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Teaching Global Manufacturing & Supply Chain Management through Study Abroad Program: A Case Study

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Abstract

In the 21st century's globalized economy, like any manufacturing enterprise, today's engineers face competition from all directions. Engineers must understand the socio-economic dynamics and business culture globally even to succeed locally. Recognizing the need, many engineering schools in the U.S. have started offering ethics and study abroad programs to their undergraduate students. Our research shows that selection of countries for study abroad programs have widened significantly in the recent years. For example, in the nineties, the US Universities were offering study abroad programs mostly in European and few other developed countries in the Asia pacific region. In recent years, that list has grown significantly including many other countries around the world like South Africa, Brazil, Russia, China, Chile, and India to name a few. This paper presents a survey of select U.S. engineering schools' study abroad programs and lessons learned from those programs. More importantly, we present a case study of a study abroad program offered by Industrial Distribution Program in the Dwight Look College of Engineering at Texas A&M University. This program is sponsored by the industry partners meaning that students actually work on the real world industry projects. In this paper, we present a case study of 2014 study abroad program to China. The project results and lessons learned from the program are discussed in detail in the paper. We believe the paper provides a good benchmark for other engineering schools that may be considering similar industry sponsored programs around the world.

Introduction

Globalization has changed the way manufacturing and distribution firms conduct business. Because of advancement of information technology, customers have better access to product information and market pricing. This has put tremendous pressure on companies to offer lower prices and shorter time-to-market. As a result, companies operate in a truly distributed supply

chain environment. For example, Apple products are designed in California, manufactured in China, apps are developed in multiple places, and sold throughout the world through their distributors. While the distributed nature of business functions allows companies to achieve faster product launch and a lower labor cost advantage depending upon the location, it also brings about a lot of challenges with respect to streamlining their business processes due to differences in work culture and business practices across the value chain. One way to tackle this problem, in part, is by hiring professionals who are knowledgeable of multiple cultures and business practices.

Similarly, like any manufacturing enterprise, today's engineers also face competition from all directions. Engineers must learn and understand the socio-economic dynamics and business culture globally even to succeed locally. The National Academy of Engineering has put forth a vision for the "Engineer of 2020" in which the epic body of highly accomplished and acclaimed engineers suggest that the future engineers must be able to live, learn, and understand other cultures and environments (NAE, 2005; Specking et al., 2013). Therefore, the sooner this learning process for future success begins, the greater would be the benefits for both the students and their employers. Recognizing this need many universities in the United States offer study abroad programs, both at graduate and undergraduate levels. Shuman et al. (2005) argue that manufacturing and global supply chain can best be studied "if classroom work is combined with truly multidisciplinary team projects and well-designed field visits" in other countries. Furthermore, one of the ABET accreditation criteria (also known as 'outcomes h') requires engineering programs to provide students with a broad understanding of impact of engineering solutions in a global, economic, environmental, and societal context (Shuman et al., 2005). In this paper, based on a literature review, we present a brief survey of some of the most popular study abroad programs offered at a number of major universities in engineering disciplines. We also researched the destinations and formats of study abroad programs of 50 highly ranked engineering schools in the US based on the information provided on their websites. Finally, we present a case study of a study abroad program offered in global engineering class at Texas A&M University.

The remainder of the paper is organized as follows. The next section provides a brief overview of current study abroad programs in the literature. The following section presents the case study of an industry sponsored study abroad program in distribution offered for engineering students at Texas A&M University. The case study is followed by the results and discussion, and lastly the conclusions of the paper.

Overview of Current Study Abroad Programs

In this section, we briefly review prior literature on study abroad programs with a special focus on the need and format of such programs. It must be noted that this paper, by no means, provides an exhaustive review of the prior works. The main purpose of this review is just to present a brief overview of the existing study abroad programs in manufacturing or other related fields within colleges of Engineering in a reasonably representative manner.

