

**AC 2007-2387: GLOBAL TECHNOLOGY INITIATIVE STUDY-TOUR TO ASIA
AT SAN JOSE STATE UNIVERSITY**

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Global Technology Initiative Study-Tour to Asia at San Jose State University

Abstract

Prompted by the outsourcing of knowledge-based jobs in Silicon Valley and elsewhere in the U.S. and by the resulting necessity for students to adapt to and capitalize on the global economy, the College of Engineering at San Jose State University established a one-million dollar Global Technology Initiative (GTI) Study Program to provide American students with a global perspective and understanding of the issues. The initiative has sponsored an annual program study tour for 25 undergraduate students on a two-week all-expense-paid study tour to Taiwan and China during the summers of 2004, 2005 and 2006. We reported our 2004 experience at the 2005 ASEE Annual Conference and developed new and improved study programs for 2005 and 2006. This paper summarizes the programs of the past three years and proposes ways to develop future study programs of a similar nature. The focus is on program development and assessment, with a brief discussion of student selection and logistics.

1. Introduction

The dawn of the 21st century has brought about the rapid global integration of corporations and workforce. Knowledge workers such as engineers compete globally on the basis of both their capabilities and their costs to the employer^{1,2}. Because American engineers demand high salaries, they need to develop higher-level capabilities in order to be competitive. It is critical that American engineering students understand and prepare themselves for this new environment. To this end, the College of Engineering at San Jose State University (SJSU) established a one-million dollar Global Technology Initiative (GTI) Study Program to educate American students on the development of global enterprise. Business leaders in the high-technology industry with strong business ties in Silicon Valley and the Asia-Pacific region provide financial support for the GTI Study Program.. The study program is structured as a one semester credit course that culminates in a two-week, all-expense-paid study-tour to companies in Asia that have strong ties to Silicon Valley industries. For each of the past three years since 2004, the GTI Study Program has sponsored 25 undergraduate students to Taiwan and China.

The 2004 GTI Study Program experience was reported at the 2005 American Society for Engineering Education Annual Conference & Exposition³. Subsequent to this new and improved study programs were developed for 2005 and 2006. The themes for the 2006 GTI Study Program were expanded to include the following issues: the global economy, sustainable development, and the social responsibility of both global businesses and individual citizens. These three issues will continue as the themes for the 2007 study program when 25 students will travel to India and Singapore. This paper summarizes the study programs of the past three years and proposes ways to develop future study programs of a similar nature. The focus is on program development and assessment, with a brief discussion of student selection and logistics.

This paper is organized as follows. Section 2 summarizes the 2004, 2005 and 2006 annual study programs and points out lessons learned about program development. Section 3 assesses study

program outcomes based on student surveys. Section 4 describes specific student activities resulting from the study tours and provides further assessment of program outcomes. Concluding remarks are given in Section 5.

2. Development and Improvement of the GTI Study Program

The GTI Study Program has been improved each year for the past three years based on the student learning outcomes and our observations. This section presents these improvements with respect to the following five aspects of the program:

- Study themes
- Student selection
- Integration of classroom learning and the study-tour
- Consideration for site selection of the study-tour
- Site visits

2.1. Study Program Themes

The GTI Study Program was launched in 2004 in response to the offshoring of technical jobs from Silicon Valley to other parts of the world in general, and the Asian Pacific region in particular⁴. It is important for the next generation of American engineers to understand this new competitive environment and to develop effective responses. The resulting 2004 GTI Study Program was a one semester credit course culminating in a two-week study tour to China and Taiwan with the following learning objectives:

- raise the level of student awareness of global competition in the global value chain, including the physical and knowledge supply chain
- motivate students to acquire high-level skill sets needed for them to be competitive
- help students identify new career opportunities

The 2004 inaugural study program focused on the global operations of information technology (IT) companies in electronics, semiconductors, computers, and software. It placed special emphasis on the critical role that innovation and entrepreneurship played in these globally competitive companies. This focus guided the selection of sites to visit. During the study program tour students asked questions such as why do engineers and workers in China and Taiwan work so hard; why do these governments invest heavily in expanding the engineering education and promoting technology businesses, and why do technology companies flourish in China and Taiwan. Some sites appeared repetitive or too specialized for participants since students came from all engineering disciplines; it became apparent that the GTI Study Program needed to expand its theme in subsequent years from a single focus (IT industries) to include broader global issues.

One broader issue that was identified is sustainable economic development with impacts on the earth's environment and energy resources fully considered⁵. As populous developing countries such as China and India grow their economies, their demand for energy grows as well. Energy supplies are global in nature, as evidenced by the rising gasoline prices in the U.S. in recent

years. The increasing fossil fuel usage around the globe has led to an increased level of carbon dioxide in the atmosphere, thus leading to possible global warming ⁶. Dealing with these environmental challenges calls for technological solutions to which our engineering students can relate.

