The Stantec Project Center
An Off-Campus Capstone Design Experience

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The WPI Civil & Environmental Engineering (CEE) Department is working with North American engineering and design firm, Stantec, to conduct undergraduate student projects at Stantec office locations throughout the US and Canada. Students are advised remotely by on-campus faculty members and on-site by Stantec personnel. This paper describes how these off-campus projects help meet the CEE Department's capstone design experience degree requirements and concludes with points of interest for others that may wish to adopt a similar learning experience.

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Introduction

Our collaboration combines WPI's fundamental educational philosophy of a project-based learning experience with Stantec's vision to continually expand their professional service capabilities and foster valuable research and learning experiences for the next generation of engineers. WPI, located in Worcester, Massachusetts, currently has over 3,000 students enrolled in its undergraduate programs. Stantec provides professional consulting services in planning, engineering, architecture, interior design, landscape architecture, surveying, environmental sciences, project management, and project economics for infrastructure and facilities projects. The company has more than 10,000 employees operating out of over 130 locations in North America.

Projects conducted by the WPI students are in the civil and environmental engineering areas with a current focus on sustainable solutions. Each year, two or three teams of three-to-four students work on projects identified by CEE faculty and Stantec. Each team is advised remotely by the center director and a faculty co-advisor. An on-site Stantec advisor also works directly with the students.

Project topics and a general understanding of scope are developed a year in advance. This provides enough time for students to register and for the advisors to finalize student accommodations during their off-campus work. Students are required to pay for their travel, lodging and other expenses, but appropriate housing facilities, local transportation, emergency facility locations and emergency contacts are finalized ahead of time by the CEE Department and WPI's Interdisciplinary Global Studies Division (IGSD) with help from the Stantec office personnel.

Objectives

Three primary objectives of the off-campus experience are to:

1. Provide students with a transition from the academic environment to a professional practice environment,
2. Introduce students to the culture of working within a large corporation, and
3. Guide the students through a design process.

The Transition from Academia to Practice

Perhaps the most challenging concept for students when transitioning from academia to professional practice is to truly adapt to their new position of leadership and responsibility. Throughout their educational careers, students are typically conditioned to rely on step-by-step guidance from their teachers. Although such a learning environment may be beneficial, an unintended side effect is that students will relegate themselves to a secondary role. Why take the risk of doing it the wrong way – let the teacher show you the right way and then simply follow directions. This cycle of instruct and replicate may be comfortable for the students and their teachers, but will break down when the students find themselves involved with a much more complex open-ended design problem. There is no one-way of approaching the problem, and there are a host of solutions.

The students must now redefine their professional make-up with a different set of qualities or attributes, such as those suggested by Davis[1]. Based upon our experience, we find the following six attributes and performance factors most applicable to succeeding with off-campus projects:

Attribute 1 – Self Motivation
- Accepts responsibility
- Provides leadership and a focused direction

Attribute 2 – Effective Teamwork Skills
- Cultivates professional relationships
- Networks well within and outside of the team
- Resolves conflicts professionally and effectively
- Is considerate of diverse backgrounds/disciplines
- Is an effective team player

Attribute 3 – Time Management Skills
- Works within time and resource constraints
- Defines targets and maintains focus on goals

Attribute 4 – Creativity & Innovation
- Is a self-sufficient learner
- Conducts independent research
- Creatively approaches problem-solving

Attribute 5 – Communication Skills
- Listens to team members and supervisors
- Conducts regular progress reports
- Presents written and oral final deliverables

Attribute 6 – Social and Professional Awareness
- Identifies environmental impacts
- Is aware of ethical considerations
- Is professionally responsible

The Culture of Working in a Large Corporation

As organizations grow in size and complexity, success increasingly depends on teams or multi-disciplined groups, not "a genius with a thousand helpers."[2] Successful organizations will transform their culture from one where everyone feels they must have the answer to one where everyone knows something; nobody knows everything, but all are confident that they will find the best solution together. "In an information-rich age, it appears that the ability to process information wisely and effectively is becoming far more valuable than the ability to gather information."[3] It is through culture and technology that modern organizations accumulate and retain the knowledge that will allow them to be successful.