Popescu (2012) outlines the following five attributes for engineering students to be successful in a global environment: a) ability to appreciate other cultures; b) ability to work in diverse team environments; c) ability to communicate in cross culture environments; d) experience or exposure to engineering in a global context; and e) ability to deal with ethical issues emanating from cultural and national differences. Specking et al. (2013) performed a comparative study of two universities (University of Arkansas, a public university, and Stevens Institute of Technology, a private university) to investigate as to what factor(s) is (are) keeping students from signing off in global studies. As per their findings, the majority of students were interested in study abroad programs in both universities. As expected, the limiting factors for global study programs were time and financial resources. Surprisingly, a study by Redden (2012) shows that only 1% of students in U.S. colleges participate in study abroad programs and only 4-5% of that 1% are from engineering disciplines. It shows the greater need of such programs in the engineering colleges across American universities. Several authors and educators have stressed the need for 21st century engineers to understand global cultures and business practices as the world is becoming increasingly flat (Wilk et al., 2001; Bidanda et al., 2005; Dave and Dong, 2010; Farris and Lane, 2011)

Our review revealed that there are about nine different formats for study abroad programs. These are described briefly in Table 1 (Parkinson, 2007).

Table 1: Study abroad program formats offered by U.S. Universities (adapted from Parkinson, 2007)

Program Format	Description
Dual degree	Students obtain two degrees- one each from home and abroad universities, often used for graduate level work.
Exchange	Students from the abroad and home universities are exchanged, take classes in abroad language, and usually initiated by an individual student.
Extended field trip	One to three week long trip to foreign countries, companies, and/or universities.
Extension	An extension campus of the home university in the abroad country. It doesn't provide much exposure to the culture.
Internship or co-op	Students working at a abroad company or at a U.S. company's abroad location.
Mentored travel	Students travel to abroad country for 4 or more weeks under a supervision of a faculty member.
Partner sub-contract	The home university partners with abroad university to offer courses. It could also be in the form of sub-contract format.
Project-based learning/service learning	Working on a project in an abroad society. For example, engineers without borders.
Research abroad	Students travel to an abroad university or any institution to conduct research under the supervision of a faculty member.

Our research shows that selection of countries for study abroad programs (SAP) has been widened significantly in the recent years. For example, in the nineties, US Universities were offering the SAP mostly in European and other English speaking countries in the Asia and Pacific region (e.g., Australia, New Zealand, and Singapore) countries (Specking et al., 2013; Koehler, 2012). In the recent years, that list has been expanded significantly to several other countries around the world like South Africa, Brazil, China, and India (Abubakr, 2007; Gattis and Edwards, 2007; Wintherell and Pittman, 2012). In fact, a recent survey of 48 highly ranked public universities in the US shows that China is the most popular destination behind the U.K. (see Figure 1). Those 48 schools included the universities such as University of California Systems schools, University of Virginia, Virginia Tech, University of Michigan, Michigan State,

Purdue University, Indiana University, Georgia Tech, University of Georgia, University of Maryland, University of North Carolina, NC State, University of Illinois, University of Florida, University of Texas, Texas A&M University, Ohio State, University of Connecticut, Clemson University, University of Minnesota, Rutgers University, SUNY Buffalo, SUNY Stony Brook, Iowa State, University of Iowa, University of Missouri, University of Kansas, University of Nebraska, University of Alabama, University of Delaware, University of New Hampshire, Florida State University, Auburn University, University of Colorado, and Colorado School of Mines. This information was gathered from the university websites, accessed in January 2015.

Our survey also revealed that there were few schools, which did not have study abroad program in the Engineering departments, more particularly in manufacturing related departments such as Industrial or Mechanical Engineering. The main reason was those schools did not have engineering programs at all (e.g., UNC-Chapel Hill and Indiana University).

