Corporate Partnerships for International Experiences: A Case Study Model of the Boeing Engineering Leadership Program

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Partnerships between universities and industry are becoming increasingly critical to consider when developing study abroad experiences for engineering students. Using a case study approach, this paper examines one short-term summer program for students of aerospace engineering, the Boeing Engineering Leadership Program, which took place in Beijing, China in July 2014. The paper examines components needed for a successful partnership to support teaching and learning activities, including a strong corporate sponsor, international host university and one or more partnering US institutions. It also outlines benefits to each partner in engaging in this type of partnership, and recommendations to other institutions wanting to design a similar program. Findings from the study can be used to inform curriculum and design of future international experiences for engineering students.

Partnerships between universities and industry have long been important for schools of engineering. In the U.S., growth in university-industry partnerships began in earnest in the 1980's due in part to changes in national technology policies which sought to promote cooperative research and increase diffusion of technologies between universities and firms.[1] These partnerships have become a prominent feature of our current global, knowledge-based economy, and coincided with universities' strategic efforts to internationalize by integrating international, intercultural or global dimensions into their curricula and programs [2,3] This synergistic relationship between corporations that desire to hire globally competent engineers and the universities who train them, has become essential to consider when developing study abroad experiences for engineering students. While collaborations between universities and industry can include research, development and industrial innovation, partnerships to support teaching and learning activities are growing rapidly and have strong ties to study abroad programs. In a partnership focused on teaching and learning, corporations may fund student activities, offer tours of facilities, give technical talks, organize meetings and plan/fund educational trips.[4]

To inform the creation of partnerships to support teaching-learning activities, it is important to determine what components are needed to create a successful partnership of this type. While attention has been called to the importance of universities pursuing corporate partnerships, there are few models available that have examined what components are necessary for the success of these relationships as well as the benefits to each partner to doing so.

Using a case study approach, this paper examines one short-term summer program for students of aerospace engineering, the Boeing Engineering Leadership Program, which took place in Beijing, China in July 2014. Originally designed as a mechanism for six Boeing-sponsored aviation clubs to share activities, it was restructured to include the University of California, Irvine (UCI) and Virginia Tech in a collaborative partnership with the Boeing Company to offer a professional leadership seminar for undergraduate aerospace engineering students at Tsingua University in Beijing. The conference was held July 14 – 15, 2014 and

included 108 student participants. This included five students from Virginia Tech, 10 from UCI, and the remaining students from nine Boeing-sponsored Aviation Clubs from six Chinese universities: Peking University, Tsinghua University, Civil Aviation University of China, Civil Aviation Flight University of China, South China University of Technology and Sun Yat-sen University.

This paper examines components needed for a successful partnership to support teaching and learning activities. It also outlines benefits to each partner in engaging in this type of partnership, and recommendations to other institutions wanting to design a similar program. Findings from the study can be used to inform curriculum and design of future international experiences for engineering students. The information shared can also be used by other institutions to inform the creation of future international experiences for engineering students in collaboration with corporate partners.

About the Boeing Engineering Leadership Program

The student leadership conference was initially proposed during a discussion between Dean Gregory Washington of the Henry Samueli School of Engineering at UCI and Boeing R&T, China in May, 2013, based on the mutual understanding and recognition that global context is extremely important for educating the next generation of engineers. To enrich the cultural component of the experience, the event was suggested to be held at Tsinghua University, where one of the Aviation Clubs was located. Virginia Tech was later added to the planning group after being referred by James Webb, a Virginia Tech alumnus and Boeing employee. Virginia Tech student delegates were selected by the Aerospace and Ocean Engineering faculty and were required to have completed the department's two semester senior capstone design project. Students from UCI were selected from an aerospace engineering student club, Design Build Fly (DBF) and also from a student satellite club, CubeSAT (SAT). The students chosen from DBF were participants of the 2013 AIAA Student DBF competition where they were awarded first place. The students selected from SAT worked closely with the Boeing satellite division.

