Integration and Practice of Entrepreneurship in Global Senior Projects

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As innovation and entrepreneurship are the major drivers of economic growth, prosperity, and quality of life, tomorrow's engineers not only will need a solid technical background, but also must be equipped with new skills associated with globalization, innovation, entrepreneurship in order to compete, succeed and lead in the future global marketplace. In the practice of WPI's China Project Center, a set of hands-on practical exercises to supplement the existing engineering curriculum with the aim to develop students' integrated skills in these areas so that they are armed with technical skill as well as business knowledge and become more valuable inside an organization.

For recent five years in the China Project Center, a growing number of WPI students have traveled to China, working with selected Chinese students from a top engineering school in mixed teams and performing their senior projects of solving real world problems. The projects have been sponsored by global companies with China operations. One of the goals of the project center is to integrate entrepreneurship in senior projects; provide opportunities of practicing entrepreneurial skills with real world problems; and to integrate and practice the entrepreneurship in global economy and multi-cultural environment. Additionally, we provide opportunities for WPI students to practice their knowledge and skills in unfamiliar cultural environments; and explore an effective way to educate a professional workforce with better understanding of the cultural and technical issues in international business.

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Introduction

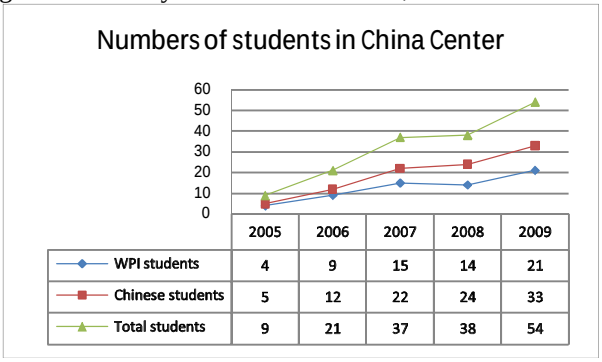
As the world is changing at an exponential rate and the economic growth constantly relies on fresh ideas and talents, tomorrow's engineers not only will need a solid technical background, but also must be equipped with new skills associated with globalization, innovation, and entrepreneurship in order to compete, succeed and lead in the future marketplace. A substantial number of U.S. based multinational companies' primary source of growth and profits is connected to global markets. New generations of consumers are growing at a rapid pace in emerging markets, particularly in China. Furthermore, the business world is becoming not only flat (Friedman, 2005), but entrepreneurial as well (Drucker, 2006), both of which are enabled and powered by innovative technologies. As such, the focus of the engineering education should be shifted consistent with the business trend and provide tomorrow's engineers a good understanding of all the critical functions for business growth as well as a new set of skills in addition to the traditional ones so that they will be able to adapt to the massive global market.

Innovation is the primary driver of growth, prosperity, and quality of life (Calrson, 2006), and has thus been embedded as an important ingredient (e.g., creative thinking) in the engineering curriculum. This component also plays an important role in new product development. However, designing new products does not warrant value creation and market demand (e.g., Young, 2005), and new product design should respond to market needs and must be introduced effectively to attract potential users and investors in order to create customer values. Recognizing the gaps between product design and commercialization in engineering education, several forward-thinking schools and programs are introducing the elements of entrepreneurship to their undergraduate engineering curriculum by offering regular classes or seminar series. In fact an entrepreneurial spirit and skill set should be established from multiple dimensions throughout the entire engineering program study. Senior project may provide students a good opportunity to practice through an effective way of experiential and collaborative learning (Chickering, 1987; Terenzini, 2001).

Project Center Operation

The China Project Center is the largest international off-campus senior project center of WPI (Rong, 2008). It is based on a cooperative arrangement between WPI and

Huazhong University of Science and Technology (HUST, 2009). Since its inception in 2005 when four students participated in center activities, the center has grown to twenty-one students in 2009, as shown below.



	2005	2006	2007	2008	2009
WPI students	4	9	15	14	21
Chinese students	5	12	22	24	33
Total students	9	21	37	38	54

In general, developing technical communication and social understanding has been an integral component of all of our China projects. The student projects afford all participants an effective means of breaking the cultural and social barriers and bringing people together with different backgrounds. WPI students, in particular, learn how to coordinate with their international teammates both in technical and cultural settings focused on real-world problem solving, and the ways of doing business and solving problems in different cultural environments. During the time they are conducting their projects, our students not only gain more understanding of the solution of technical problems, but are also challenged to work with and learn from engineers who have different ways of approaching problems, all while practicing teamwork and leadership in an unfamiliar culture and a different social environment.

