

Developing Global Partnerships in Civil Engineering Education: Lessons from a Five-Year Collaboration with ABP Consult

¹ John Aidoo¹, Namita Shrestha¹, Mitchel Daniel¹, Timothy Chow¹, Kwaku Boampong² and Kishor Bagale Thapa³

¹*Rose-Hulman Institute of Technology*

²*ABP Consult Ltd, Ghana*

³*Kathford: Engineering and Management College, Nepal*

Since 2005, our international collaborative efforts have included partnerships with Kwame Nkrumah University of Science and Technology (KNUST) in Ghana and various non-technical clients across Africa, Asia, and Central America. In 2019, the Department of Civil and Environmental Engineering (CEE) at Rose-Hulman Institute of Technology (RHIT) sought to establish an international partnership with ABP Consult, a private consulting firm in Ghana. Based on a Memorandum of Understanding (MOU) established with ABP Consult in 2019, we launched our first collaboration during the 2019-2020 academic year. Since then, the CEE Department has partnered with ABP Consult on five humanitarian service-learning projects located in underdeveloped Ghanaian communities. These projects were selected as opportunities to help upgrade existing infrastructure in these areas. To strengthen the partnership, a senior member of ABP Consult visited RHIT in 2019 to meet with key administrators and members of the CEE Department and to explore additional avenues for collaboration. This paper describes the types of service-learning projects completed by our student teams, the benefits of partnering with an international civil engineering firm, and the lessons learned throughout the collaboration. It also outlines the assessment strategy developed to ensure that future partnerships remain sustainable and mutually beneficial for all stakeholders.

Keywords: international capstone design, service-learning, industry-academic partnerships, global civil engineering education.

Corresponding Author: John Aidoo, aidoo@rose-hulman.edu

Introduction

Since 2005, the Civil and Environmental Engineering (CEE) department has incorporated at least one international design project into its year-long, client-based capstone design course. International design collaborative efforts were implemented through an overseas academic institution, partnerships with the Rose-Hulman Engineers Without Borders (RHIT-EWB) Student Chapter, and projects provided by international clients¹. In 2005, Rose-Hulman faculty felt that the foray into international capstone would benefit our students². The benefits of international capstone design project experiences and the lessons learned are well documented^{3,4}. To date, 118 civil engineering seniors have worked on 28 international capstone design projects in ten countries: Ghana, Haiti, India, Kenya, Nepal, Pakistan, Sudan, Trinidad, Uganda, and Zimbabwe⁵. These projects are based on partnerships with Kwame Nkrumah University of Science and Technology (KNUST), RHIT-EWB, ABP Consult, and other international technical and non-technical clients. With the goal of enhancing students' experiences in

international capstone design projects, in 2019, the CEE department at Rose-Hulman Institute of Technology (RHIT) established a partnership with ABP Consult, a renowned civil engineering consulting firm in Ghana. The reasons for this partnership were to obtain⁵:

- Mentorship for the student team from a professional engineer in the project source country.
- Knowledge of the design codes, local construction practices, and local construction materials.
- Knowledge of the impact of their design decisions on project stakeholders.

This paper discusses the types of service-learning projects our student teams completed, the benefits of this partnership, and the lessons learned during the five-year collaborative period with ABP Consult.

Partnership Formation and Early Activities

ABP Consult was selected as the civil engineering consulting firm for this partnership due to its long-

standing experience with similar collaborative efforts with KNUST. In addition, the partnership with ABP Consult provides the student teams with the relevant site-specific engineering data such as:

(a) Information about previous and current land use, including current photos of the project site, (b) Region-specific geologic and soil mapping information, (c) Site and regional topographic data, (d) Pertinent codes and local construction and design practices. Most importantly, through this partnership, students gain an understanding of the impact of engineering solutions in a global, economic, environmental, and societal context. This impact directly aligns with and satisfies one of the student outcomes required by the program accreditor ABET⁶.

