

# International Design Project Experiences: Assessing the Long-term Impact on Students

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In 2005, the Department of Civil Engineering at Rose Hulman Institute of Technology (RHIT) decided to incorporate an international component into its 18 year old capstone senior design projects. Since then, the department has ensured that at least one international design project is offered every year.

During the 2006-07 academic year, five civil engineering students had the invaluable experience of visiting Ghana as part of their capstone design experience. Prior to their visit, the Civil Engineering Department and the Office of Institutional Research, Planning and Assessment (IRPA) of RHIT developed and administered three assessment instruments in order to collect data on the short term impact of international design projects on student experiences. The results indicated that, despite the associated challenges, the benefits to the students are seen as immediate and profound. To date, there is little or no information on assessing the long-term benefits of such projects. Consequently, the Civil Engineering Department and IRPA have implemented an on-going assessment plan that involved sending out questionnaires to past students (alumni) who have been involved in international design projects. The goal is to assess the impact of such projects on their professional career and growth.

This paper discusses the results of the data collected during the assessment process. Additionally, the paper compares two main student groups: student who undertook international projects and those who took part in domestic projects. Finally, the paper concludes with suggestions for future improvement.

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## Introduction

Each summer, fifteen to twenty corporate or governmental sponsors submit proposals for design projects to the Civil Engineering (CE) Department at Rose-Hulman Institute of Technology (RHIT). In August each student ranks the projects, and assignments are made to maximize student preferences. Each design team includes four to five seniors, a faculty coach, the client, and the course instructor. There is no charge for the design projects other than direct costs. These year-long, client-based projects have been the senior design capstone model at Rose-Hulman since 1988.

The four learning objectives for client-based, senior design projects include: (1) problem-based learning (of the civil engineering design process), (2) communication proficiency, (3) team-work skills, and (4) project management orientation. The year-long experience contains many key elements and deliverables to achieve these learning objectives.

In 2005, members of the civil engineering faculty decided it would be beneficial for students to venture into the international arena. The dialog began when a faculty member participated in a mission's trip to Trinidad during the summer of 2005. Conversations with the physician in charge of the project resulted in a

senior design project for Rose-Hulman students. The end result was a design report for a missionary complex complete with an orphanage, a medical facility, a home for battered women, and a soup kitchen.

There are many good reasons to expose engineering students to international projects. For example, the explosion of knowledge precipitated by the Internet and the resulting global economy will make engineering services increasingly dependent on an international talent pool. This is very apparent to the National Academy of Engineering as stated in its report on the engineer of 2020<sup>1</sup>. Global competition from India and China is an inescapable conclusion of Thomas Friedman in his book entitled "The World is Flat"<sup>2</sup>. Engineers ignore these economic dynamics at their own peril; embracing change and competition is likely to produce satisfactory results. A new technological workforce will emerge in the 21<sup>st</sup> century according to author and futurist David Heenan<sup>3</sup> and we need to prepare for it.

The advantages of international experiences for engineering students are well documented:

- Partnerships with local or international organizations.
- Exposure to international design codes.
- Experience in the global working environment.

These are just a few of the benefits associated with international projects. However getting involved in foreign projects is not without its problems:

- Students face challenges associated with distance (e.g., site visits).
- Students have to deal with the different cultural and educational environments.
- Students experience difficulty obtaining necessary data.

Despite the associated challenges, the benefits to the students are seen as immediate and profound.

Our first international senior design project (2005-2006 academic year) produced many challenges. The lessons learned encompassed all phases of the project as summarized by Hanson et al<sup>4</sup>. Examples of the primary lessons are listed below in their appropriate categories:

- Purpose (International projects should align clearly with program outcomes.)
- Project Acquisition (Personal relationships with perspective clients is invaluable.)
- Project Planning (Build a budget; site visits are just as critical for international projects.)
- Site Visit (Itemize and prioritize the objectives of the site visit.)
- Design (Information acquisition and factors of safety are important design considerations.)

