)
FEC/UNICAMP:
Research areas as support for better education

- Housing evaluation and interventions
  - Vernacular
  - Self-built
  - Low-income public housing
  - Open space
  - Innovation and kaizen/target costing
- School building evaluation
  - Comfort conditions and optimization
  - Resource efficiency
  - Teaching comfort
- Vegetation and urban climate studies
- Creativity and design process
- Accessibility and universal design
Pitt Program Objectives

- Train engineers to routinely incorporate sustainability into designs.
- Educate engineers to effectively operate in international contexts and appreciate the diversity in sustainable design across countries and cultures.
- Create sustainable products and processes, especially for the construction and water collection/purification industries.
International Opportunities

Long-term
- Traditional study abroad (typically for one semester)
- Semester-at-sea

Short term
- International service learning programs
- Integrated Field Trip Abroad (IFTA)
  - Plus3 (Germany, Chile, Brazil, China and now Vietnam)
  - EMPOWER (Brazil)
  - INNOVATE (Comparative study of two Asian countries)
  - Product Realization for Global Opportunities (Brazil)
Why A Short-term Program?

- Doesn’t delay time to graduation
- Incorporates international experience in creative and relevant manner
- Frequently less expensive
- Easier for students to study in non-English speaking, non-traditional destinations
- Easier option for non-traditional (older) students
- Teaser: Students desire to go abroad again
IFTA

- Combine course (typically in spring term) with a short-term experience (spring break or summer)
- Structured academics, and organized itineraries but freedom outside classroom
- Offered at various levels (rising sophomores through seniors and even graduate students)
- Highly interdisciplinary in nature and often with other universities and/or colleges within Pitt
- Could be used to fulfill technical elective or Humanities / Social Science requirements
IFTA Example Plus3

- Designed for rising sophomore engineering and business students
- Provides a multidisciplinary team experience
- Have visited: Brazil, China, Chile, Czech Republic, France, Germany and now Vietnam
- Won 2005 Heiskell Award for Innovation in International Education
Plus3: Add-on Course at end of Freshman Year

- Pre-departure
  - Overview of history, philosophical traditions, relationship to U.S., political situation, economic development, art and architecture
  - Basic language instruction
  - Overview of companies to visit; team assignments
  - Tips on traveling; approximately half the students have not traveled internationally.
Plus3 Program Goals

- Immerse young engineering and business students in a foreign culture for two weeks
- Provide experiences in multiple dimensions:
  - Technical
  - Business
  - Cultural
  - Historical
  - Philosophical
  - Political
Plus3 – In-Country

- Company and University visits
- Lectures on economics, relationship to US, politics
- Continued basic language training
- Cultural activities
- Time to interact with hosts
Complete an electronic journal
Prepare a 25 page report
Prepare a 15 minute presentation for symposium in early September
Evaluation and reflection
**Strategic Fit Within the Automotive Industry**

- **Youth**
  - New Facilities = Innovative Techniques
  - Developing Identity
  - Market Selectivity

- **Global Network**
  - Local Facilities to Meet Local Needs

- **Hybrid Vehicles**
  - Leader in Hydrogen-Electric Hybrid Vehicles

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**Workforce**

- **Large Labor Pool**
  - Population of 14 Million People
  - Almost 11 Million People Between the Ages of 15 and 65
  - Many Job Seekers

- **Low Cost Labor**
  - Workers Are Paid Much Less Than in Developed Nations
  - Greater Profit Margins

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**CCTV Headquarters**

- Supposed to be completed by the 2008 Olympics
- Utilizing 2000 workers, 4000 workers at peak to complete project

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**Communism + Capitalism = Success?**

- China produces four times as many engineers as the United States
- Lower salaries for engineers
- Central Government Financing
- Lack of Silicon Manufacturing
- Outsourced to the United States
Sustainability: Combining Education and Research

- Undergraduate Education
  - Certificate Courses
  - NCIIA
  - FIPSE-CAPES
- Graduate Education
  - ESW
  - EWB
  - IRES
- Research
  - GAP
  - IGERT
  - GAANN Courses
  - MSI Fellows
Graduate Education: Overview

- International research based in sustainable design

- Research
  - IRES Research Opportunities
  - IGERT

- Graduate Education
  - IGERT
  - GAANN

- Student Organizations
  - Engineers Without Borders
  - Engineers for a Sustainable World
Integrative Graduate Education and Research Traineeship

- Create sustainable products and processes related to construction industry and water resources

- Forging International Research Collaborations
  - UNICAMP – Campinas
  - University of Puerto Rico – Mayaguez
  - Center for Latin American Studies
Integrative Graduate Education and Research Traineeship