MOU between ABP Consult and RHIT

In August of 2019, a Memorandum of Understanding (MOU) was established between ABP Consult and RHIT to support international capstone design projects collaboration. This partnership promotes cooperation in engineering education by engaging students and practicing engineers in industry-sponsored design projects. For a long-lasting partnership with ABP Consult, both partners agreed to pursue humanitarian projects in underdeveloped communities in Ghana. Under the agreement, ABP Consult provides real-world project opportunities, professional mentorship, and technical input while RHIT integrates these projects into its capstone design curriculum to meet educational objectives. Collaboration includes student design projects, exchange of technical knowledge, and potential joint publications. Projects follow a structured academic timeline, and student work is performed at no cost to the client. The agreement emphasizes experiential learning, global, and societal impact and is intended to operate over a multi-year period with provisions for renewal.

Highlights of Service-Learning Projects with ABP Consult (2019-2025)

Based on the MOU with ABP Consult, student teams at RHIT collaborated with ABP Consult on five service-learning projects between 2019 and 2025 as part of the capstone design course. Highlights of each project are provided in the following sections. The framework for collaboration, timeline, and project deliverables with ABP Consult is outlined in a 2022 publication⁵.

1. Design of Urban Upgrading & Inner-City Development (2019-20)

This project involved the design of an urban upgrading and inner-city development for the Ayeduase community, a suburb of Kumasi, Ghana. The student team was tasked with redesigning congested intersections, developing pavement designs for major

roadways, completing the structural design of a hostel for KNUST students, and designing improved infrastructure for wastewater treatment and clean drinking water supply. The goal of this project was to improve the livelihoods of residents in the Ayeduase community. Ayeduase, a suburb of Kumasi, has struggled to meet the growing demands on roadways, sewage systems and building development. The project site encompassed multiple locations totaling approximately 307 acres. The area was relatively developed, with a mix of residential and commercial structures, and includes several high-traffic roadways supporting both vehicular and pedestrian movement⁷. While the drainage systems along the heavily trafficked roads are generally functional, they are prone to flooding during severe rainfall events. This was the only student team that had the opportunity to travel to Ghana and obtain first-hand project information.

2. Design of Energy City Enclave (2020-21)

This project involved the design of an Energy City enclave in Accra, Ghana. The student team was tasked with designing a new transit hub, redesigning congested roadways, developing pavement designs for the proposed roadways, and designing wastewater and stormwater management systems. The primary goal was to reduce traffic congestion along the major roadways surrounding the project site while also increasing safety for both pedestrians and drivers. These improvements are intended to benefit local communities and residents of Accra, as well as tourists traveling to and from Accra via Kotoka International Airport (KIA). The project site encompassed multiple locations totaling approximately 150 acres located just west of KIA. The overall vision was to redevelop an existing residential area for military staff, who will be relocated into a new mixed-use enclave featuring high-rise office buildings, hotels, and transportation infrastructure. The proposed roadway improvements are expected to reduce congestion in the area, while the new transit hub will serve as a modern gateway to Accra for travelers to and from KIA⁸.

3. Upgrade of an Existing Urban Community (2021-22)

This project involved the design of a mixed development enclave in Abira, a suburb of Kumasi. The student team was tasked with designing apartment structures, developing the transportation layout for internal roadways, and designing systems for wastewater management as well as the supply and distribution of drinking water. The project site is a parcel of land totaling approximately 230 acres, located in a small farming community northeast of Kumasi. Previously used for agricultural purposes, the site is largely undeveloped green space with no existing infrastructure and covered with dense vegetation. The mixed development was intended to provide housing for middle-income residents

of Kumasi through a combination of single-family homes, townhomes, and two- and three-bedroom apartments. Additionally, the development includes communal and commercial spaces designed to foster a sense of community and provide an economic boost to the local area⁹.

