



## **Successful Academic Partnership in the Development of an International Construction Practices Course**

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Dr. Jaselskis has served as a program director for the National Science Foundation in the area of information technology and infrastructure systems and director for the Engineering Policy and Leadership Institute and professor-in-charge of the construction program at Iowa State University.

He has conducted research in the areas of construction project success and advanced information technologies with funding provided by federal (National Cooperative Highway Research Program and National Science Foundation), state (Iowa DOT), and industrial sponsors (Weitz, Western Summit, and the Construction Industry Institute). He is currently working on the use of RFID technology to provide continuous tracking of personnel on a construction site and investigating the determinants of construction project success on complex projects.

Dr. Jaselskis is a registered professional engineer in the State of Iowa and has memberships in several organizations (American Society of Civil Engineering, Construction Institute, Transportation Research Board, American Society for Engineering Education, Sigma Xi, and National Society of Professional Engineers). He is also a member of the National Academy of Construction.

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As an instructional designer, Dede Nelson, M.Ed., works collaboratively with engineering faculty to help identify and facilitate the effective integration of instructional technology and strategies that enhance the learning experience for today's engineering students. Economic globalization, advances in technology, and increasing demands by accrediting bodies are influences causing engineering educators to reconsider many of the traditional models for the design and delivery of engineering education. A broad range of expertise is required for best results, and leveraging the use of library resources, working with instructional designers, and taking advantage of copyright experts, media specialists, and centralized IT support are often necessary for innovative course offerings such as the one described in this article.

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## Abstract

The challenge of working effectively with multicultural teams will continue to grow in importance. Students graduating from engineering and construction management programs need to be functional in this global environment. To address this need, this paper discusses a successful partnership among several international universities to develop a construction practices course designed to prepare engineers for the global workforce. The course specifically focuses on sharing global construction engineering and management practices and includes partnerships primarily with universities located in the U.S., China, India, Canada, and Chinese Taipei. Development challenges confronted by the leadership team pertained to *planning and logistical issues* and *technology issues*. Students gained tremendous knowledge about construction practices and issues in other countries and got a taste of what it will be like when they work in the real world and are faced with communication issues on multi-national teams. The significance of this paper is to provide lessons learned to help others better understand the challenges of developing a successful partnership among multiple international universities.

## Introduction

As in many other industries, globalization is having a significant impact on engineering education and the construction industry. The National Academy of Engineering (NAE) cites factors such as increased access to high performance computing, Internet connectivity and other technology by previously under-developed countries as some of the reasons for the increased number of firms globally that are now competing for engineering projects <sup>(1)</sup>. In some cases, major projects require the contributions of virtual global teams made up of members located in different parts of the world. These teams often function across multiple time zones, multiple cultures, and sometimes multiple languages. They also can take place synchronously (live) or asynchronously (viewed at a later time). The challenge of working effectively with multicultural teams will continue to grow in importance. NAE authors predict that a globalized market place will present many challenges, but at the same time they suggest that significant opportunities will exist if engineering educational programs can provide learning experiences that operate under some of these same conditions <sup>(2)</sup>.

To provide exposure to students on global construction practices, an international multi-institutional course has been developed and offered by a consortium of seven universities from six different countries. This paper provides a brief overview of this course including the background, content, structure, teaching approach, and assignments. This is followed by a discussion of the challenges related to planning and executing this course. Also, sustainable construction practices are discussed, providing insights about the lessons learned by the students. Finally, recommendations are provided to enhance future offerings of this course.

## Course Content

Development of this course involved not only esteemed internationally known faculty and professionals in the field of civil engineering from countries such as Germany, Ireland, Panama, Singapore, and South Africa. In addition, the course involved professionals in other fields including librarians with special copyright expertise, engineering distance education program

administration, strong teaching assistant support, video communication experts, and an instructional designer. Students are presented with a critical body of knowledge related to international construction management practices (e.g., bidding/procurement, safety, finance, leadership, communications, legal aspects, dispute resolution, and sustainability) and develop an appreciation for designing and building projects in a multinational, multicultural, and multilingual environment. Content is delivered using a combination of live and pre-recorded lectures or presentations and the course has been offered twice thus far.

