

Effective Internet Based International Projects to Enhance Students' Multidisciplinary Skills

Roxanne Jacoby, Jean Le Mee
The Albert Nerken School of Engineering, Cooper Union

Abstract

The substantial advances in Internet technology of the past decade have tremendously facilitated rapid, relatively inexpensive communications around the globe. In education, a great variety of creative, easy to implement, budget oriented collaborative projects between domestic and overseas colleges and universities have become a reality. The Globetech International Joint-Venture Project Simulation developed and offered on the Internet free of charge by Cooper Union for the past seven years, is one of those successful collaborative projects. The simulation was developed under the auspices of the Gateway Engineering Education Coalition. More than 350 students and faculty from 12 engineering and business schools, from five countries on three continents, have participated in the seven Globetech simulations offered up to now. The project aims at developing students' practical global technology management, and other multidisciplinary skills, through the creation and negotiation of Requests of Proposals (RFP's) and Proposals for several international joint-venture projects each year. In the same time, since most of the projects deal with new, clean, renewable energy sources, or other new technologies, the simulation has the added benefit of exposing the students to practical engineering and managerial concerns they might encounter in their future careers. It also gives them an ethical background related to sustainable development and environmental issues, which will play a major role in the years to come. This article presents our positive and sometimes not so positive experiences with this project, and aims to encourage other schools to participate in this, or similar projects.

Introduction

We live in very exciting times. A time when, due to rapid increase in globalization, most products assembled in the United States have more than 70% of their content supplied by various domestic and overseas firms. As examples consider the motors fabricated in Japan for the Big Three American car manufacturers, or the many essential parts and subassemblies imported by Boeing for their planes. It is a time when staying competitive, at the cutting edge of technology, bringing to market products desired by customers, of excellent quality and at competitive prices, is absolutely essential.

One question that comes to mind is how do we, the engineering schools and faculty, prepare our students for this new, brave world? Do we give them enough overall understanding of the world they are about to enter? Do we provide the right tools for professional success?

Many would say yes. That our schools give them an excellent theoretical and practical engineering education, that our students will be able to succeed no matter the challenges out there. We feel that in today's business climate the emphasis on a strong technical approach is not enough. Besides an excellent technical education, our students need at least a strong introductory business education. They have to become aware of the financial and managerial implications of their work, of what are the essential requirements for a firm or individual to be competitive in today's complex business world. And this elementary business education should not be acquired with a few elective courses, chosen at random, but be part of a well designed, comprehensive educational program that would give our students all the necessary tools for success in their careers.

To create this new, global business oriented engineer, Cooper Union in the past ten years has substantially revised its curriculum and the way courses are taught. The school reevaluated its faculty and courses, introduced new courses and expanded old ones to give students new skills and exposure to business implications within most courses. As an important change, we introduced new interdisciplinary elective courses in entrepreneurship, operations and project management, ethics, business law, and global technology management. Based on the success of our graduates in the past several years, both in the companies where they work, and in the type and caliber of graduate studies they pursue, we think that our new educational emphasis is paying off.

The Global Perspectives in Technology Management Course (EID-372)

One of the new curriculum courses introduced the fall of 1994 was the interdisciplinary elective Global Perspectives in Technology Management (EID-372), open to juniors, seniors, and graduate students. The course aims to prepare the students for global practice by discussing the globalization phenomena, how it will affect their careers and lives, the specifics of doing business in various countries, the necessity of international agreements and standards, etc. It also discusses new technologies, environmental, sustainable development and new energy issues, thus preparing the students for a world of continuous change and innovation, a world in which their professional success will depend on their flexibility to adapt and the capacity to upgrade their skills on a regular basis. The course also introduces students to the techniques of international negotiations, thus better preparing them for their managerial role in real life. Since 1999 the course is available on the Internet free of charge to all students participating in the GLOBETECH simulations.

The GLOBETECH Project

An important part of this course is a "hands-on" Internet based simulation project called GLOBETECH. The GLOBETECH International Joint-Venture Project Internet Simulation was developed for the first time in the summer of 1995 as a Gateway Engineering Education Coalition¹ funded project. The project was based on the very positive experience gained by Prof. Jacoby and the EID-372 students who participated in the ICONS² simulation in the fall of 1994.