Another broader issue that was identified is the social responsibility of the global corporation and the individual citizen ⁷. An important issue for study program participants to explore is what it means to be a responsible global corporation or citizen and to determine if global corporations “take advantage” of lax environmental and labor laws in developing countries. It was decided that it was important to include this ethical dimension in the study program so students could study and reflect on their role as a citizen of the increasingly interconnected world.

The expanded themes of global economy, sustainable development, and responsible global citizenships guided the lesson plans for the 2005 and 2006 GTI Study Programs. In addition, studies on the cultural, political, and economic issues that deepen students’ understanding of China and Taiwan were included in the study program.

2.2. Study Program Student Selection

In selecting student participants, preference was given to student leaders with strong academic records, with the expectation that these students would more readily disseminate what they had learned from the study program and, consequently, influence their peers. As for the class of participants, students were considered who were in their early college careers so they could better plan their studies. The counterbalancing consideration was the maturity of the students and their ability to more fully appreciate such a program. The result was that the majority of students selected were juniors and seniors, with a few sophomores; no graduate students were included in the study program. As more experience was gained throughout the years, more students from outside the engineering disciplines were included. The 2004 program consisted of all engineering students, the 2005 program added three business students, and the 2006 program added an additional student in economics and another in creative writing. This increase in the diversity of students’ disciplines provided unique learning opportunities for the study program participants and enriched their learning experience. This practice will be continued for the 2007 GTI Study Program and beyond.

The GTI Study Program engineering students (25 for the 2004 Program and 22 for the 2005 and 2006 programs) were selected from approximately 100 applications, each of which included a 500-word essay on how the GTI Study Program would impact his or her career and life. Approximately 40 out of the 100 applicants went through an interview process before the final selection was made. The level of applications is an indicator of the program success as it compels students to relate globalization to their own career development, which they otherwise would not in their normal course of studying technical topics.

2.3. Study Program Integration of Classroom Learning

Each of the three annual study programs included six pre-trip lectures. One or two of these lectures consisted of an introduction to the study program and provided participants with the

logistics of the study tour. In the 2004 inaugural program, three business professors and one philosophy professor taught students international business and finance as well as Chinese culture. Feedback from students indicated that they had difficulty fully understanding these high-level topics with the result that more tactical topics were included in subsequent programs. For instance, the lecture on Chinese culture was replaced by country profiles on China and Taiwan along with the political, economical, and educational systems of these two countries. An electrical engineering professor who had extensive business experience taught value creation of innovation in the IT industry. A business professor led the discussion on the ethical aspect of global corporations along with information about the United Nations initiative in encouraging global corporations to be socially responsible around the globe.

Study program themes were expanded to include issues on energy and the environment with the result that students studied various research projects funded by the National Science Foundation, Transportation Research Board and several National Laboratories, as well as the information provided by the Energy Information Administration (EIA) of the U.S. Department of Energy. Based on information in the “Energy 101” section of the EIA website ⁸, students learned that the proven conventional oil reserve in the US is approximately 22 billion barrels—about a 1000-day supply based on the U.S. daily consumption of approximately 21 million barrels. The U.S. situation of supply and demand coupled with the environmental impact of burning fossil fuel on a global scale makes students keenly aware of the challenges in front of them. One Civil and Environmental Engineering professor who had conducted research on the coal usage in China led a very enthusiastic discussion on “Energy and Environmental Issues for China.”

Each student was assigned to study selected sites in depth and present his or her findings to the group on the day of the visit. In addition, students were expected to keep a journal documenting their reflections on what they had witnessed and learned throughout the trip. After the study-tour, the GTI Study Program participants made presentations to 200+ students in the College of Engineering about the information they had learned and the impact of globalization on everyone’s lives.

2.4. Study Program Site Selection

As mentioned earlier, all participants were undergraduate students; most of them were juniors and seniors. It was discovered that stimulating student interest was best achieved by selecting study program sites that provided activities with the following characteristics:

- visceral or mobile activities (e.g., touring a PC-assembly or car-assembly plant, a nuclear power plant or a solid-waste incineration plant)
- participatory activities (e.g., interactive questions and answers with the hosts during and after the host presentations)
- activities hosted by people who have connections with participants (e.g., SJSU alumni working in Taiwan and China or American expatriates with strong ties to Silicon Valley)

In addition to available activities, the themes of the GTI Study Program drove the selection of study program sites. The following examples illustrate the derivation process.