The course was targeted for senior undergraduate and graduate students in construction management and civil engineering programs. Each formal partner institution was required to provide content for one session including preparing lecture notes and identifying a construction organization willing to participate in the session both through the video recording of its site operations and participation by a project representative. In addition, guest speakers from industry and academia lectured on such topics as global construction challenges, procurement issues, legal aspects, international finance and public private partnerships, leadership, industry best practices, and lean construction techniques. Other topics covered included specific construction practices in Canada, China, India, Ireland, Italy, the U.S., Germany, South Africa, and Latin America. Assigned readings were to be completed before each class period. The text used for this course is *Global Engineering and Construction*<sup>(3)</sup>, a book that covers most of the relevant topics covered in this course. Additional background information, appropriate readings from textbook chapters, scholarly journals, and trade publications were also available in digital format to all enrolled students.

In addition to lectures by faculty and guest speakers on key topics relevant to global construction, teams of students from each institution were required to give presentations on construction practices found in their respective countries, and each student was required to participate in a collaborative term project across universities. An online open-source discussion forum, called Piazza, was available to students from all participating institutions. The goal was for all students to interact with one another through this forum, sharing their opinions by posting questions and answers for their classmates. Teaching assistants also served as liaisons with the speakers, conveying student questions or comments and sharing the responses with students in the discussion forum. Although students from each participating institution shared the same lecture content and readings, specific assignments and grading requirements were determined by the local instructors at each institution.

### **Structure and delivery mode**

Development of this course was truly a team effort from the beginning. Without this strong collaborative effort, this course would not have been possible. As each university had its own academic requirements and schedule, the course needed to be structured in a flexible way so that the participating institutions could adapt it to their curriculum and semester schedule. This course was offered for 3-credits with 45 contact hours and included both lectures and field experiences. Evaluation of student participation and performance was the responsibility of each individual institution. Each university had a slightly different syllabus. A summary of the key attributes of this course are as follows:

- Purpose: course to share sustainable global construction practices pertaining to procurement, legal issues, risk and finance, best practices and leadership.

- Partner Institutions: NC State (Host), IIT-Madras, University of Calgary, Tianjin University, and Tsinghua University, and National Taiwan University
- Delivery mode: combination of synchronous (live) and asynchronous (pre-recorded) media
- Assignments: 2 major (1 report and presentation on construction practices in their country and 1 report on increasing the use of sustainable construction practices in different countries) and 1 independent report.

The slotting of timing for the course had to be worked out given the challenge of offering it across various time zones. Ultimately, NC State and IIT-Madras offered the class meetings synchronously (through a two-way classroom video conferencing hook-up) in the morning for NC State and evening for IIT-Madras). With the use of Mediasite rich media capture software, NC State made recordings of these live synchronous class meetings and shared them with the University of Calgary where students viewed the pre-recorded sessions together at weekly class meetings. Since Tianjin and Tsinghua Universities began their semesters six weeks after the other universities, it was decided that they would watch most of their lectures using a pre-recorded format. Tianjin decided to join three lectures live and use the pre-recorded Mediasite recordings for other classes. Tsinghua decided to participate using all pre-recorded content. The University of Ulster used several of the pre-recorded lectures which were integrated into an existing course that had separate assignments. National Taiwan University planned to offer this course another semester in a completely pre-recorded format.

The course blends several delivery modes including face-to-face (with both synchronous and asynchronous delivery of lecture content) and online instruction. The host university, NC State, offered one section of the course as an on-campus, face-to-face class with Dr. Jaselskis as the faculty member who introduced the outline for each lecture and who kept the class on schedule. For the first offering of the course the class met once weekly for 3 hours with a 5 to 10 minute break and included a combination of live and previously recorded lectures throughout the semester. The second offering used a flipped approach whereby the students watched 1 to 2 hours of prerecorded content prior to class and then attended a 2 hour lecture in which new material was covered.