The ICONS simulation was sponsored by the University of Maryland at College Park, and represented an early experiment of using the Internet research, chat and e-mail for long-distance

collaboration among several student teams at various colleges to discuss specific topics in global politics and economics.

Based on the ICONS model, but designed by Cooper Union specifically for engineering students, the GLOBETECH simulation deals with current global technology management issues relevant to students' future careers. It adds the important practical dimension of developing international joint-venture project request for proposals and proposals, negotiating them, and awarding contracts to the best proposals.

Since 1995, the GLOBETECH Project is offered every fall semester, from October to December, for an eight-week duration. The main goal of GLOBETECH is to provide practical ways to enhance students' global engineering management skills and essential technical and leadership skills by simulating the following activities:

- Student teams develop Requests for Proposals (RFPs) and Proposals for international joint venture projects based on given scenarios. The work involves:
 - Researching the political, economic, technology, etc., conditions in one or several countries,
 - Getting in touch with various equipment and engineering services vendors to get price and technology information,
 - Finalizing the processes, equipment to be used, and project costs,
 - Writing complete, professional level, RFPs and Proposals.
- The RFPs and proposals are thoroughly discussed and negotiated by the various participating teams via the Internet, and the contracts awarded to the best overall proposals,
- Students and faculty have the opportunity to participate via the Internet in the project feedback process, to discuss the positive and negative aspects of each team's participation.

GLOBETECH Experiences

In 1995 and 1996, GLOBETECH- I and II discussed automobile and vans manufacturing joint ventures in China and Thailand. In 1997, reflecting the world's increased interest in environmental issues, GLOBETECH-III explored projects in the air pollution control and abatement field. The retrofit of a fossil power plant in Russia with air pollution control equipment, and a study to monitor air pollution along the Autobahn in Germany were the two projects discussed. In 1998, the discussion shifted towards new, renewable energy sources. GLOBETECH-IV discussed an air pollution control project in China and photovoltaic equipped dispensary vans in Africa. In the fall of 1999 GLOBETECH-V discussed fuel cell equipped taxis for Los Angeles, California, and continued the discussion of photovoltaic equipped vans for South Africa. GLOBETECH-6³ and GLOBETECH-7³ discuss fuel cell technology applications and wind power farms in various countries. GLOBETECH-7 also discussed a joint-venture interactive television project in Italy. Our latest simulation site, GLOBETECH-7, and links to previous simulations can be found at: www.cooper.edu/GTK-7

For the past seven years the GLOBETECH project has succeeded to attract more than

350 students and faculty from various countries. One of its merits is not only to attract participation from undergraduate and graduate engineering students, but also from graduate business students eager to discuss and experiment with international joint-venture technical projects. Student teams from Carnegie Mellon, Rensselaer Polytechnic, the Drexel University, the North Carolina Agriculture and Technology University (all four from the USA) participated in the simulation. Also students from the Nancy University, the Albi School of Mines, and the Toulouse School of Commerce (all three from France), the Tokyo Institute of Technology, Japan, the Iasi Technical University, Romania, the St. Petersburg Technical University, Russia, the Milan Polytechnic, Italy, and of course, Cooper Union.

GLOBETECH-7 was the most successful simulation so far, attracting 103 students in 20 teams, from four schools (NCA&T, ESC-Toulouse, Polytechnic Milan, and Cooper Union), and from three countries (France, Italy, and the USA). The fact that the students were enrolled in undergraduate and graduate engineering, and MBA classes contributed substantially to enriching everyone's collaborative experience. The teams' experiences were generally positive, directly proportional with the amount of interest, work and interface each team and leading faculty put into the simulation.

Simulation Difficulties

One of the most difficult tasks related to this project is creating interest and recruiting other schools for participation. This work is done by the project leader months ahead of the project start date by researching via the Internet for faculty members that might be interested in this project, in departments such as Environmental, Industrial Engineering, Engineering Management, etc. Then contacting these faculty members and the administration of various domestic and foreign engineering schools, explaining the project, and asking for their participation. Over the years, we were able to develop a core of schools with which to interface on this project. It is worth noting that due to our consistent efforts, the number of students and faculty participating in this simulation have continuously increased over the years.