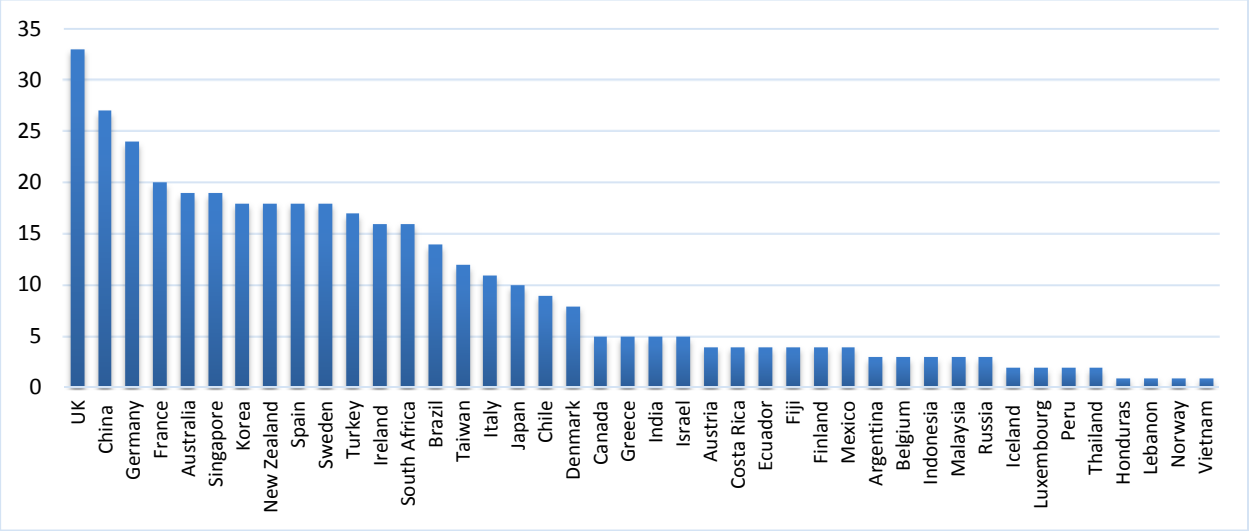

Figure 1: Study abroad programs destinations for 48 highly ranked public universities in 2015

Figure 2 presents the summary of SAP formats offered at the above-mentioned 48 highly ranked public universities. Based on our sample, course only format seems to be most common followed course plus research project in abroad country. However, we caution readers that this is again by

no means an exhaustive survey based on direct interviews. This was primarily based on the website information. Therefore, while they may have other formats of study abroad programs such as mentored travel, extension, etc. mentioned in Table 1, those are not included in our survey. As mentioned earlier, the main objective for our study was to identify the first two categories shown in Figure 2.

