

## **AC 2010-637: THE VALUE OF EXCHANGE: THE BENEFITS OF INTER-CULTURAL ENGINEERING STUDY– A DESIGN TEAM PERSPECTIVE**

### **Saeed Foroudastan, Middle Tennessee State University**

Dr. Saeed D. Foroudastan is the Associate Dean of the College of Basic and Applied Sciences and Professor of Engineering Technology. He received his B.S. in Civil Engineering (1980), his M.S. in Civil Engineering (1982), and his Ph.D. in Mechanical Engineering (1987) from Tennessee Technological University. Professor Foroudastan's employment vitae includes: Assistant professor of Mechanical Engineering for Tennessee Technological University, Senior Engineer, Advanced Development Department, Textron Aerostructures, and Middle Tennessee State University. Professor Foroudastan is involved with several professional organizations and honor societies, and has many publications to his name. He has secured over one million dollars in the form of both internal and external grants and research funding. He also holds U.S. and European patents.

### **Sandi Hyde, Middle Tennessee State University**

Ms. Sandi Hyde received her B.S. in Mechanical Engineering from Tennessee Technological University in 1994. She worked at Nissan North America as Senior Chassis Engineer from 1994 to 2007. She is a Graduate Candidate / Graduate Research Assistant at Middle Tennessee State University.

# **The Value of Exchange: The Benefits of Inter-Cultural Engineering Study- A Design Team Perspective**

## **Abstract**

Children in the sixties and seventies grew up watching cartoons in which characters used futuristic items such as computers and video phones. Now, less than fifty years later, such items are commonplace for many and promote international communications and commerce. Despite the ease with which technological advances have allowed ideas to be shared, language barriers and lack of access to culturally balanced information may still be difficult to overcome. The growth of global economies facilitates a need to understand cultures for which products and services are to be designed, produced, and sold. Surmounting these, and other, challenges is achievable through the promotion of foreign-student involvement in design clubs and through promotion of student-exchange programs.

International student involvement in campus activities and student exchange programs facilitate communication, work to overcome cultural bias, and promote cultural diffusion and diversity while preparing future scientists and engineers for work in a global economy. Middle Tennessee State University (MTSU) has effectively modeled cultural interaction through Engineering Technology Program Clubs such as SAE Formula One, SAE Baja, and Moonbuggy. Domestic students and international students improve their communication and leadership skills while simultaneously learning about varying cultures through these activities at MTSU.

Effective communication occurs in many forms. Colloquialisms and slang often complicate communication between those of differing native languages, as well as different cultures within the same language. While Britains and Americans ostensibly speak the same language, engineers studying trunk closure effort in the US could be understandably confused by “boot” data received from a British counterpart. The mutual exposure of domestic and international students at universities raises awareness of cultural communication differences and facilitates the exchange of ideas.

Business is no longer nationally cloistered. Products may be designed in one country, produced in another, and then sold in another. In order to be competitive, companies must understand not only the market to which they are targeting their products, but also the workforces of the markets in which their products will be produced. Efforts to improve understanding through media outlets alone are not necessarily effective. News reports and the internet often document negative or sensationalistic information that can foster cultural bias. Students at universities, both domestic and international, are more apt to glean an accurate understanding of differing

cultures through their mutual interaction. More importantly, they can develop awareness for the importance of understanding the differences.

Engineering and science students studying abroad will, generally, improve their communication skills and gain confidence from their abilities to interact in a culturally diverse environment. Moreover, they promote cultural diffusion, which can be effective in ensuring their future designs and production activities meet the challenges of global commerce. This paper will discuss the value gained through intercultural interaction and the model that MTSU's Engineering Technology Department has successfully employed.

### **Introduction:**

In the past fifty years, what may have seemed unimaginable in terms of technological advancements have now become commonplace. The TV show *Lost In Space* showed characters using lasers as cutting devices, and now delicate eye surgeries can be conducted using lasers and eliminating the need for eyeglasses or contact lenses. Communications on the cartoon *The Jetsons* occurred over "video phones," and now inter-continental meetings can occur on a face-to-face basis using video-conferencing. Information sent by traditional mail with indeterminate arrival times of days to months can now travel across the internet with the click of a mouse within seconds to the far reaches of the globe. While technological advancements have facilitated global communication and the sharing of ideas, language barriers and lack of access to culturally balanced information remains daunting. Moreover, the ease with which global communications now occur creates new challenges. The growth of global economies reinforces the need for cultural sensitivity and cultural awareness about the countries in which products and services are to be designed, produced. Ideally, these concepts and their importance are introduced to students early in their academic careers through international travel or international studies. However, many engineering programs are rigidly structured in a way that makes taking a semester to study abroad, or taking additional classes in international business, prohibitive. Therefore, it becomes necessary to expose students to culturally-diverse concepts outside of the ideal.