Based on the lessons learned from the department's first international project, changes were made to the format of subsequent international projects undertaken by the department. Specifically, the following recommendations were implemented:

- Partnership with the Rose-Hulman Engineers Without Borders (EWB-RHIT) Chapter
- Collaboration with overseas academic institution
- Support provided by an engineer in the problem-source country

### **Models for International Capstone Design Projects**

International capstone design projects have taken a variety of forms over the last few years: joint project, travel overseas, and stay at home.

The advantages and disadvantages of each model are discussed by Hanson et al<sup>4</sup>.

#### ***Joint Project***

One model is to have student teams partner with student teams from another country in order to accomplish the project jointly.

#### ***Travel Overseas***

Another model is to send student teams abroad to work on projects in the host country.

#### ***Stay at Home***

Yet another model is for student teams to work on the project while at their home institution. This is the model that has been explored at Rose-Hulman for our international senior design projects.

#### **International Projects Undertaken (2005-2008)**

Prior to sending out the questionnaires to past students (alumni) the CE department had collaborated on projects from three different countries: Trinidad, Ghana, and Sudan. A summary of the scope of work for these projects are provided below:

##### ***Trinidad, 2005***

This involved the design of a missionary compound in Las Lomas, Trinidad. The compound included a medical facility, orphanage, battered women's shelter, soup kitchen, and house for visiting missionaries.

##### ***Ghana, 2006***

This involved the design of an agricultural training facility. The facility included a computer training center, conference hall, caretaker house, hostel, poultry building, office space, and executive chalets.

##### ***Sudan, 2007***

This involved the design of an educational campus. The educational campus included an office building, a gymnasium/auditorium building, a football field, and a wastewater treatment system.

#### **Student Team's Visit to Ghana, 2007**

In the summer of 2007, the student team commissioned to design the agricultural training facility in Ghana had the invaluable experience of visiting Ghana. This trip came about as a result of the Institute's as well as the CE department's desire to provide some international design experience to our students.

As part of the senior design requirements, the student team presented their final design report to the District Chief Executive of the town, the local engineer, and most importantly, the local community. Furthermore, the student team explored the feasibility of collaborating with students from Kwame Nkrumah University of Science and Technology (KNUST) on future senior design projects. Finally, to expand their cultural awareness, the students toured some of educational and historic treasures of Ghana.

#### **Assessing the Short Term Impact on Students**

A summative assessment was planned for the 2006-2007 academic year to examine the impact of actually spending time in Ghana as part of a senior design project on students both academically and personally.

Three assessment components were implemented for the current assessment including: 1) a pre-trip survey; 2) a focus group following the trip; and 3) daily journals kept by students during the trip.

Seven main components were focused on for exploration during this assessment:

- a) expectations for the trip, b) motivation for the trip,
- c) preconceptions of Ghana, d) benefits of the trip,
- e) enjoyment of the trip, f) suggestions for change, and
- d) student viewpoint of importance

A summary of the results published by Aidoo et al<sup>5</sup>. indicates that the short term benefits are immediate and profound.

### Assessing Long Term Impact on Students

Based on the positive results obtained from assessing short term impacts on student experiences, our next goal was to assess the long-term benefits. In 2011-12 academic year, questionnaires were sent to alumni who had been involved with international design projects as well as those involved with domestic projects. A total of 84 alumni completed the survey (11-international, 73 domestic; representing a 56% response rate). The goal was to contact these students after graduation to assess the impact of international design experience on their professional career and growth.

These were students that had worked on international or domestic senior design projects since 2005. The results follow a similar pattern to the survey administered in 2008. The results from this survey are shown in Table 1.0. The survey addressed eight main issues namely:

- o *The engineering skills applied in humanitarian work*
- o *Types of humanitarian work involved in that did not require engineering skills*
- o *Interest in applying engineering skills for pro-bono work in the future either domestically or internationally*
- o *The number of international trips taken for career, pleasure or humanitarian work*
- o *The percentage of international projects worked on*
- o *Ability to conduct a site visit and the benefit of a site visit on their professional development*
- o *Overall satisfaction with senior design experience*
- o *The current field of practice*

### Survey Results

From the responses obtained from the survey, the following conclusions are drawn:

- o Those that did international design projects are much more likely to undertake international trips to do humanitarian work.