Boeing provided programming addressing both the business and technical aspects of the company. These included a panel on career and leadership development, a lecture on next generation aircraft design and group discussions on ethics. Dean Washington's luncheon talk contextualized the need for global leadership in engineering. Student representatives from each Aviation Club and the two US universities presented on their research and activities and participated in icebreakers and a design challenge. Tom Wujec's Marshmallow Challenge [9] was chosen to highlight lessons in creativity, innovation and global collaboration. Teams of four, including both U.S. and Chinese students, were asked to create the tallest freestanding structure possible, using only dry spaghetti, string and masking tape. Towers had to be topped with a marshmallow, and groups were given just 18 minutes to complete the task. Successful teams typically utilize iteration, inherent in the engineering design process, and address hidden assumptions, such as the idea that marshmallows are light and fluffy and therefore do not need to be considered. University representatives from Tsinghua University, UCI and Virginia Tech also gave overviews of their respective universities, and program participants were given a tour of the

Tsinghua Skyworks Studio. This space allows students, both teams and individuals, to create, design and build their own projects utilizing faculty mentors.[i]

All students were housed at campus hotels and meals were provided, allowing for informal student interactions. Virginia Tech and UCI students also participated in a group tour of cultural landmarks in and around Beijing. Funding for all conference meals and events was provided by Boeing Research & Technology, China. Transportation, hotel accommodations and sightseeing expenses were covered by the sending institutions through funds given by the Boeing Company. Virginia Tech was able to use a Boeing Cybergrant to cover costs, and UCI utilized financial support from the Boeing Company Gift Fund. Following the conclusion of the conference, all but one US student remained in the country to continue exploring the culture and academic institutions. Virginia Tech students participated in planned visits with Tianjin University and the Civil Aviation University of China, both in Tianjin; the Shandong University campuses in Jinan and Qingdoa; and China Ocean University in Qingdao.

Because of its prominent role in the aviation industry in China, the Boeing Company was uniquely situated as a corporate partner. The Boeing Company has a long-standing relationship with the Chinese aviation system at both the federal and university level. Over half of the commercial jetliners operating in China are manufactured by Boeing, and many of Boeing's parts and assemblies are built in China. Boeing is involved with many commercial joint ventures and works with universities and research centers to develop technologies such as sustainable aviation biofuels. They are committed to enhancing STEM education, including the establishment in 2010 of Aviation Clubs at six Chinese Universities (Peking University, Tsinghua University, Civil Aviation University of China, Civil Aviation Flight University of China, South China University of Technology and Sun Yat-sen University).[5] The goal of these clubs is to build future leaders for the aerospace industry by promoting student interest and research, thereby attracting talented students to work in the industry.[6]

Methodology

This case study, an in-depth examination of a singular subject, aims to examine the student outcomes of participating in this short-term leadership program in order to define the components needed for a successful partnership. Two separate focus groups were held in fall 2014, one with the Virginia Tech cohort and another with students from UCI. At the time of each focus group, all of the students in the cohort under study had graduated with their BS degree in engineering and were either working in industry or were enrolled in their first semester of a MS program. The protocol for both groups included questions that were designed to elicit information about the conference delivery and design, best practices for such a conference, and how the conference enhanced the ability of students to work collaboratively and successfully in a global engineering environment. They were also designed to examine whether participation shaped their motivation to pursue future international experiences, and the extent to which the program contributed to how they thought about a global engineer. Both focus groups lasted about one hour in length. The sessions were audio recorded and transcribed. In total, all five students in the Virginia Tech cohort and three of the ten students in the UC Irvine cohort attended the focus groups, for a total of eight students.

[i] For a full conference schedule, please see http://sites.uci.edu/boeingsld/agenda/.

Analysis

The focus groups were transcribed and analyzed in fall 2014. A line-by-line open coding technique was used to identify concepts and categories that emerged in relation to each question. From these categories, themes arose that allowed the evaluator to examine the data from a subjective perspective and provide data on both the student outcomes and the conference itself.