4. Design of an Inland Port (2023-24)

This project involved the design of an inland port in Kubease, a suburb of Kumasi. The student team was tasked with designing a warehouse and loading dock walls, developing new roadways within the site, and designing wastewater and stormwater management systems. The purpose of this project is to alleviate congestion at the seaports by improving the connection between the ports at Tema and Takoradi two major cities in Ghana. This initiative aims to enhance the overall efficiency and quality of import and export transportation across the country. Specifically, the inland port will handle imports and exports from northern Ghana as well as neighboring countries to the north, such as Burkina Faso. The project site is a 400-acre parcel of land located approximately 17 miles away from Kumasi, 183 miles from the Port of Tema, and 205 miles from the Port of Takoradi. The site is largely undeveloped and covered with dense vegetation. The inland port will facilitate more efficient international trade and stimulate the local economy. It will provide adequate living standards for new residents and migrant workers who will move to Kubease. As the population grows, these enhancements will create greater social opportunities, encouraging more people to settle in Kubease¹⁰.

5. Design of a Teaching Hospital (2024-25)

This project involved the design of an expansion to the teaching hospital on the KNUST campus in Kumasi, Ghana. The student team was tasked with designing a six-story teaching hospital, including the foundations and stormwater management systems. The project is intended to enhance healthcare infrastructure through the construction of new facilities, the expansion of existing facilities, and the integration of critical support systems, including stormwater management, drainage, and waste treatment. The teaching hospital will improve the quality of life for both the local and surrounding communities by expanding access to healthcare, education, and training opportunities. The expansion project will serve dual purposes: educating nearby KNUST students in the healthcare professions and providing additional, larger spaces for community members in need of medical care¹¹.

Visit by ABP Consult Staff and Its Impact

Mr. Kwaku Boampong, Deputy Chief Executive and former President of the Ghana Institute of Engineers, visited Rose-Hulman in the winter of 2019. He has

approximately 32 years of experience with the firm and has led numerous projects in Ghana. During his visit, he met with members of Rose-Hulman administration, including the Dean of Professional Development, the Provost and Vice President of Academic Affairs, the Dean of Faculty, the Head of the CEE Department, and the Director of the Center for Global Engagement. Discussions focused on the challenges and opportunities of the partnership with ABP Consult and explored avenues for its continued and sustained growth. Mr. Boampong also met with the student team involved in our first collaboration with ABP Consult to discuss the requirements and objectives of the Ghana project.

Educational Benefits and Professional Skill Development for Students

Since introducing international design projects in our capstone design course, we have collected feedback from 519 students over 14 years (from 2005 to 2019) regarding the impact of participating in these projects. The previous survey design, based on Olson and Kroeger's Global Competency and Intercultural Sensitivity Index¹², is detailed in a 2006 publication². Between 2020 and 2025, we emphasized more targeted feedback surveys for students participating in international design projects. Over this five-year period, we received feedback from 35 students. Students emphasized how international collaboration expanded their "knowledge about different construction and design practices, codes, standards, and regulations" and helped them "to understand what aspects of the civil engineering profession extend worldwide, but also how [things] differ". Students additionally described learning to be more flexible in their time management and communication skills to navigate challenges related to cultural differences, language barriers, time zone differences, and delays in obtaining data. Many of the students described how navigating these challenges helped them to become more resourceful and better critical thinkers. For example, students wrote that "international project-based learning has enabled me... to solve unknown information given very limited resources," and "having this as a foundation... allowed us to critically evaluate things we had learned".

Several students described the value of the international design project in terms of their competitiveness for engineering positions. For example, "working on an international project seems to impress a lot of companies", and "it has helped immensely with job prospects, being able to discuss skills [such] as collaboration, global engagement, critical thinking, etc.". Students also described becoming "more aware of working on a global scale" and cognizant of cultural differences in the meaning attached to different words.

Many students additionally described increased interest in a career related to international development because of the potential for helping people. The survey results from 2020 to 2025 are consistent with findings from 2005 to 2019.