The 2006 study program included visits to companies covering a broad array of engineering disciplines, ranging from electronics and automobile manufacturing to bio-medical devices. The companies were selected specifically to represent the different stages of the value chain of particular products or services. Companies of different “nationalities” were selected to illustrate the cultural differences and competitive positions of these organizations. Industrial parks and government-sponsored research institutes were included to underscore the government’s role in promoting and developing key industries.

To impress upon students the important role that innovation and entrepreneurship play in creating high added values, students learned first-hand how low the pay was for an assembly-line worker or an engineer in China given the fierce competition among the abundant Chinese labor force. They learned during a visit to SEMI China (the regional office of Semiconductor Equipment and Materials International for the China region) that a Chinese manufacturer of a DVD player (retailed in the U.S. for about \$50 or less) must pay a technology-license fee of \$10 to the patent holders for each unit manufactured. With a 100% to 200% retailer mark-up assumed, it is clear that manufacturing is a cut-throat business, and technological innovation pays off.

The population density of China is four times that of the U.S. and the population density of Taiwan (one of the highest in the world) is 20 times that of the US. The high population density of Taiwan coupled with fast economic growth exert a tremendous pressure on the environment. Students learned that the Taiwan government is aggressively addressing this issue by comparing them to the US. For example, Taiwan is building its fourth nuclear power plant housing its seventh and eighth nuclear reactors. The U.S., on the other hand, has 103 operating power plants with no new nuclear reactors ordered or built since 1973. To reduce its reliance on fossil fuel and nuclear energy, Taiwan is promoting research, development and deployment of renewable energy. In addition, companies like Delta Electronics, a leading supplier of power electronics, has been developing energy-efficient and environmentally friendly electronic products and portray themselves as a “green company.”

High population densities coupled with small oil reserves have driven Asian companies like Toyota and Honda to be the first ones to develop and successfully market the hybrid car. Japan has few oil reserves and relies almost completely on imports for its energy needs. Moreover, its high population density results in much stop-and-go traffic, which benefits the most from a hybrid engine. For instance, the gas mileage of a hybrid car is higher on the city streets than on the freeway. Could countries like Japan, China and Taiwan eventually dominate the technologies related to energy efficiency and environmental protection? These are the questions raised and discussed by the students on the study tour.

Social responsibility of a global business or citizen goes beyond developing a sustainable lifestyle for developed nations; it also encompasses alleviation of poverty for developing or underdeveloped nations. We live in a world of disparate personal wealth, ranging from \$30,000 per capita annual income to \$300 per capita—a whopping ratio of 100 to 1. China has a significantly high level of poverty, especially in its rural areas. The GTI Study Program participants learned first-hand about the Poverty Alleviation Project sponsored by Tsinghua University, a leading university in China. During the summer of 2006, the Poverty Alleviation

Project organized approximately 100 student teams, each of which consisted of nine Tsinghua students and one American student, and sent the teams to the poorest counties across China. The teams were trained at Tsinghua University in Beijing for one week before being sent to work for three weeks in the counties. While Tsinghua students worked to establish an internet-based e-Learning center, the American students taught English to local teachers, government officials, and students. San Jose State University participated in this project during the summer of 2006 for the first time⁹.

Inspiring the students with modern-day engineering achievements is an integral part of the GTI Study Program. Taking the world's fastest elevator to the top of the world's tallest building—the Taipei Financial Center (Taipei 101)—gives them an opportunity to actually experience state-of-the-art engineering design. Riding the world's fastest train—the magnetic levitation (Maglev) train from Shanghai Pudong International Airport to Shanghai—which traveled at the speed of approximately 270 miles per hour is not only thrilling but also inspiring. Viewing the entire City of Shanghai from the top of one of the world's tallest towers and then seeing a scale model of the City of Shanghai as it is envisioned in 2020 provides aspiring engineers with the opportunity to visualize the challenge of balancing human needs and desires with limited natural resources. Seeing bioengineered silkworms produce yellow and red cocoons instead of the naturally occurring white ones provided a lasting visual and intellectual impact on the students.

A visit to the Forbidden City and the Great Wall gave students a glimpse into China's past history. Their visit to the thousand-year-old Ling-Ying Buddhist Temple outside Hangzhou impressed upon them the difference in religious traditions between the East and the West. The distinctness and uniqueness of Chinese history and culture have piqued many of the students' interest.

Visiting universities in China and Taiwan and interacting with students there provided an opportunity for study program participants to establish bonds and compare notes with their peers. SJSU students concluded that Chinese and Taiwanese students are much more serious about their studies and work much harder than American students.