All China Project Center projects are completed during the summer (the WPI E term). Pre-selected senior or junior students travel to China, work with HUST senior engineering students in mixed teams, and conduct real world research projects sponsored by local companies and/or US/foreign companies in China (e.g., Caterpillar China, Saint Gobain China, Amphenol China, and CIS China). All projects are co-advised by WPI and HUST professors.

The intellectual focus of the projects typically involves solving technical problems related to international design and manufacturing operations. A typical example of the projects is to improve the product design process. The students work with a partner company and engineers in China to examine the existing process, specify the requirements, formulate the problem, propose alternative solutions, implement the design and conduct testing. Another example project is the implementation of lean manufacturing principles in a local Chinese company for optimal operation of production. Optimization to reduce cost and delivery time while maintaining quality, is a mission critical task for many US companies that have manufacturing operations or joint ventures in China. For these sponsors, the students have worked together to study ways to convert traditional manufacturing factories into lean manufacturing shops, all in collaboration with the partner professors and engineers.

Project Experience

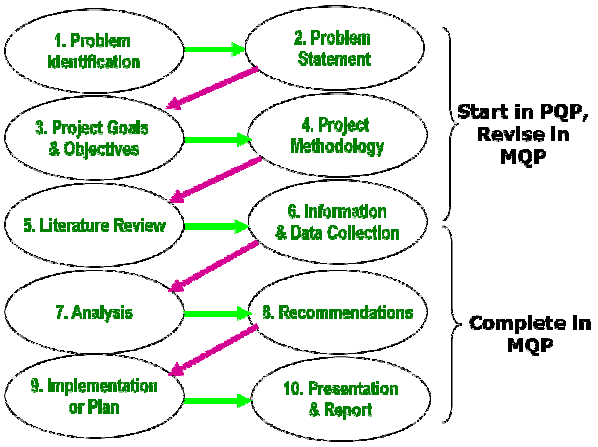
For each project, at least one engineer from the sponsoring company serves as an industry mentor, participates in group meetings, provides project background and technical information, and helps the students define the problem and verify the solutions.

In order to achieve the goal of each project within a short time of seven week on site, the preparation is critical toward success. First the center directors work with potential corporate project sponsors to clarify the target and scope of each project as a draft project description. Subsequently, project descriptions are finalized and announced to the students at WPI and HUST. Students apply to the China Capstone project Center and are individually interviewed. The selection criteria include academic record, an interest in the manufacturing industry, an interest in acquiring a unique global experience, and an interest in engineering research. Selected students are formed into teams (3-4 students typically) based on their specific project interests. Selected students are required to register for a preliminary qualifying project (PQP) where the student teams conduct literature reviews and learn the necessary project background, both technical and cultural. During the PQP, meets with the students once a week for discussion on any questions and problems. It is also during this time that the students begin to communicate with their Chinese partners and co-advisor. The culmination of the PQP is a research proposal that is made available to all participants and presented during a formal oral presentation period at the end of the PQP.

When the students travel to China, they live in HUST housing except traveling to the company location according to the need of the project progress. While on-site, each team is expected to work diligently on their project, write a report, and make a professional presentation to their sponsors before returning to Worcester. While on site, the students are co-advised by both WPI and HUST professors as well as mentored by engineers from the local project sponsoring companies. The local company representatives are invited to all presentations, engage in discussions, and give their opinions on the projects. The experience brings the WPI students face-to-face with another culture in a powerful, often life-changing way.

The major impact of the projects is expected to be both the development and growth of highly qualified

young professionals and the technical results of the projects which, combined with dual cultural creativities and intellectual achievements, will ensure lasting results. The participating students are valued by US companies because of their very significant international experience. The following figure shows such a project process.



Through the China MQP Program, participating students realize a variety of critical educational outcomes, many of which are included in new the outcomes-oriented accreditation criteria that the ABET is using to evaluate engineering programs in the United States. For example, students learn to solve open-ended integrative problems, they make connections between classroom and experiential learning, and they come to appreciate the impact of the decisions on local cultures and communities, as well as the impact of culture and community.

The student experience in China

Unlike most US students who study abroad, WPI students become immersed in the local culture as they tackle important problems for sponsors: most often local companies that receive solutions to important issues they face and also identify potential employees. The projects completed at WPI China Project Center in China make a real difference to individuals, universities, and companies around the globe.