- Introduction to Sustainable Engineering
  - Life cycle analysis
  - Environmental costing
  - Worldwide regulatory frameworks
  - Global and legal issues
  - Risk analysis
  - Social and international implications of non-sustainable design
  - Environmental management in industry
  - Ethics
  - Responsible conduct of research

- Capstone Design Course
  - Two-semester
  - Inter-disciplinary
  - Team-based

- Preparation for Research Study in Brazil
  - Two, 5-credit courses in Portuguese
  - One, 3-credit course in technical Portuguese language
  - IGERT Seminar – economic, political, social, and cultural aspects of Brazil & Latin America
Undergraduate Education: Sustainability/Brazil Overview

- Today’s engineers must function effectively on multinational teams
- Sustainability has not been systematically covered in undergraduate engineering curricula

- Research
  - IRES
  - MSI Summer Research Fellows

- Undergraduate Education
  - NCIIA - International Product Realization
  - EMPOWER
  - FIPSE-CAPES

- Student Organizations
  - Engineers Without Borders
  - Engineers for a Sustainable World
• Investigate renewable energy sources
• Explore Brazil’s utilization of clean power
• Hydroelectric, wind and alternative fuels
• Engage in dialogue with Brazilian sustainable energy industry leaders
• Experience the culture of Brazil
• Utilized Production Consumption Model as sustainability framework
Co-sponsored with IAESTE

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Delegates
- Pitt, CMU, Rice, Wisconsin, Minnesota, Kentucky, Illinois
- Chemical, Industrial, Mechanical, Civil/Environmental, Food/Ag, Bio, Electrical, Materials, Nuclear & Industrial Design
Undergraduate Education: EMPOWER

- **Pre-Departure**
  - Six weeks
  - Brazilian culture, economics, politics
  - Regional & national talks about renewable energy
  - Portuguese

- **Assignments**
  - Perspectives of field to sustainability
  - Sustainability considerations given country infrastructure
  - US energy bills
  - Company reports

- **Post Field Experience**
  - Comparison research report
Undergraduate Education:
EMPOWER Field Experience
IFTA Example
International Product Realization

- Pitt and UNICAMP junior/senior engineering students
- Collaboratively create new products
- Focused on sustainable human development
- Natural extension of IGERT research activities
- Overcome differences
  - Scheduling, Language, Culture
- Visit UNICAMP during Spring Break
  - Collaborate directly on project
  - Internet and video conferencing thereafter
- Funded in part by NCIIA
Initiatives value - Learning from different realities

Ex.: housing in the Brazilian context

- Spatial (social) separation prevalent
- User satisfaction rates - high in all classes when:
  - Ownership is guaranteed
  - Security provided
- Satisfaction cannot be used as indicator:
  - Comfort conditions overlooked
  - Low quality does not trigger user attitudes directly
- Territoriality strongly expressed
- Privacy often a problem
- Communal urban areas rarely adopted by users
- Urban parks and vegetation insufficiently valued
- **Quality of life:** job, family, health and God
- **Sustainability:** reduction in utility bills
Learning from different realities:
Undergraduate Education: NCIIA International Product Realization

- Improve the safety, reliability and energy usage of hot water for showering
- Improve the quality of lighting in homes while reducing energy consumption
Undergraduate Education: NCIIA International Product Realization

- Improve the quality of construction methods and materials for self-built homes
Undergraduate Education: NCIIA International Product Realization

- Find a method to supply clean, safe water that supplements the current systems of municipal supply
- IRES
FIPSE-CAPES: US-Brazil Partnership in Sustainability and Innovative Design (S&ID)

- University of Pittsburgh
- Rose-Hulman Institute of Technology
- State University of Campinas (UNICAMP)
- Federal University of Espirito Santo
Learn to work cross-culturally, in diverse teams (architecture, business and engineering) in international settings both in-person and in virtual, collaborative environments;

Develop viable, marketable products that address sustainable development needs;

Understand the impact of engineering solutions in a global and societal context and achieving insight into professional and ethical responsibilities; and

Acquire language skills and the ability to study in a non-native language.
FIPSE-CAPES

- 16 to 20 students from each country
- US students will receive $1000 travel stipend; $200 per month expense stipend while in Brazil
- $1000 for language acquisition
- Internship experience in Brazil
Undergraduate Education: Research - IRES International Internships

- Research team experience tightly linked to IGERT
  - Two or more IGERT fellows
  - Two or more IRES interns

- Co-led by Pitt and UNICAMP faculty

- *Kick off – Summer 2007*

First Summer
- Six weeks at Pitt (pre departure)
- Four weeks at UNICAMP
- Two weeks at Pitt (post return)

If student takes 10 credits of Brazilian Portuguese, *then*

Second Summer
- Four weeks at Pitt
- Eight weeks at UNICAMP
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University of Pittsburgh