Student involvement in campus activities enhances the students' communication and networking skills and becomes inherently valuable for personal and professional growth, regardless of cultural backgrounds. Encouraging international student involvement in these types of activities provides opportunities for students to overcome cultural bias and promotes cultural diffusion and diversity in a much more relaxing atmosphere than they may encounter in their future jobs. Middle Tennessee State University (MTSU) has effectively modeled cultural interaction through Engineering Technology program clubs such as SAE Formula One, SAE Baja, and NASA Moonbuggy. Domestic and international students of all academic majors improve their communication and leadership skills while simultaneously learning about varying cultures through these activities at MTSU.

## Communication:

Effective communication occurs in many forms and requires skills that must be developed and practiced perpetually. Colloquialisms and slang often complicate communication between those of differing native languages, as well as different cultures within the same language. George Bernard Shaw said, “England and America are divided by a common language.” While this statement may not make sense on the surface, an American who asks a British colleague for a tire changing kit, expecting, perhaps, a tire iron and a jack, may be stymied to receive a pair of running shorts. A “counter jumper” in America might be assumed to be a rogue or thief instead of a salesperson in Britain.<sup>1</sup> Therefore, it is not safe to assume that individuals who speak English will be speaking the *same* English. Effective communication is further stymied when cultural norms between individuals of differing native languages are not recognized or understood. Receiving an answer of “yes,” or “maybe,” from a Japanese associate may actually mean, “I understand your reasoning, but my answer is no.”<sup>2</sup> And while verbal discourse between those of differing native languages may seem to be a primary communication hurdle, non-verbal queues can also present substantial challenges. Unspoken communication, such as eye contact, hand movement, or posture, has been attributed to account for up to 55% of communication dealing with attitudes.<sup>3</sup> If a thumb’s-up gesture, commonly used to signal “OK,” or “good job,” in Egypt, Greece, or Ireland means something offensively opposite if displayed in Iran or Nigeria, then it is vital to be aware of these differences in order to achieve both business and social successes.<sup>4</sup> Furthering the verbal and non-verbal communication challenges are the often-parodied communication abilities of scientists and engineers, exemplified even in children’s programs through characters like Jim Henson’s laboratory Muppet™ “Beaker” who is only able to speak in unintelligible “meeps.” It is easily conceivable that domestic science and engineering students, studying abroad or exposed to and working with students of varying cultures, can develop skills necessary to overcome these, and other similar, communication impediments. As Allan Goodman, president and CEO at the International Education Institute aptly stated in a speech delivered at Chatham University, “Languages convey much more than facts. Since they are the repositories of culture, knowing them enables us to gain perspective” (Allan, 2009, pg. 368).<sup>5</sup> Therefore, interaction among students with differing native tongues provides invaluable opportunities to improve their language skills and cultural awareness simultaneously. Students from varying backgrounds, enrolled at Middle Tennessee State University, are exposed to peer-led-team-learning environments through the Experimental Vehicles Program (EVP), an interdisciplinary collaboration in engineering projects. Figures 1 – 4 show examples of the vehicles built by EVP students, including students from the Caribbean, the Middle East, Mexico, and South America.