The course originated from an NC State studio classroom, at times having a guest speaker in the classroom at NC State, at other times having speakers join the class via video conference, and at other times having in-class students view pre-recorded presentations. All in-class activities including the lectures were captured using Mediasite, a lecture capture tool that can create webcasts to be viewed in real time or viewed on demand, in either streaming or download format. In general, students have access to the lecture recordings, which are available online in a password-protected space approximately 15 minutes after the conclusion of the on-campus class meeting. NC State students can view the recordings according to their own schedules, as often as they like, and on-campus students often report that they find the recordings useful if they miss an on-campus class or for reviewing difficult material.

Instructors at the other universities have access to the Mediasite recordings and can download the lecture and show it to their students, but individual students at the other institutions are not given direct access to the recordings. For the partnering institutions at Calgary, Tianjin, and Tsinghua

classes are taught on-site at their respective universities with a local instructor who presents recordings from NC State in class to their respective students. Each of the partnering universities created their own course website for this course where students upload assignments, and access the syllabus and other reading materials. Although students from each participating institution share the same lecture content and readings, specific assignments and grading requirements are determined by the local instructors at each institution. However, a common online open-source discussion forum known as Piazza was used for all registered students, regardless of the institution where they were enrolled. The goal was for all students to interact with one another through the Piazza discussion forum and share their opinions through posting questions and answers for their classmates. Also, teacher assistants communicate with the speakers to convey student questions or comments and share responses with students in the discussion forum.

### **Challenges**

There were significant challenges associated with the planning, development, and execution of this course that were based on the perceptions of the instructors, support personnel, and students. Challenges from the leadership team's perspective can be grouped into two main areas: 1) planning and logistics and 2) technology related. Following is a brief discussion of each area.

### ***Planning and Logistics Issues***

A multi-institutional international class requires a significant amount of planning and logistics as it relates to identifying partnership opportunities with international institutions, conducting effective planning meetings, determining appropriate content, securing funding, addressing different semester schedules and time zones, addressing intellectual copyright issues, preparing meaningful lectures, and student and teaching assistant challenges. Identifying the partnerships was relatively easy as the idea was generated amongst a core of three of the partners and quickly expanded to others based on personal contacts. Planning meetings were conducted initially face-to-face then were entirely done through video conferencing. It was invaluable for several of the members to initially meet face-to-face as this provided an effective means of communication and helped to strengthen the overall buy-in of the course. A significant communication challenge related to scheduling synchronous online meetings during the initial planning phase and having full participation among the partnering international institutions. Having the team attend all meetings was not practical due to time zone differences and busy schedules. As a result, the partners accommodated by providing a substitute team member from their side. This approach plus the follow-up emails allowed the team to have good communication.

Creating such a course required funding from real and in-kind sources. Funding for the initial planning trip to the different countries was supported by a combination of internal funds at NC State from the International Programs Office, travel start-up and discretionary professorship funds. Funding to cover the cost of the teaching assistant at NC State was provided by the Engineering Online Program (EOL). A significant amount of in-kind resources were provided by both EOL and Distance Education and Learning Technology Applications (DELTA) at NC State not to mention resources required from the other universities to deliver this course. In India, this course was offered at night and required their technical support staff to work after normal business hours. Tianjin University had to renovate a classroom to accommodate a distance learning format.

Varying semester schedules and time zone differences made it difficult to offer the course synchronously to all universities. The University of Calgary preferred to offer the course at night due to the large number of graduate students who worked during the day. NC State preferred to offer the course in the morning due to the availability of support staff and possibility to offer the course with IIT-Madras and the Chinese universities. Essentially, it was impossible to offer this course synchronously amongst all of the universities.