The WPI students have learned about the Chinese culture, particularly on the economic development, the working/living environment, university campus and higher education as well as student life, the people in local community and in the companies they work with, and enjoying travel for sight-seeing and Chinese food.

One WPI student said, “Doing a project in China was an unbelievable learning experience, not just on the school front, but also on the cultural front. I learned a lot about the design process and how you need to change things depending on what equipment you have to manufacture the parts. …… Overall, it was a wonderful and eye-opening experience that I would recommend to anyone who gets the opportunity to go. I only wish we had time to have seen more of the country, but I can always go back.” And another quote from a WPI student, “The best part was working with students from another culture and learning from them about their country. This was a once in a lifetime opportunity to catch a glimpse of what China is really like and to see how they view our own country. I gained an entirely new perspective of Chinese life, culture, and ideas that I never would have expected. My only regret about the trip was that we couldn’t stay longer.”

At the same time, the HUST students have learned a lot from the projects too. Usually this is the first time for them to do a real world project. From a follow-up survey, the HUST students particularly pointed out that they have explored new ways of thinking, including team work and leadership role, the process to start and conduct a project, and the design justification as equal important as the design itself. They have also practiced the way to work with US students and the way of communication, understanding, and coordination, and “feel” about the life of US students

Several quotes from the HUST students, “My biggest gain in this project is to know a good procedure of doing a project”; “I learned how to start, how to discuss with people, how to come up with initial idea of a new design, and how to present the idea/results of the project”; “Particularly, I learned how to represent myself, my idea, the work we have done, the results and conclusion of the project, and more importantly, the person I am”; and “I am impressed by the WPI students on their intention to take the leadership, their confidence on what they are doing, their quick way to implement the ideas we may have, and their curiosity on finding new things they do not know, not necessary to be project related”.

Impact to the Sponsoring Companies

Senior students have learned based knowledge in their major field mostly in classroom. They have learned the way of learning with some project experience from junior project (IQP: Interactive Qualifying Project in WPI system) and upper-level classes. More importantly, they are eager to practice the knowledge and skills they have learned in the real world problem solving to contribute and create values mainly through fresh ideas, mixed teams, and collaborations. Most project sponsors are satisfied the student project work and willingness to continue the sponsorships. Here are two quotes from the project sponsoring companies.

“The two projects sponsored by Nypro China were quite successful and exceeded expectations. The students were courteous, thoughtful and very interested

in their project topics and showed mature attitudes. The mixing of local Chinese students with the American students created unique challenges for the students and sponsors. The most noticeable challenges were relating to oral communication, cultural differences in methods used to communicate ideas along with a general lack of knowledge or experience in the fields. The students were able to overcome the challenges because of their relative overall maturity as individuals, support from the WPI professors and extensive guidance from their sponsor. The projects will ultimately add value to Nypro in terms of meeting Nypro's cost savings and environmental goals along with having provided to students an experience that will be everlasting to them professionally and personally."

"Coming into this project, I wanted to make sure that we had a win-win situation that would benefit both the engineering students as well as our company. To be honest, I felt that this would end up a training exercise for the students and would just take valuable time from our team as we are dealing with a difficult economic time in our industry. However, I was pleasantly surprised how seemless the students worked with our people as well as the overall results from the project. Creating a database to monitor and track supply chain activity seems fairly straight forward, but the work the students did to first document our process and then create the database around it was very not trivial. It required interviewing and discussing the roles and responsibilities of numerous functional departments and then combining that information into a process flow that all involved parties agreed on. I also thought initially that I would have to 'hold their hands' and help gather this information, but they jumped right in, contacted the necessary people and got the information on their own. None of the students had experience with access before this project, but they were able to learn the software, do the modeling and mapping and create the database quite effectively."

Summary

China Project Center at WPI has been successfully operated for five year. As of the sixth year of 2010, we have expanded the center with ~30 WPI students from multiple majors (ME, MFE, MGE, IE, ECE, and RBE), working with about 40 Chinese students from our university, and with student choice of summer or fall terms. The number of project sponsoring companies reaches 10+. It is clear that the China Project Center program is much beneficial to our students and also the project sponsoring companies. It is also our wish that the practice we are exploring will contribute to the innovation of engineering education and many more students may have the opportunity to involved and take advantaged from it.

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