We are currently living in an information economy and are rapidly moving towards a knowledge economy. This transformation has created a new type of worker that "engage[s] in complex problem solving that involves a great deal of independent judgment and requires high levels of education or human capital.[4] This shift has forced organizations, which up until recently created their value in the manufacturing or service industries, to adapt from employing people that are paid to "execute according to plan" to employing knowledge workers who "are primarily paid to create."[4] As more and more work becomes knowledge based it will become increasingly important for organizations to develop a collaborative climate where workers can creatively solve problems.

When hosting WPI student teams, Stantec strives to create an environment where students are presented with a challenge, but not with step-by-step instructions on how to achieve the objective. When students arrive they are welcomed as any new employee. They are provided with a cubicle, security card and computer and orientation of the company. Then they are left on their own to complete their project. An important objective of hosting the students on site is for them to integrate the theory and the practice -- where as much is learned at the water cooler as staring at a computer screen. The challenge for the students is to identify the people within the organization that possess the knowledge required for their project and persuade these people to take the time from their own projects to assist. As Stantec has more than 130 offices, the person may not reside physically in the same office as the students. This adds another layer of complexity.

To help them navigate this large organization the sponsor facilitates introductions, in person or electronically, with some of the experts that have worked on similar projects and often these lead to further introductions. Project topics are deliberately kept broad and no deliverable is defined. Student teams are expected to work together in developing a final project deliverable and are expected to search out the resources and expertise within Stantec with only limited guidance from the sponsor. This is representative of the complex assignments Stantec works on with their clients. Students are judged on their process, final presentation and how well they communicate what they have learned so that this knowledge can be integrated into Stantec's knowledge repository. Students are provided with a safe environment where they can explore, and more importantly, fail.

The Design Process

Undergraduate students are certainly provided with many basic skills needed to successfully plan and complete a design problem through coursework experiences, but are rarely given the opportunity (or challenge) to combine those skills. Placing the students in this off-campus environment and giving them an open-ended problem with realistic constraints meets that objective. Features of a design problem that are needed include:

- An Open Ended Problem -- multiple approaches may be used and there are many correct answers.

- Basic Skill requirements -- science, mathematics and engineering science
- A Systematic Methodology -- formulate the problem, identify specifications, and define constraints
- A Decision Process -- iterative process, compare and rate alternate solutions
- Realistic Constraints and Established Design Standards -- practicality, economic considerations, social impacts and sustainability.

Methods

Student teams work with the faculty advisors one term prior to their off-campus term (each term is approximately seven weeks). During this pre-project period, the students conduct literature reviews, prepare a scope of work and develop a proposal complete with itemized tasks, target goals and a timetable. Communication with the off-campus project advisor (Stantec employee) is accomplished through a variety of methods including telephone conferencing, video recordings, web-based communications and e-mail. Meetings with the faculty advisors are held on a weekly basis – sometimes during a conference call with the Stantec advisor.

Define the Scope of Work

The scope of work is jointly defined by the sponsor (Stantec) in collaboration with the WPI faculty advisors and the student teams (usually about three students per team). This is a collaborative effort involving three distinct perspectives. In general the sponsor will want a project that can be used by their organization, the faculty advisors will want a project that challenges their students to satisfy the overall objectives of the off-campus experience, as listed in the previous section, and the students will want a project that will allow them to use many of the basic skills they have gained through coursework. The primary objective at this stage of work is to establish a professional rapport between the student team and the advisors (faculty advisors and off-campus advisors) and to clearly define the project topic and constraints.

Prepare a Proposal

With the scope of work finished, students are next asked to develop a more comprehensive description of the project topic with an annotated bibliography and a detailed timetable. By this time, the students should begin to realize the meaning of the phrase: "This is your project" -- which has been repeated many times during the scope of work phase. In other words, Objectives 1 & 2 are being addressed with increased emphasis. The student groups maintain regular communication with the Stantec advisor and meet with the faculty advisors weekly.

