

Global Engineering Competency: Defining, Developing, and Assessing

Global E3 / AE3 Meeting
April 11, 2011

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Global Engineering Competency Activity

Scenario: Imagine you are an engineer working for a multinational corporation that is expanding operations in both South America and Southeast Asia. You are involved in evaluating the feasibility of the expansion, including finding suitable locations and planning operations. How prepared are you to enter this work situation? What knowledge and capabilities do you have and what do you lack?

Task: List and briefly describe five (5) competencies (knowledge, skills, and/or attitudes) you think would be most needed to complete this work assignment.



What is Global Competency?

Possess the knowledge, ability, and predisposition to work effectively with people who define and solve problems differently than they do.

Understand how national differences are important in engineering work.

Adapted from Downey et al., "The Globally Competent Engineer: Working Effectively with People Who Define Problems Differently," *Journal of Engineering Education*, 2006.

International Research and Education in Engineering (IREE): Developing Globally Competent Engineering Researchers

Co-PIs: E. Daniel Hirtleman, Brent K. Jesiek, and Eckhard Groll, with support from Yating Chang and Yi Shen

Program Objectives

- Leverage international partnerships to enhance education and research innovations in U.S.
- Enhance global competency of future U.S. engineers and engineering researchers
- Set stage for future scale-up, including by systematically studying aspects of program

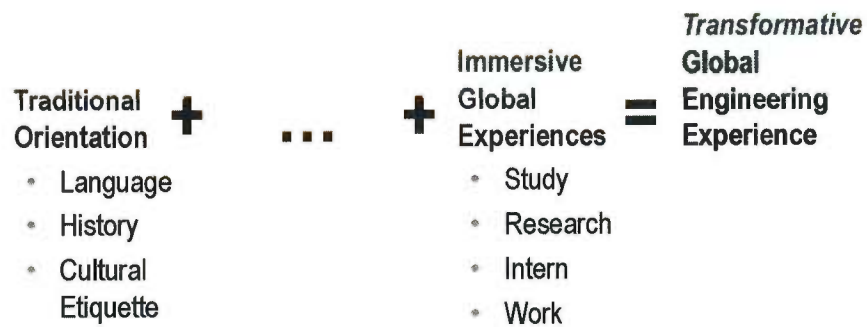
Participant Summary

- 360 applications, 278 complete
- 58 IREE awardees selected
- 21 site- and 37 self-placement
- 27 (46%) women, 26 (45%) undergrad
- 40+ U.S. schools represented
- Diverse host sites, including:
 - Tsinghua University
 - Shanghai Jiao Tong University
 - Xi'an Jiaotong University
 - Tianjin University
 - Peking Union Hospital
 - Microsoft Research Asia
 - Time Medical
 - Intel

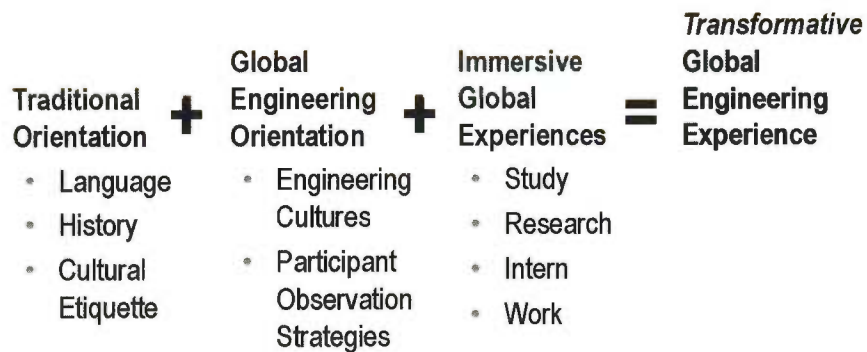


IREE 2010 is administered by Purdue University and supported by NSF through award #0965733