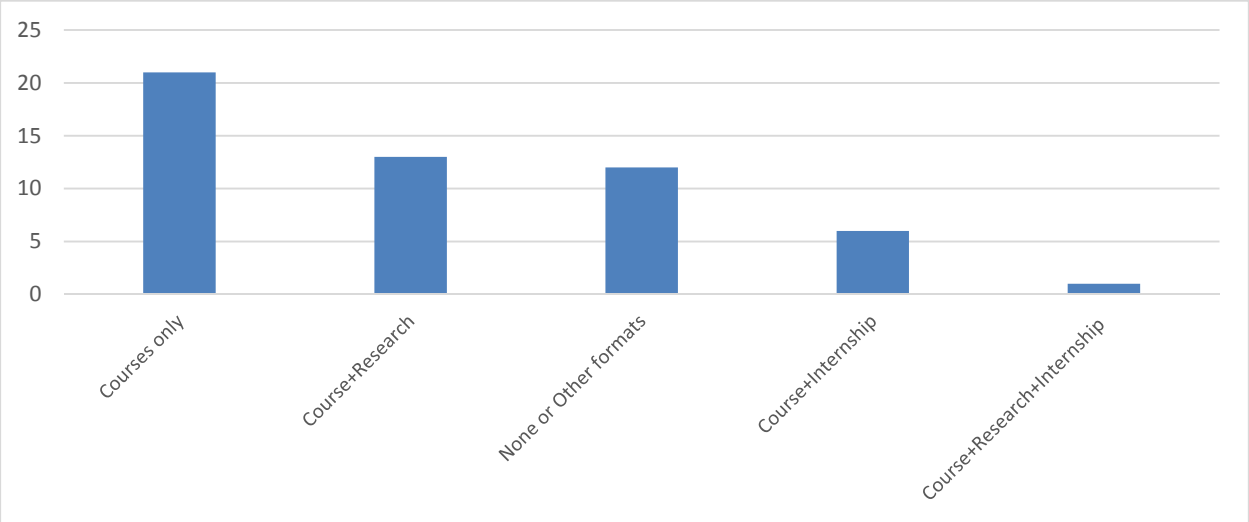

Figure 2: Common SAP formats offered in the select U.S. universities in engineering

Industry Sponsored Study Abroad Program at Texas A&M University: A Case Study

As pointed by Specking et al. (2013) and discussing with other colleagues in the university who had conducted SAP in prior years, we were aware of the challenges students faced with respect to time and financial situations. Therefore, the idea of an industry sponsored SAP was presented to the Program Industry Advisory Board (IAB) in a meeting about six years ago. The IAB members liked this idea and one of the member companies offered to sponsor the program for five years. One year later, another IAB member company joined the co-sponsorship. Now there are more industry partners who are interested in sponsoring this class. We also have an endowment established for this class by our industry partners. This case study presents the Summer 2014 class entitled “Global Engineering” offered to any engineering students within the Dwight Look College of Engineering. This class went to China for its study abroad program. Below we first provide the structure of the class followed by the industry project that students conducted for a specialty chemical distributor in China as a part of this class.

Course description

Students study a framework for the systematic analysis of globalization in technical endeavors. Decision making methods that allow the integration of quantitative and qualitative factors will be studied and applied in the context of global engineering projects. Applications are based on the analysis of real cases, field trips with industry experts, and student projects. The course material provides an overview of international project management, design, and legal issues. The course focuses on the role of government intervention and regulations and security and risk management for international product and project development.

Why China?

The relationship with China has been complex. Many distributors have moved their operations to China in response to requests from customers and suppliers. China has opened its doors to distributors since realizing they cannot support their manufacturing base otherwise. If the United States is to be competitive in its exports, distributors, who are the channel to market for most Small and Mid-Sized Enterprises (SMEs), must continue to globalize. Most distributors are US based so this stands as the number one growth initiative for the industry. They need recruits with global understanding and a desire to work in the Asian market. Therefore, this zone and partner firms in China were chosen for this class to practice basic global skills and solve global supply chain problems in a real world setting.

Course structure

This course is offered during Summer I semester. It has all the materials that a typical course would have plus international trip and a company sponsored project. The majority of travel expenses is supported by industry funds and endowment dedicated to just this class. Thus, the students are required to work on the problems suggested by the sponsoring companies. However, the projects are developed in collaboration with instructors and the sponsors. In other words, the course activities include: Case studies in Global Engineering, invited industry guest speakers, in-class discussions, a project based in China with industrial partners, and two exams. Students have to make a preliminary presentation during the trip to validate the understanding of their problem. Towards the end of semester, students make final presentation to the CEO and other executives of the company in China and their counterparts in the U.S. via Video conference.

Developing opportunities for specialty chemical products in China- a sample student project

Entering a new market requires a deep analysis of factors such as industry dynamics and relationships between customers and suppliers. The Global Distribution Study Abroad class offered at Texas A&M University involved the development and execution of a project for a global chemical distributor. The project content presented the challenge of diversifying and expanding specialty chemical products to the local market (China), and globally (mainly to Latin America).

The class (30 students) was divided into 5 groups. The main project "Developing Opportunities for Specialty Chemicals in China" was divided into five sub-topics thereby allowing each group to work one sub-topic. A snapshot of project activities for each group is described as follows:

Group 1: Specialties Product Portfolio Analysis: Embedded in this topic is the understanding of best practices regarding product and service portfolio management. These best practices include evaluating new products within markets where the company is already in. The main goal is to organize the portfolio to obtain largest ROI possible. This process includes diversifying products and services' portfolio, and therefore increasing profit possibilities. With a broadened portfolio, the company will gain market share, enhance customer and supplier relationships, and achieve a competitive advantage unique only to the company capabilities and offerings.