Structuring an acceptable memorandum of understanding (MOU) that each university agreed to in advance was also a challenge. Initially drafted by NC State's legal counsel, the MOU was sent out for review by all of the participating institutions. The buy-in from all institutions was difficult; several sets of revisions were made to the original MOU before it was ready to be signed by all institutions. Key sticking points related to intellectual property in terms of who owns the lecture material and how long it can be reused by each institution.

### ***Technology Challenges***

Without the use of the internet and a host of other technologies, this course would not have been possible to deliver. Numerous issues arose and were solved using a variety of technologies and support staff assistance. As previously mentioned, each institution was responsible for providing adequate physical resources for their own students. Tianjin University had to create a new high tech classroom to support this course, but the other universities already had such facilities. According to one of the instructional staff members, "the fact that the model for this course was something that had never been attempted before was the biggest challenge".

Setting up all of the media connections between universities was also a significant challenge. As was mentioned before, some universities had to purchase special equipment to transmit or receive the course content. "The biggest challenge I faced was at the start of this course i.e., in making the technical people to test the equipment between both the countries (India and U.S.)" stated the teaching assistant at IIT-Madras. A technical support person from NC State said, "Early communication between the technician and professor are key essentials to providing quality service."

During the development phase the ability to transfer and manage large document files, videos and presentations was also initially a problem. Developers were collecting lecture media in multiple formats from many presenters around the world. The solution used was Velocity, an application developed at NC State for sending and sharing large-sized files. It is similar to applications such as Dropbox but it does not have a limited capacity and is free. Each user sets up an account with their email address. The disadvantage is that files expire every 31 days, so users had to keep extending the time for each file until each university downloaded them. There were a few main challenges in dealing with a server like Velocity. First of all the participants had to learn how to use it. Second, not all the files had the same expiration date, so it was important to constantly check the availability of the files and make sure that everyone had downloaded the content prior to its expiration. The key was to keep this file sharing system well organized and labeled so participants could easily figure out what files they needed. NC State's teaching assistant was in charge of keeping Velocity updated and functional.

Use of the discussion forum within NC State's Moodle learning management system (LMS) was considered. It would have been technically possible to make that system available to students from all participating institutions, but due to some variation in semester schedules for the international classes, there was a desire on the part of the host university to avoid having to provide technical support and manage a somewhat cumbersome administrative process of creating enrollment IDs for non-NC State students and providing support after the NC State semester had ended. With Piazza an email invitation was sent to all enrolled students and the registration and login process was very simple. Over 150 students signed in to post and/or respond to posts from instructors or other students.

Use of traditional LMS discussion forums can become unwieldy for high enrollment courses, often with limited options for managing previously read posts and the inability to make edits to previous posts. Piazza provides the option for wiki-style Q&A posts initiated by either students or faculty. When a student has a course-related question, one of the instructors or other students can respond. Students can collaborate to co-edit responses or make changes in their own posts to clarify or add details. Piazza includes the use of many social media strategies such as including keyword hash tags, adding "likes" to favorite posts, tagging of individual posts that are particularly useful and archiving messages for later review. The freeform nature of discussion within this platform worked well for the diverse needs of a large enrollment class and more closely simulated a natural dialog that might take place among students if they were co-located in the same classroom.

### **Lessons Learned about sustainable practices**

The course was designed for students to develop an appreciation for the challenges and differences found on construction projects in various countries and learn about cultural and ethnic differences, language barriers, and different construction techniques. One major assignment related to providing solutions for improving sustainable engineering and construction practices in each respective country. This assignment engaged a diverse group of students to analyze sustainable practices as it pertained to construction site safety, productivity, quality, minimizing environmental impact, increasing skilled labor, and infrastructure funding. Each international team of students from China, India, and the U.S. was required to provide a brief summary of the current state of practice, desired state, and a plausible plan to achieve the desired state. This section focuses on some of the practices that were found as a part of this assignment.