Global Engineering Experience



Transformative Global Engineering Experience



The Janus Face of Culture

**Within a culture,
people are similar.**

**Even within a culture,
people are different.**



Positives

- Easy to learn and remember images
- Allows us to use patterned responses tuned to images

Negatives

- Oversimplifies
- May blind us to exceptions
- Sometimes difficult to detect changing dominant images

Positives

- A much more realistic outlook
- Encourages us to focus on individuals rather than groups

Negatives

- Complexity can be overwhelming
- Individual actions difficult to interpret
- Optimal responses not always clear

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中国工程文化

ENGINEERING CULTURES CHINA
Engineering Education in China:
20th Century Developments

Chapter 10
Educating Engineers for National Development and Defense: A History of Shanghai's Jiao Tong University during China's Nationalist Period, 1896-1949
From: Scott A. Davis

Abstract: This chapter summarizes the nationalized history of one of China's most important and well-regarded engineering schools, Shanghai Jiao Tong University (SJTU). In particular, it examines how the university and its engineering programs evolved in tandem with national developmental and defense objectives from the school's founding in 1906 through the founding of the People's Republic of China (PRC) in 1949. More specifically, we look at key changes in the school's administrative policies, pedagogy, curriculum, and organizational structure, as well as related career pathways for its graduates. To further contextualize the account, the chapter begins with a general history of engineering education and professions in China from the late Qing Dynasty through the Nationalist period. This chapter should be of interest to those working to learn more about the historical foundations of modern engineering education and professions in China, including the role of leading educational institutions in China's nation development.

Key words: China, Engineering Education, Engineering Professions, History, National Development, Nationalism, People's Republic of China, Shanghai Jiao Tong University

Grand Auditorium,
Tsinghua University,
Beijing, China

Source: http://globalhub.berkeley.edu/wiki/index.php/Engineering_Cultures_China Grand_auditorium.JPG

<http://globalhub.org/resources/engcultureschina>

Participant Observation Strategy: Problem Solving with People



Location?
Knowledge?
Desire?

Model Adapted from
G. Downey and J. Lucena,
Engineering Cultures
Course Content

Source: http://marthabeck.com/blog/wp-content/uploads/bigstockphoto_global_business_team_630626.jpg

IREE 2010 China: Comprehensive Research and Evaluation Framework

	Pre-Assess 1 (prior to orientation)	Pre-Assess 2 (during orientation)	Post-Assess 1 (after orientation)	Post-Assess 2 (during experience)	Post-Assess 3 (at or after re-entry meeting)
(a) Background demographic survey	✓				
(b) Readiness assessment	✓		✓		
(c) Diversity survey (MGUDS-S)	✓				✓
(d) Global competency assessment	✓		✓		✓
(e) Reflective exercises, assignments		✓		✓	✓
(f) Survey evaluation of orientation			✓		
(g) Participant interviews, focus groups					✓
(h) Survey evaluation of full program					✓
(i) Survey of hosts and sponsors					✓

Readiness Assessment V2

Readiness Assessment

Last four digits of your cell phone number: _____ (only used for tracking survey data/results)

Please evaluate each statement listed below

	Strongly disagree	Disagree	Disagree a little bit	Agree a little bit	Agree	Strongly agree
1. I am anxious about going abroad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. If I need help while abroad, I will know who to contact.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. While abroad, I know how to keep in touch with my family.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I am prepared to go abroad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I question if going abroad was a good decision.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Adapting to the host country will be difficult for me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I worry about being away from friends and family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. I wish I knew more	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. I fear I will have no	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Going abroad helps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. My experiences ab	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. While abroad, I wil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I am ready to inter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I have sound reasons for deciding to go abroad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Factors**
- Knowledge and Readiness
 - Doubt
 - Perception of Benefits
 - Anxiety

MGUDS-S: Measuring UDO

Miville-Guzman Universality-Diversity Scale – Short Form (MGUDS-S)