With the completion of the proposal, the student team should have developed a professional line of communication with all advisors, have a clear understanding of the project scope and are ready to efficiently begin work on their project. Meeting this level of readiness is absolutely essential, as the groups are strictly constrained to a seven-week period to complete their projects at the off-campus location. By the close of seven weeks, the groups are required to deliver their finished product to the client and give a formal oral presentation.

Team Building

Throughout the pre-project term and into the project term, students are asked to develop and participate in team-building exercises. These exercises range from informal social gatherings with each other and perhaps the faculty advisors to more formal activities – such as organizing a dinner with Stantec employees while at the off-campus location. Experience in working with student groups on these off-campus projects with very strict time constraints with clearly defined targets and deliverables has clearly confirmed the need for this activity.

Conduct the Project On-Site

Once the students arrive at the off-campus site, they are orientated to routine office protocols (IDs, computer assignments, desk assignments, an introduction to office staff, telephone and computer access codes … etc). The students are expected to function as Stantec employees and work in the office (or off-site field locations) during normal working hours, hold periodic progress meetings with their Stantec advisor, organize meetings with Stantec personnel (as recommended by their advisor), and participate in office functions.

During the project period, the students are completely immersed into a professional practice environment and will experience:

- Sudden shifts in the project direction (sometimes suggested by the advisors, sometimes suggested by the student group).
- The need to arrange and conduct meetings with people who are very busy and pressed for time.
- Conflicting opinions from people they meet.
- Responding to the "Five Minute Elevator Pitch" challenge.
- Working overtime to produce a last minute request for information (such as a quick presentation on their progress to date or to help with a company

proposal that is closely related to their project topic).
- The necessity of time management and a clear focus on their goals and targets.

Conclude with Deliverables

At the end of their off-campus seven-week term, the students are required to produce their final deliverables – usually an in-house report for the company, a formal oral presentation at the company office, and their student project document -- the Major Qualifying Project (MQP) report. The MQP report will contain more details relating to the capstone design aspects of their work that are not needed for the in-house company deliverable, such as:

- A clear definition of an open-ended problem –the student team with advice from their advisors will sometimes create a design challenge that is directly related to the project topic.
- A detailed description of the methodology used, including the specifications and standards used and the constraints considered.
- A step-by-step description and presentation of the analysis process used (possibly an iterative process).
- Economic, social and sustainability aspects of the design problem.

Results and Conclusion

The Stantec Project Center has been in operation for three years. Details on student projects with examples of their deliverables may be found at the WPI/Stantec Project Center website: http://www.wpi.edu/academics/Depts/CEE/stantec.html

All three groups involved in this exercise (Stantec advisors, faculty advisors and student groups), have observed the need to make adjustments for these off-campus and remotely advised projects to be successful. For example:

Stantec Advisors

- Adjust to an academic calendar that requires significant advance preparation – commit to a project theme six months before the project starts.
- Recognize the difference between an advisor and a supervisor – give the students ample room to self-learn, wait for the teachable moment and maintain close observations throughout the project period with routine progress-report meetings.
- Be available for consultation, but avoid accepting a leadership role with the team.
- Help the students focus on time management and the need to recognize a client's expectations rather than blindly following pre-established objectives.

Faculty Advisors

- Focus on team building and communication protocols during the pre-term period.
- Maintain a progress report schedule, but also be available to provide advice on a 24/7 basis for technical as well as non-technical situations.
- Require the student groups to follow a clear schedule with target goals.

Student Groups

- Learn how to prepare for meetings, conduct interviews, hold progress meetings, prepare professional level documents and give formal and informal presentations.
- Learn time management skills, teamwork dynamics, and social skills.

In conclusion, these projects are not internships or co-op assignments. They challenge the students to move beyond research and inventory and challenge the advisors to guide the students in the application of the knowledge they have acquired – both in their off-campus experience and in their preceding undergraduate education. This approach meets WPI's belief that "students should understand how to apply knowledge – not just how to cite facts and theories."[5] And it meets Stantec's objectives as well. As Stantec's boomers start to retire it is important that they find and develop passionate new employees whose value lies not in their factual knowledge but the ability to contribute to multi-disciplined project teams through creative and social skills. Hosting these WPI students is the first step in that process.

References

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