The students performed a SWOT (strength, weakness, opportunity, and threat) analysis on the organization, as well as on the critical suppliers from other markets (Latin America) to assess the opportunity for creating a value proposition that improves service to customers and enhances relationships even further. This is done by providing value added services such as breaking bulk, improve credit abilities, and increase in product offerings, especially when specialty products are introduced. This also brings a unique competitive advantage for the distributor. Furthermore, students of this group were able to identify key products the distributor could offer in China by leveraging their sourcing organizations in Latin America as "hub-spoke" distribution

methodology. Ability to provide new offering would clearly differentiate the distributor from its competition. Findings and recommendations included: optimizing key central distribution centers at Wuhan and Chongqing to strategically locate service facilities to extend product reach, and developing logistic infrastructure to solidify its position in the growing distribution market in China before other competitors enter into the market.

Group 2: Expansion Plan of Rubbers, Plastics and Polymers: The methodology and project approach of this group was based on identifying the need and usage of specialty rubbers, plastics, and polymers in key industries that are in demand in China. Moreover, the students identified growth strategies aligned to this segment and targeted three different markets for penetration and expansion. Then, they analyzed suppliers that could collaborate with the chemical organization for introducing a new product line. Through analysis students selected construction, automotive, and electronics as the potential industries that would provide a strong opportunity for growth for specialty chemical products thereby help the chemical company to create a strong market share. Furthermore, the analysis was broken down into regions and cities, showing where the company presence could expand, so that it could capture more potential customers. As part of final deliverables, the students focused on different growth drivers that affect the plastics, polymers, and rubbers market in China.

Group 3: Expansion Plan of Specialty Chemicals for Water Treatment: Developing water treatment facilities is part of the Chinese Government's infrastructure plan. So, the water treatment specialties sector could experience substantial and profitable growth in the near future. Students were able to initially separate the analysis on water treatment into two target market groups: one focused on end user consumption, and the other focused on industrial water treatment chemicals, meaning the need for companies to clean and purify the water that they use in their chemical processes. This group based their project on the evaluation of the industrial potential of water treatment. In terms of application and usage, the oil and gas industry was selected as macro-segment and the shale gas extraction process was considered as micro-segment.

Extensive research was produced in regards to the oil and gas industry in China. The focus was identifying location of reserves, areas of development, market potential, drilling process, main competitors and environmental regulations. The students also identified an industrial process that can be implemented in the water treatment that potentially creates a competitive advantage. They validated their assumptions by identifying case studies and discussing with a group of suppliers. This activity requires a high level of participation and real application of distribution knowledge the students need to conduct and execute a project that involves a global corporation, foreign suppliers, local customers, domestic and international markets and global supply chains.

Group 4: Expansion Plan of Specialty Chemicals for ACES (Adhesives, Coatings, and Elastomers) and Food & Beverage: Due to the early developmental stage of the specialties market in China, this group of students determined that the best way for the chemical distributor to expand the current ACES product line into new areas that are primed for growth. In the ACES market the two broad trends that existed in the Chinese market were the continued urbanization of the population and the governmental push for sustainability and environmental protection. These policies have a direct impact on the growing of ACES, for example in the construction industry, there is a demand for energy-efficient buildings, or 'green buildings', and environmentally friendly materials. Therefore, the students analyzed the main potential growth industry segments for ACES, and tailored their project into detailed analyses by selecting micro segments of the market. For example, within the construction industry they broke the analysis into materials for insulation, flooring, and roofing. A similar approach was followed for food and beverage specialty chemical market. In order to support their findings, the students also studied food and health behaviors of Chinese people and government regulations.

Moreover, food security was considered as a critical factor in the growing strategy for the company along with the healthy trends among the population. For instance, the students considered the correlation of the growing diabetes crisis in China. Over 114 million people have been diagnosed with the disease, and this has resulted in a growing awareness of health and nutrition. The project produced tangible deliverables that were considered by the company in the

different market segments that were studied in the food industry (frozen foods and prepared meats).