- Designed to measure universal-diverse orientation (UDO), or “an attitude of awareness and acceptance of both similarities and differences that exist among people” (Miville et al., 1999).
- 15-item short form (Fuentes, et al., 2000) with three subscales to examine cognitive, behavioral, and affective dimensions of UDO:
 1. seeking *diversity of contact* with others
 2. having *relativistic appreciation* of oneself and others
 3. degree of emotional *comfort with differences*

Miville, M.L., Holloway, P., Gelso, C., Pannu, R., Liu, W., Touradji, P., and Fuentes, J. (1999). "Appreciating Similarities and Valuing Differences: The Miville-Guzman Universality-Diversity Scale." *Journal of Counseling Psychology*, 46(3): 291-307.

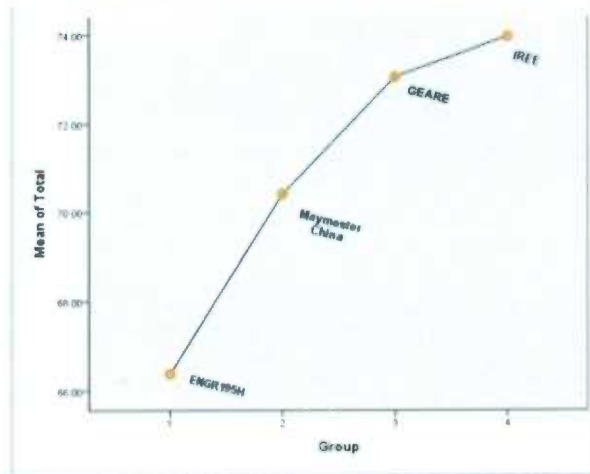
Fuentes, J., Miville, M., Mohr, J., Sedlacek, W., and Gretchen, D. (2000). "Factor structure and short form of the Miville-Guzman Universality-Diversity Scale." *Measurement & Evaluation in Counseling and Development*, 33(3): 157-170.

MGUDS-S: Measuring UDO

	1	2	3	4	5	6
	Strongly Disagree	Disagree	Disagree a little bit	Agree a Little bit	Agree	Strongly Agree
1. I would like to join an organization that emphasizes getting to know people from different countries.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Persons with disabilities can teach me things I could not learn elsewhere.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Getting to know someone of another race is generally an uncomfortable experience for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I would like to go to dances that feature music from other countries.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I can best understand someone after I get to know how he/she is both similar and different from me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I am only at ease with people of my race.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I often listen to music of other cultures.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Knowing how a person differs from me greatly enhances our friendship.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

MGUDS-S Results

Figure 1. Group Comparisons of Total MGUDS-S Scores



Shen, Yi and Brent K. Jesiek. (2011). "Cultural Orientation and Global Competency: A Comparative Assessment of Engineering Students." Forthcoming in *Proceedings of 2011 ASEE Annual Conference and Exposition*, Vancouver, Canada, June 26-29, 2011.

MGUDS-S Results

Mean MGUDS-S Total Scores, Pre/Post-IREE, by Gender



Global Engineering Competency Activity

Scenario 2: As an employee in a large multinational corporation, you are temporarily assigned to your company's branch operations in Shanghai, China. Your work team consists of three Chinese engineers, all at about the same rank as you. Your team reports to an engineering manager, who is also Chinese. In a recent team meeting, your manager presented a solution to a difficult quality control problem. However, you feel you feel the proposed solution will likely fail. How would you handle this situation, and why would you handle it this way?

Global Engineering Competency Activity

Response Pre-IREE (May 2010)

"I would first discuss my opinion with my other these [sic] Chinese teammates (assuming we can communicate). If they agreed with my belief about the failure, then I would suggest we approach the manager as a team and confront him. If they disagreed, or suggested that it was a bad idea to confront the manager, I would still confront him especially if I felt SURE that the product would fail. If the team command me otherwise, I would obviously not go through with it (as long as their reasoning was based on sound engineering/science)."