- o Student satisfaction with senior design is very high and is influenced by completing a site visit.
- o Satisfactions with international and domestic projects are about the same.
- o Student interest in humanitarian work is high regardless of the type of project they worked on (i.e. international or domestic).
- o The percentage of students working on international projects in their career is greater for those that worked on international senior design projects.

**Table 1.0** Results of alumni surveys conducted to assess the long-term impacts of both international & domestic senior design projects on student experiences.

	International Students who worked on International projects	Domestic Students who worked on domestic projects
<b>Engineering Skills Applied to Humanitarian Work</b>		
Design	27%	43%
Construction	46%	40%
Supervision	36%	36%
<b>Humanitarian Work Involvement</b>		
Financial Support	55%	62%
Tutoring/Mentoring	55%	30%
Manual Labor	55%	55%
Relational Work	45%	34%
Other	18%	5%
<b>Pro-Bono Interest</b>		
Interested	82%	75%
<b>International Trips (average number of trips taken)</b>		
Career	.64	.37
Pleasure	1.27	1.40
Humanitarian Work	.55	.01
<b>Percentage of Work on International Projects</b>		
0%	55%	70%
1-5%	0%	11%
6-10%	0%	11%
11-25%	0%	1%
26-50%	18%	0%
51-75%	18%	0%
76-100%	9%	3%
Site Visit	18%	84%
Senior Design Experience Satisfaction	5.27	4.99
<b>Current Field of Employment</b>		
Civil Engineering Design	36%	52%
Construction	0%	1%
Law	0%	0%
Medicine/Dental/Veterinary	36%	25%

## Future Work and Recommendations

The next phase of this project will be to update and expand the database for long-term assessment of international design projects on student experiences.

Additionally, the CE department would like to implement the “Joint Project Model” for subsequent international design projects. Specifically, Rose students will be paired with KNUST students to design a project in Ghana. This will present a new and exciting chapter for Rose and KNUST students.

## Epilog: An Alumnus Perspective on International Design Projects

The senior year for civil engineering student at RHIT is hallmarked by a year-long capstone senior design project. During my senior year, I had the privilege of participating on an international senior design project. The experience was greatly rewarding, and I believe had a great number of benefits beyond a domestic counterpart. Looking back on the experience, it is easy to identify strengths of an international experience for undergraduate students and required activities to enable a successful project.

The initial hurdle to overcome is, certainly, gaining interest in the project. In regards to my project, The Mission Compound in Trinidad, several factors played into the international project being my first choice. First and foremost, the project had components that were close to my area of interest; namely structures. Certainly, if the project had been hydraulics or transportation focused, I would not have selected this project. The second leading factor that contributed to my excitement of the project was primarily focused on the potential social impact. The project, once successfully completed, would have a profound impact on the families of this town. It may be surprising, but the fact that this was an international project was more of a deterrent than an attraction. Intrigue definitely existed, but it was also very clear that this project would bring a great number of difficulties that a domestic project would not encounter. In retrospect, my uncertainty was confirmed.

Beyond the typical senior design obstacles, my group encountered a myriad of issues that were inherent of an international project. Unlike other groups, we were unable to perform a thorough site investigation. We had to rely on correspondence from our client and frequently deal with a lack of information necessary for design. Communication between our design team and our client was at a significantly slower pace than other groups. And due to readily available materials and local skilled labor, it was necessary for us to design using a material (reinforced masonry) that had not been studied by any team members.

My assumption that the project, over that of a domestic equivalent, would be significantly more challenging was proven correct. However, the benefits were equally in excess. We were forced to become aware of the cultural side of business and engineering. Communication, especially verbal, was given enormous weight. Since we could not meet in person and were limited by what we could pass back and forth, we had to become very skilled at clearly explaining what we were planning on doing. Work in Trinidad allowed us to also see design in a country with another building code (or lack thereof). In all, the additional effort required proved to be very enriching and rewarding. Beyond the civil engineering skill required to complete the project, the international aspect of the project gave the team experience with the increasingly connected world that we live and work in.

## References

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