Benefits

This program possesses a number of unique attributes. First, it is a student-centered conference. While a few professional organizations offer student engineering conferences, including the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), the American Institute of Chemical Engineers (AIChE) and the Institute of Industrial Engineers (IEE), only the ASME conference is offered outside of the United States. In addition, only the AIChE conference includes a dedicated student presentation component. While individual corporate employees may contribute community service time and companies frequently provide financial support, it is unusual for industry to take on the logistical details and event planning needed for such a venture. Finally, the collaboration between university and industry across many time zones contributed to a much richer offering of experiences for the students.

At the university level, programs providing international experiences such as this enhance the reputation of the colleges and universities involved, and increase the attractiveness of each institution to new students, both graduate and undergraduate. This is especially true for colleges with aerospace engineering programs that may not offer a wide variety of study abroad options for its students. For U.S. students, an opportunity to gain experience in China, a leading country in aerospace design and manufacturing, is an attractive option. For both U.S. and Chinese universities, offering students of aerospace engineering exposure to a leading company in the industry strengthens the teaching and learning aspects of the major by better positioning the school's graduates to work in a global environment. This type of program can also serve as a recruitment tool for graduate applicants as undergraduate participants gain exposure to institutions they may not have been exposed to previously. The involvement of faculty as mentors for each student group also involves researchers in the program and exposes them to the research and development activities of the company. Over time, these synergistic partnerships between universities and corporations can contribute to making universities a stronger contender for large, complex, multidisciplinary research projects.

For Boeing, being involved in this type of program allowed the company to directly contribute to supporting innovation in STEM education in China. In 2010, the Ministry of Education in China launched the Excellent Engineer Training Program, which aims to improve engineering education by incorporating more practice solving applied problems, increasing student-teacher interactions, and promoting greater collaboration with industry. The long-term goal of this national program is to foster innovation, social responsibility, communication and leadership in Chinese engineers.[7,8] Hosting an international leadership program of this type allowed Boeing to further expand their university partnerships beyond support of aviation clubs at a number of universities to creating synergistic relationships between those clubs, thereby further contributing to China's goals of innovation in STEM education.

The addition of students from the two US universities added aspects of cultural and language exchange that broadened the scope of the event. The American students' presentations modeled the innovation, collaboration and communication that are frequently seen to be lacking in Chinese engineering education. Grooming young talent for the aerospace industry and enhancing Boeing's reputation among academic institutions were also important to Boeing. An unanticipated benefit of teaming with UCI and VT for Boeing was the content of the conference itself. While Boeing provided the technical expertise, the universities were able to contribute pedagogical knowledge. For example, a collaborative design challenge was added to the agenda to promote teamwork, innovation and creativity. The planners also experienced firsthand many of the challenges faced by global engineers working across different time zones and cultures.

Students gained many benefits by participating in the Boeing Engineering Leadership Program. To gain an understanding of the benefits obtained by students, focus groups with students from Virginia Tech and UCI were a part of the needs assessment used to evaluate the overall effectiveness and learning outcomes of the conference. Data from the focus group found that for the students from the United States, a greater understanding of cultural and engineering differences prepared them to approach future collaborations with an open mind. Students were able to note differences, not only of the design processes between the United States and China, but of the delegation of tasks when it comes to the manufacturing of materials. Finding that their international counterparts were more, in their opinion, "results" driven, allowed U.S. students to reflect on how different the cultures were when it comes to collaboration. The students felt that the American system offered benefits in learning collaborative problem-solving skills throughout their coursework.