Response Level: 1

Response Post-IREE (September 2010)

"Even though Chinese people (particularly those of high rank) are constantly concerned about 'losing face', I think issues of quality control need to be addressed upfront and to the point. I would definitely approach the manager one-on-one though, so that the issue is just between he and I."

Response Level: 3

Global Engineering Competency Activity

Level / Description / Example			
0	1	2	3
Clear Evidence of Cultural Insensitivity or Inappropriateness	Cultural Sensitivity Unclear (Response is Neutral or Ambiguous)	Clear Evidence of Predisposition to Cultural Sensitivity (Not Context Specific)	Clear Evidence of Cultural Sensitivity, Including Awareness of Specific Context
"To be completely honest, I'd handle this problem exactly as I would in the USA. I'd make my thoughts known and express the reasoning behind my thought process. Should communication barriers arise, I would handle that in the 'normal' fashion. Honestly, being in China changes nothing about how one handles engineering problems, in my opinion." (FYE Student)	"I would inform the team of my concern and address the concern and any potential solution with my team before speaking with the manager. I am ethically bound to address the problem even the [sic] doing so may be socially awkward." (FYE Student)	"I would prior to being assigned here read about Chinese culture then decide how I could inform him without offending anyone, due to the cultural differences." (FYE Student)	"I would meet with the manager privately, and discuss the situation with him. I wouldn't discuss it with the coworkers because I wouldn't want him to lose face. I would try to bring up the issue politely and pose it as a question, 'Do you think it is possible that it might fail? Do you think that if we did XYZ ... it would have a higher probability of success, etc.?'" (IREE Student)

Advancing
Global Engineering

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- Chinese History and Culture
- Publications and Presentations
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IREE 2010 Outcomes

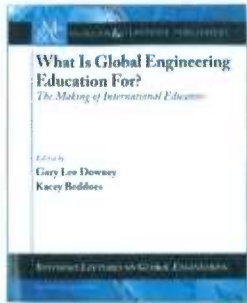
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- Photo Contest Entries

in Engineering (IREE) Program, sponsored by the National University, has completed reviewing applications for the 2010 stipend (US\$4,000 for graduate students and US\$3,000 for undergrad-related research in China from May - August 2010) and will announce for an orientation program; travel to/from and expenses. The 50 students (20 undergraduate and 30 graduate students) will spend 8-10 weeks working on frontier engineering research projects in China.

Good academic standing as degree-seeking undergraduate OR graduate student in a U.S. university. They must also be able to express both a strong interest in related research, and a desire to work in China. Finally, strong ties to the U.S. (citizens or nationals, or permanent residents of the United States) in order to ensure that students from schools with limited research opportunities are able to benefit from the program.

The National Science Foundation (ENG/EEG) in 2006 to promote international engineering professionals, development of collaborations and to provide students with opportunities to experience the life and culture of a different country. It enables U.S. students to gain international research experience and perspective. IREE also seeks to enhance U.S. innovation in both research and education, as well as enable connections between the research programs of NSF's divisions with the education of students.

<http://globalhub.org/iree>



CHAPTER 2

45

From Diplomacy and Development to Competitiveness and Globalization: Historical Perspectives on the Internationalization of Engineering Education

Brent K. Jesiek and Kacey Beddoes

Jesiek, Brent K. and Kacey Beddoes. (2010). "From Diplomacy and Development to Competitiveness and Globalization: Historical Perspectives on the Internationalization of Engineering Education." In Gary L. Downey and Kacey Beddoes (Eds.), *What is Global Engineering Education For?: The Making of International Educators* (pp. 45-76). San Rafael, CA: Morgan and Claypool.

Building Trust

By Roger Neil Rovekamp
Purdue University

This picture was taken from inside the Oriental Pearl Tower in Shanghai. The floor was a thick sheet of glass. It symbolizes the fact that the global engineer must place a certain level of trust in his or her host culture in order to be successful.