Although many similarities were identified in how projects are designed and constructed there were several differences as well. The students learned that each country has its unique design codes and regulations that must be followed. The most significant differences were found in areas of policies, green rating systems, and cultural norms. Factors that have promoted the implementation of the sustainable practices in construction projects include regulations, awareness, client demand, cost reduction, market differentiation, and suppliers<sup>(4)</sup>. In agreement with other studies<sup>(5)</sup>, regulations are the main drivers to enforce the implementation of sustainable construction practices. Also, it is important to note that some of the sustainable approaches used in these three countries are moving targets—they may be different 10 years from now. In developed countries, such as the U.S., green materials are possibilities. In India, the feasibility of recycling materials is not considered seriously in most cases. Some materials are more preferred in some countries because they are found locally and the labor is familiar with



the installation techniques. For instance, fly-ash, silica fume, rice husk ash, bagasse ash, coconut husk, and many other products are used as a replacement to cement in India. In India, water is typically used to cure concrete as instead of chemical curing compounds. Furthermore, unique differences were found related to customs; for example, India has its ceremonies at the beginning and end of projects. China and U.S. have similar ones but are not as rigid. The use of Vastu-Shastra and Fengshui to develop and maintain buildings by harnessing the natural light, wind and positive energies that surround us is also very important in India and China, respectively <sup>(6)</sup>. In India, for example, the layout of the construction site is important as is the orientation of the project manager's desk.

Despite the fact that there remain productivity differences in the current state of these three countries, the future state in all cases was for their improvement. Currently, India is facing schedule and cost overruns on 60% of its projects for various reasons related to management, technological, human/labor factors and external factors. Labor productivity in China's construction industry is lagging behind other countries. A common path forward for all countries to improve productivity is to (1) improve the quality of construction labor, improve worker training, improve organization and management of construction production, use technology innovation, and connect wage rates to production output.

In addition to learning about sustainable practices, the students found strategies that should be considered in international projects such as:

- Conduct a detailed study to understand the cultural and institutional differences
- Carefully consult the lessons learned from the past projects if the same exists
- Understand and follow local codes and regulations
- Local knowledge should be as high as possible

The results from this assignment provided a broad overview of the construction sustainability issues found in each country. The conclusions emphasize the importance for global project management teams to understand both the similarities and differences of sustainable practices in order to improve a project's chance of success when operating in another country.

## **Recommendations**

Several recommendations are provided from the perspective of improving the course in its next iteration. When learners have a different cultural background from the teacher or other students, it is important to recognize that there are different approaches to classroom discussions and group learning experiences. In a class with students who have diverse cultural backgrounds and a variety of life experiences, the professor needs to more explicitly explain expectations for participation in course-related discussions or other activities. International students, who are often participating in a language other than their native language, need to be reassured if the focus for discussion is more on course content issues than perfect grammar and syntax. Students need to know whether their discussions should primarily reflect ideas from lectures and readings, or if they are encouraged to question statements by others or to share their own opinions or experiences.

Another recommendation from the instructional designer was to provide more structured interactions with students before initiating the term project. It was recommended that teams

should be formed earlier in the semester. Each team could be responsible for an activity such as answering the “questions of the week” and posting their group responses. This would serve two purposes: it would make sure that students are reading the materials and would provide team building opportunities and time to experiment with satisfactory options for synchronous communication prior to work on the more complicated term project.

Finally, support staff at all institutions were challenged by the demands of this course and rose to the occasion, thereby increasing their internal capabilities. Faculty were able to offer a new course that has relevance for the construction industry and created scholarship to share their experiences with the rest of the world. In the future, it is recommended to maximize the use of live speakers and minimize the use of pre-recorded media, to the extent possible. For future course offerings, less lecture material is also recommended with more time for in-class discussion.

### **Conclusions**

This paper has described the collaborative process that was used in the design, development and delivery and evaluation of an international multi-institutional engineering and construction management course. With a lot of hard work and cooperation among many individuals with a diverse range of expertise, this global construction practices course was successful from a student, faculty, and support staff perspective. Students gained significant knowledge about construction practices and issues in other countries and got a taste of what it will be like when they become practitioners in the global construction industry and are faced with communication issues on multi-national teams.

### **Acknowledgement**

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