Group 5: Value Proposition for Customers and Suppliers: The students of this group were tasked to examine the relationship of the chemical company with its suppliers and customers. Through their analysis they evaluated the criteria for the supplier selection and explained why specific suppliers were critical in the relationship with the chemical organization; explained the nature of growth drivers impacting customer relationships in order to expand the specialties market globally; and created a value proposition for customers and suppliers to enhance the position of the company in the Chinese market and produced a roadmap for implementing the value proposition.

Results and Discussions

Among key findings, the students assessed the capability and capacity of the chemical organization to develop new products, establish alliances with new suppliers, and serve other customers in the specialty chemicals market in China. They leveraged the strong position of the organization as a distributor of chemicals around the globe and determined threats from a weak strategy if the market participants (government, suppliers, local agents, etc.) are not educated on value of specialty chemicals.

The students also studied internal and external factors that are associated with the value proposition to generate growth in this market and concluded that the focus of selling specialties is not based on low price, high quality, and after-sale service, but rather on revenue generation, risk aversion, and the associated cost and time. The findings suggested that the chemical distributor was in a strong position for generating profits in the specialties market in China.

The students recommended the company not only work with suppliers that add value to customers, but also bring value to its strategic suppliers by allowing them to utilize the many different innovative distribution functions they support. Such an innovative and strategic

partnership was an additional value the chemical organization could bring to its suppliers and ultimately to customers. This idea of shared value is important as it allows suppliers to participate in the company's growth resulting in a win-win relationship. For example, suppliers may want to expand their product offering or introduce products in markets where they are currently not doing business. On the other hand, the chemical distributor can obtain support from suppliers on market trends, market entrance challenges, information about other products and more. Similarly on the customer side, additional services could be offered in form of extending credits, managing logistics and deliveries, assuming supply chain risks, providing a dedicated sales force among others.

The students concluded their project evaluating the effectiveness of the sales force, and conducted several interviews and surveys to understand the constraints, challenges and limitations that multinational organizations face when entering into a new market diverse as China. They finalized proposing three ideas for effective sales: evaluating the selling process, sales generation (professional pursuit of targeted customers), and efficiently communicating the value proposition.

Their roadmap for implementation included: a) the analysis of customer and supplier stratification (directly applying concepts and theories that the students learned in the class); and b) the alignment of the organization key values and successful global strategies customized for a local market (China).

The Texas A&M University model provides students with an excellent opportunity for development and execution of an international project. It encourages them to be very creative and apply strategic thinking. The students learn project management tools and techniques, concepts of global supply chain and logistics, international sales and marketing concepts, data and business analysis to improve their problem solving and idea generation skills. Finally, this class offers an experiential learning environment for undergraduate engineering students.

Conclusions

This paper presented a survey of select U.S. engineering schools' study abroad programs and lessons learned from those programs. Our research shows that selection of countries for study abroad programs has been widened significantly in the recent years beyond the traditional destinations such as Western Europe and Australia to Asian countries like China and India. Our survey also revealed that there were few schools, which did not have a study abroad program in the Engineering departments, more particularly in the manufacturing related departments such as Industrial or Mechanical Engineering. However, these programs vary significantly in terms of scope. For example, many of these programs are course only program, as opposed to industry sponsored real world research. This paper has presented a case study of Industrial Distribution's Global Study Abroad program at Texas A&M University. The case study was based on 2014 Summer I semester class in which 30 students from the college of engineering participated study abroad program in China. This program was sponsored by a global chemical distributor. The class was divided into multiple groups, each of which had worked on a separate topic of a major project. At the end of the semester, the findings were presented to the company management team in China via webinar.

The global study program was a very positive unique experience for the students who all aspired to be global leaders in their professions. More importantly, we believe that the case study provided a good benchmark for other engineering schools that may be considering similar industry sponsored study abroad programs for undergraduate students.

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