Virginia Tech students found that they could contribute to the conference in areas of both process and leadership. Following the guidance of an advisor, Dr. Pradeep Raj, Professor of Aerospace Engineering, students incorporated lessons learned pertaining to leadership from creating their Senior Capstone Projects. They felt that this allowed them to embrace the theme of the conference while also producing technically sound presentations. UCI students contributed to the conference by demonstrating two specific case studies of product development with emphasis on engineering design, innovation, and project management. They integrated the topic of leadership by focusing on the success of collaboration and knowledge transfer from prior team leads. Furthermore, the presentation described the process from project initiation to completion within a relatively large group setting (approximately 20 students per project) under industry mentorship similar to an actual industry experience. The two different presentation approaches from VT and UCI provided a more well-rounded perspective for the student audience in China of how American engineering students applied problem solving skills, established effective communications, interacted with industry, and moreover, developed student leadership.

All students felt that the keynote speakers brought a wide variety of viewpoints on how someone became a leader in the field of aerospace engineering through training and experience. They spoke to the point that leadership can come in many forms and is amplified through collaborative work both domestically and internationally. Additionally, students recognized the need to be fluent in a second language, especially one as vastly different from English as Chinese. They wished they had had more preparation time in Chinese so that interactions with the Chinese students could have been deeper and more meaningful. Recognizing that one of

ASEE's aspect of being a "global engineer" is to be fluent in at least two languages, students are currently making an effort to ensure that they will be prepared in the future, taking advantage of software such as Rosetta Stone since returning from their trip. In summary, students recognized four main benefits to participating in the conference, including increased cultural understanding, collaborative problem-solving skills, leadership skills, and understanding of the need to be proficient in foreign languages. They all expressed the desire for other students to have similar experiences in the future.

Program Model Recommendations

The Boeing Engineering Leadership Conference represents a new and unique model for corporate and industrial collaboration. Necessary components include a corporate sponsor, international host university and one or more partnering US institutions. Ideally, planning would begin a year in advance to discuss the dates, length, funding and selection of student participants. While this program relied on the Boeing-sponsored Aviation Clubs, conference attendees could be recruited more broadly. Establishing the mode of communication and frequency, identifying a point person for each institution and defining individual responsibilities are also critical.

While the agenda could be modified, key components of this leadership program included student presentations, time for student interactions with industry representatives and student-to-student communication during formal and informal events. The addition of specific leadership training and professional skills development should be considered.

One significant drawback to the current model was the heavy workload for the onsite Boeing personnel in terms of event planning and logistics during the conference. While it is inevitable that more of the burden falls on team members located in the host country, it would have been helpful to shift some tasks to the institutional partners, such as logistics at the hosting university. Registration and creation of materials, such as the program brochure, could have also been handled from outside the country, reducing the burden on the corporate partner.

Conclusion

Partnerships between universities and industry to support teaching-learning activities provide a unique opportunity for companies, universities and students. For the corporate partner, hosting an international engineering leadership program for students allowed the company to connect aviation clubs beyond financial support to building synergistic relationships between them. This unique program model with interactions between students and Boeing professionals allowed the company to interact with college students with the aim of attracting these students to the aerospace industry while also connecting with the results of Boeing-sponsored student activities and research. For universities, this program model allowed the offering of a very unique, hands-on, intercultural learning experience to students. The opportunity for undergraduate students to interact with and present their engineering designs to a prominent global company like Boeing allowed participating universities to add a unique learning opportunity to aerospace engineering programs by connecting what students are learning in the classroom directly to the aerospace industry. For students, participating in this short-term program introduced them in a very tangible way to the competencies needed to work in a global environment, including skills in intercultural communication, collaborative problem-solving, leadership, and proficiency in a foreign language.

Components needed for a successful partnership of this type include a strong corporate sponsor, international host university and one or more partnering US institutions. While this program was designed as a pilot program, Boeing is considering holding this event every other year with the possibility of including students from other strategic corporate locations like Japan. In addition, the success and benefits of this program has led other corporate partners of Virginia Tech and UCI to inquire about replicating the program. It is hoped that the benefits and lessons learned through this pilot program can be used by other institutions to inform the creation of future international experiences for engineering students in collaboration with corporate partners.

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