**Figure 1. MTSU NASA Moonbuggy Frame**



**Figure 2. MTSU Solar Boat**



**Figure 3. MTSU SAE Baja Vehicle**



**Figure 4. MTSU Formula One Vehicle**

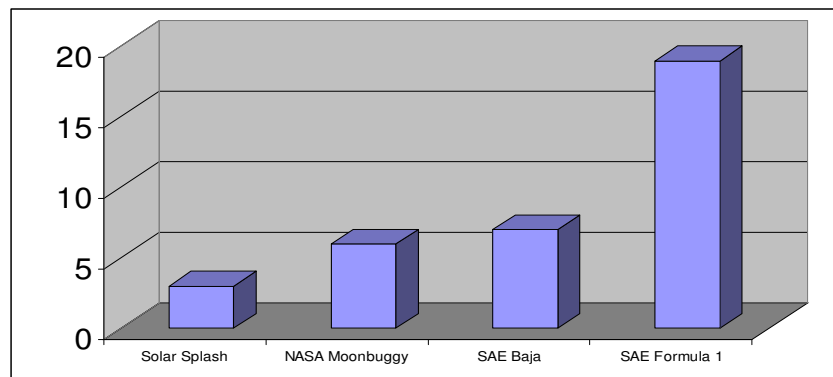
The student-run program, under the guidance of an academic advisor, is based in the Engineering Technology Department but is open to students from any campus major. This program provides a venue for students from all majors, backgrounds, and cultures to hone their verbal, non-verbal, and written communication skills within these diverse groups. EVP members participate in an annual campus-wide fair to promote the team and to encourage others to join. Almost all of the international students at MTSU participating in the EVP have stated that their understanding of, and proficiency with, the spoken English language and American slang has improved as a result of their interaction with other team members and their involvement in making presentations. Domestic students have stated that having international teammates has improved their abilities to understand accents, slang, and typically accepted non-verbal queues, such as personal space boundaries or eye contact. Domestic students engaging in team activities with international students learn to “tune their ears” to individuals speaking English as a second language and are awakened to, possibly many, communication differences that may exist. Students are challenged, then, to learn to effectively and creatively work to overcome communication challenges. The EVP students, when asked, stated that they all felt they had more patience in dealing with cultural hurdles after working among diverse team members than before as a result of working together to raise program funds, to design and build their projects, and to compete nationally and internationally. Not unlike a global workforce, the success of the student teams depends upon their abilities to successfully propagate ideas, explain the reasoning behind technical and non-technical concepts, respect differing opinions, negotiate, delegate, and merge into a cohesive unit of culturally diverse individuals. Additional opportunities for improving, specifically, written communications skills are provided for these students. A team member from the Middle East was especially proud of the improvement in his English writing skills after working with teammates to develop reports and presentation materials. Student teams participating in national and international design competitions must write and submit technical reports about their designs to the judging committees. The team environments provide friendly

venues for students to overcome communication challenges without frustrations. On the rare occasions when there is not at least one international team member on the MTSU team, members meet and communicate with other international teams during design competitions, such as those from Canada, Mexico, and India at the SAE Formula One competition. The communication skills developed through multi-cultural interactions are a significant asset to future engineers and scientists and will prepare them for additional global challenges.

## **Cultural Diversity**

Prior to NAFTA and CAFTA, in the US at least, many products were manufactured in the countries in which they were purchased and sold. With the advent of globalization, products are often designed in one country, produced in another, and marketed and sold in multiple locations. In order to be competitive, companies must understand not only the market they are targeting their products to, but the workforces of the markets their products, or services, will be produced and marketed. Attempts to gain understanding of cultural diversity through the internet or news are not necessarily effective. The aforementioned media outlets often document negative or sensationalistic information that can foster cultural bias. The importance of developing skills to manage differences cannot be overlooked. The full, open-handed wave of Americans is a signal for “no” in many other countries where a wave is accomplished with a still-hand and while raising and lowering the fingers from the palm.<sup>1</sup> Australians appreciate direct and brief business negotiations, which may seem rushed or rude to Argentineans who prefer extensive discussions and multiple consuming meetings before arriving at a consensus. Purple flowers are a predominant theme at Brazilian funerals, so manufacturing children’s toys adorned with violets might be dissuaded. A quality inspection device stamped with a company logo containing a four-leaf clover may be well-accepted in Ireland, but the same device may be eschewed by inspectors in Japan, where the number 4 is considered bad luck.<sup>6</sup> Failure to understand the culture or the reasoning behind cultural concepts may not only seem frustrating but can impede business, marketing, or engineering progress and success while fostering cultural bias. International study and group interaction with international students motivates the exchange of both ideas and cultural ideals while fostering situational sensitivities. Exposure to differing approaches to design, the reasoning behind these approaches, and need to understand these differences is vital to future engineers. Foreign student participation in MTSU’s design team programs and projects provides opportunities for enlightenment to cultural sensitivities and can erode pre-conceived ideas, thoughts, or bias established by limited physical access or exposure to other cultures through regular interaction with individuals from varying cultural backgrounds. In an article entitled “The Paradox of ‘The Box’,” Marianne Lewis wrote that experiential knowledge gained through the multi-cultural interaction teaches students to “think globally and act locally” (Lewis, 2002, pg.1). Additionally, she found that students who spent time at international businesses and among international families transformed their initial focus on perceived inadequacies and differences of the unfamiliar culture at the beginning into respect for the reasoning behind the differences.<sup>7</sup> Along similar lines, MTSU EVP students participate