Partnership Benefits to ABP Consult and Communities

As part of the capstone design requirements, student teams were required to produce a final report documenting their technical designs across the various civil engineering subdisciplines involved in each project. These reports served as preliminary design blueprints that professional engineers at ABP Consult could further develop to meet industry standards. In addition, the partnership enabled both stakeholders to collaborate on humanitarian projects in underdeveloped communities in Ghana, providing a viable approach for upgrading existing infrastructure in these areas. The added benefits to ABP Consult include increased visibility of the firm and its impact in Ghana, enhanced engagement with underprivileged communities and greater awareness of engineering services it provides through publications and presentations at professional meetings and conferences.

Key Lessons for Cultivating Partnership

We have found that the following insights are important for building and maintaining strong partnerships:

- These partnerships are complex and require ongoing effort.
- Not all partnerships are financially driven.
- Mentorship programs can create a win-win for all stakeholders.
- Identifying stakeholder motivations is key to sustainable partnerships.

Sustainability and Future Directions

We will use Ruben's BASIC¹³ (Behavioral Approach to Intercultural Communicative Competence) to assess interactions in video-recorded meetings between the student teams and their international client.

Each year, we survey students, faculty, and clients involved in the international design project. We will continue with this assessment process and refine it based on the feedback received.

References

1. Aidoo, J., Annor, F., Sipes, S., Boampong, K., and Hammett, K., (2020). Building Sustainable International Partnerships Through Capstone Design Projects, Virtual Proceedings of the Capstone Design Conference
2. Hanson, J., Houghtalen, R., Houghtalen, J., Johnson, Z., Lovell, M., and Houten, M., (2006). Our First Experience with International Senior Design Projects-Lessons Learned, Proceedings of the ASEE Annual Conference & Exposition, June 18-21, Chicago, IL
3. Aidoo, J., Hanson, J., Sutterer, K., Houghtalen, R., and Ahiamadi, S., (2007). Our Second International Senior Design Project, National Capstone Design Conference, June 13-15, Boulder, Colorado
4. Aidoo, J., Sexton, S., Hanson, J., Houghtalen, R., and Lovell, M., (2012). International Design Project Experiences: Assessing the Long-term Impact on Students, Capstone Design Conference, Champaign-Urbana, IL
5. Thompson, A., Miller, K., Biske, M., Robinson, M., and Brady, P., Aidoo, J., Ohene, F., Sipes, S., Boampong, K., and Shrestha, N., (2022). Our First Collaboration with an International Consulting Firm on Capstone Design Project, Capstone Design Conference, June 6-8, Dallas, Texas
6. ABET, 2024a, Criteria for Accrediting Engineering Programs, 2024-25 Review Cycle, Engineering Accreditation Commission
7. Thompson, A., Miller, K., Biske, M., Robinson, M., and Brady, P., (2020). Capstone Design Report-Urban Upgrading and Inner-City Development in Ghana, Rose-Hulman Institute of Technology, Terre Haute, IN.
8. Boutell, J., Wurtz, T., Tate, Z., Banda, F., and Householter, P., (2021). Capstone Design Report-Design of Energy City Enclave in Ghana, Rose-Hulman Institute of Technology, Terre Haute, IN
9. Collier, A., Nystrom, S., Reifeis, J., and Renn, J., (2022). Capstone Design Report-Upgrade of Existing Urban Community in Ghana, Rose-Hulman Institute of Technology, Terre Haute, IN
10. Lawton, W., Andrews, N., Lincoln, G., Randolph, M., (2024). Capstone Design Report-Design of an In-land Port in Ghana, Rose-Hulman Institute of Technology, Terre Haute, IN
11. Baum, J., Adkins, E., and Fosnot, M., (2025). Capstone Design Report-Design of a Teaching Hospital in Ghana, Rose-Hulman Institute of Technology, Terre Haute, IN
12. Olson, C. L., and Kroeger, K. R., (2001). Global Competency and Intercultural Sensitivity. Journal of Studies in International Education, 5(2), 116-137
13. Ruben, B. D., (1976). Assessing Communication Competency for Intercultural Adaptation. Group and Organization Studies, 1(3), 334-354.