2.5. Study Program Site Logistics

During the summer of 2004, the study program participants visited 27 sites, four of which were cultural sites. The 2005 program visited 25 technical or business organizations, some of which were cultural sites. The 2006 study program, designed with lessons learned in the two previous programs in mind, visited 35 sites: 15 high-tech companies, two R&D organizations, two universities, including Tsinghua University in Beijing, five modern engineering sites, one investment company and ten cultural sites

Checking in and out of hotels and traveling from one city to another by air is very time consuming. Because of this, it was decided that a study-tour of two weeks duration should visit at most three to four cities. Since Shanghai is the commercial and technology hub of China it was designated as the last stop of the study-tour. In this way the study program participants will leave China with a long-lasting parting impression of China's pace and scope of development. Study program participants were encouraged to extend their trips beyond the two week tour.

3. GTI Study Program Assessment

As part of the assessment for the 2004 and 2005 programs, student feedback indicated that students learn more from a program with a balance between corporate visits and face-to-face discussions with the founders of smaller companies and start-ups. The founders' personal stories of their educational and career paths provide an inspiring model of success for SJSU students. In addition, corporate visits should be supported by a basic understanding of the history and culture of the host countries and complemented by visits to cultural sites.

As in 2004, most of the 2005 and 2006 study program participants regarded the study tour as a life-changing experience. All of them realized the closing of the technological gap between the U.S. and China, not to mention Taiwan. Many decided to go to graduate school. Some decided to learn a foreign language in general or Chinese in particular as preparation for an international career. The trip opened up the possibilities for participants to consider working in a foreign country. They also witnessed the severity of the energy and environmental issues in China, the U.S., and the world. In Beijing, the air pollution was so serious that the sun was barely visible on all four "sunny" days during the visit.

At the end of each annual program, a student survey is conducted. The survey consists of 20 questions that are grouped into three categories: (a) changes in career plan or planning, (b) changes in attitudes and (c) stronger desires to learn more about the world. For each of the questions, students were instructed to answer "Yes" or "No." For each of the "Yes" responses, students were directed to identify the top five lessons or impacts first and then rank the five from 1 through 5, with 1 signifying the top impact. In order to somewhat quantify the importance of the 20 possible impacts, weights of 5, 4, 3, 2 and 1 were assigned respectively to the first, second, third, fourth, and fifth most important impacts and then added across all students to obtain 20 "impact scores." Note that students were explicitly asked to answer "Yes" if and only if the impact resulted from participating in the study program. For example, one of the 20 questions asked if they decided to go to graduate school as a result of the study program. Some of the 25 students had already decided to go to graduate school prior to participating in the study tour; they were reminded to answer "No" to the question.

Based on the 2004, 2005 and 2006 surveys, the following two actionable lessons or impacts for the students are consistently ranked as among top three:

- liked to travel, to see the world more, and learn about those things not learnable in the classroom
- realized the importance of innovation and entrepreneurship.

The following was regarded as among the top three only by the participants of the 2005 program.

- would consider or take advantage of career opportunities overseas (but never considered a career involving temporary or long-term living in a foreign country before).

The following becomes more and more important as the annual program went on; it is among the top four most important ones for the 2005 and 2006 programs.

- became more concerned about environmental and energy issues.

This can be attributed to the fact that energy and environmental issues (sustainable development) was introduced as a theme for the 2005 and 2006 study programs and that there has been a steadily increasing level of awareness of these issues by the general public. In the 2006 program, the delegation visited West Lake in the city of Hangzhou. Despite the fact that West Lake has been one of the most celebrated and romantic natural wonders in Chinese history, some students observed many dead fish in the lake without consciously looking for them.

4. Student Actions as Program Outcomes for Assessment

More and more student initiatives were observed as the annual GTI Study Program continued in subsequent years. A 2004 GTI participant developed, with several of his classmates, an electrical “razor” scooter that can be folded into a handsome briefcase; he subsequently worked with a manufacturer for product manufacturing and marketing. A 2005 GTI student not only liked the study tour himself, but also believed that arranging such study-tours had the potential for being highly profitable. As a result, he founded a private company to provide services much like the GTI Study Program tours.

The 2006 GTI scholars have been engaged in more activities. Three of them submitted three project proposals to develop innovative devices or products. They were selected for financial support among 15 submissions. Several other GTI scholars successfully and quickly formed a local chapter of Engineers without Borders (EWB) at San Jose State University. Several others have already participated or have applied for participation in the aforementioned Poverty Alleviation Project, whose 2007 application deadline is beyond the deadline for submission of this paper⁹. They put into action the lessons learned about the social responsibility of a global citizen.

5. Conclusion

The GTI Study Program enables students to witness first-hand global economy in action. They see in a visceral way how dynamic and competitive Chinese and Taiwanese engineers are and realize that they need to change in order to be competitive. Their transformation is profound. It is desirable to disseminate participants’ learning more broadly so that students who did not participate in the program will also orient and prepare themselves for a global environment.

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