in multiple design team competitions internationally, with international teammates, and among other international teams. The culturally-diverse teams participating in SAE Baja, NASA Moonbuggy, SAE Formula One, and Solar Splash receive increased exposure to other cultures and other cultural design approaches through these collegiate activities. A common benefit often noted by team members has been their newfound openness to approaching individuals from other countries to ask questions about their customs and how those were incorporated in their designs. Figure 5 illustrates the number of different countries whose students participate in these specific design competitions in which MTSU students have also participated. On average, the EVP teams at MTSU have at least one international team member. While it would be interesting to note how this compares to other Tennessee colleges and universities, access to their statistics in this area has not been obtainable.



**Figure 5. Number of Different Countries Participating in Collegiate Design Competitions of which MTSU has Competed**

Students at MTSU, international and domestic, glean an accurate understanding of differing cultures when they are working alongside them or convivially competing. More importantly, they develop recognition of differences and develop awareness for the importance of understanding the differences. Participation in the EVP allows for the development of leadership and problem-solving skills and abilities in unfamiliar environments. MTSU EVP students of any major or background may develop leadership skills by serving as one of five elected program officers: human resources (HR) manager, public relations (PR) manager, inter-project administrator (IPA), documentation manager, or industry liaison. The HR manager is responsible for managing program awareness campaigns, student recruitment, and member retention. Students holding this office gain invaluable personnel management skills and learn methods for developing rapport with culturally diverse individuals and for developing respect for diversity and difference. The PR manager raises public awareness of the vehicles teams' activities and hones writing skills through the submission of event press-releases. The IP



manager develops time management, space management, and financial management skills. IP managers ensure that each design team has received adequate development time and shop floor space and distributes available funding for each project. The documentation manager gains valuable R&D experience archiving team design and development processes, analysis spreadsheets, preferred suppliers lists, and CAD models and drawings. The industry liaison gains invaluable negotiating skills while generating interest in team activities with potential and existing industry sponsors. All students holding EVP management positions learn leadership skills and obtain techniques for managing culturally diverse groups. Students participating on the teams learn to creatively express their ideas while being led by culturally diverse peer-managers. The resulting team dynamic is a catalyst for growth in understanding of, and respect for, the different cultures of each member. Some of MTSU's past international EVP students have indicated that they would like to start similar clubs after they returned home. As a result of these design and competition activities, indirect cultural diffusion occurs, and walls of ethnocentricity and cultural bias can be removed. Indirect cultural diffusion continues to be the largest thrust behind the global spread of ideas.<sup>8</sup> A study conducted by the Institute for the International Education of Students found that 97% to 99% of all respondents who had studied abroad believed their study-abroad experiences increased their confidence, left long-lasting impacts on their world views, provided increased understanding of cultural values and biases, and provided long-term influence with regards to multi-cultural interactions.<sup>10</sup> And, while this study focused just on study abroad experiences, the results are also applicable to domestic students interacting with international students.

## **Conclusion**

Nobel Laureate Doris Lessing stated in her 2007 Nobel Prize acceptance speech, "We are in a fragmenting culture, where our certainties of even a few decades ago are questioned and where it is common for young men and women, who have had years of education, to know nothing of the world..." (Lessing, 2007, pg. 8).<sup>9</sup> Students at MTSU who are participating in the EVP program's Formula One, Moonbuggy, Solar Boat, and Baja teams are getting invaluable exposure working with, and among, individuals from other countries. These opportunities build communication skills and give them confidence in their abilities work in a multi-cultural environment. This experiential learning environment instills an intercultural cognizance necessary for ensuring cultural flexibility and cultural diversity as the students enter the workforce.

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