Another important activity is the simulation logistic and thematic development. The projects for the next simulation and the general simulation schedule are chosen several months ahead of the simulation start date. Then the project leader, with the help of a few Internet and computer software savvy students, develops all required documentation and establishes the simulation Internet Home Page. It is a difficult, time-consuming process, but a rewarding one when the simulation works seamlessly, and the student teams, no matter where located, have all the information necessary to learn and participate in the simulation.

Our main operating difficulties in the GLOBETECH project, like in any international real-time collaborative work, were due to the differences in school schedules, time zones between countries, and the developing status of the Internet communications. From one year to the next we have noticed substantial communication advances, and our job has been made easier, at least from this point of view. The high technical level of all students' work and their enthusiasm for this project amazed us. We had no substantial language difficulty since most foreign students and

faculty participating in the simulation had a good command of the English language and was eager to communicate and improve their language skills.

Main Benefits of GLOBETECH

This project is ideally suited to prepare both graduate and undergraduate engineering and technically oriented MBA students for global practice and globalization by:

- Exposing them to new technology virtual projects that take place in various countries,
- Encouraging collaboration, negotiations, and competition among various international teams,
- Presenting a practical, stimulating and interactive way to learn global technology management issues in specific engineering fields,
- Encouraging creativity and innovation in both students and faculty to find the best technical, financial, and managerial solutions for each project,
- Creating an interdisciplinary learning atmosphere, since students and faculty with different specialties, strengths, and interests participate in the simulation,
- Encouraging international cooperative learning via the Internet. Students work in teams representing various corporations and government entities. They interface via e-mail, Internet Chat, or tele-conferences.
- Using new long distance learning technologies for research and communication.
- Improving students' verbal and written communications, team work and leadership skills, thus better preparing them for management roles in the global economy.
- By being offered free of any charge to all participants, it does not tax the budget of any school. Schools are able to offer a superior collaborative experience at basically no extra cost.

Accomplishments:

The course and the GLOBETECH simulation were well advertised to the Cooper Union body of students well in advance of the course start date. The students had a pretty good idea what to expect from this particular course and simulation, what will be the required work level, and as a result, we did not have any student recruitment or retention problems.

Although the course and the simulation make substantial demands on the students' already busy schedules, requiring a good amount of reading, research, team interface, weekly case studies, and Internet collaboration, a majority of the students are very pleased to have elected to participate. As a result of the Global Technology Management course and the GLOBETECH simulation many of the Cooper Union participating students decided to pursue graduate degrees in engineering management and MBA' s. Several of them were awarded scholarships at prestigious engineering schools and Fulbright scholarships to pursue engineering studies abroad.

Also worthy to note, due to the service oriented employment climate of New York City, many companies such as banks, investment firms, consulting, IT firms, etc., are eager to employ

Cooper Union engineering graduates for their technical and general management knowledge, and communications skills. This is a clear example of being able to use newly acquired engineering and business skills in the post-industrial working climate of the 21st century.

Unfortunately we do not have the time and financial resources to track our graduates in their places of employment and gauge how this particular project has affected their job performance and professional success. However due to the informal feedback received from some of our students, we are convinced that this project played a positive role in their better understanding of today's global business climate, has given them more self-assurance to better handle the managerial aspects of their jobs, thus helping them to advance more rapidly on the corporate ladder.

Plans for the Future

Based on our positive experience, we plan to continue teaching the Global Perspectives in Technology Management course, and offer the GLOBETECH simulation every fall semester for the foreseeable future. We feel that the GLOBETECH simulation adds new depth and practical experience to the course. For the past few years, we have been working hard to develop strong ties with several engineering schools, that would permit us a stronger, repeat collaboration in the simulation and course. We will also continue to actively search for new schools interested to participate in our future simulations. In the fall of 1999 the Global Perspectives in Technology Management Course was posted on the Internet for easy, free of charge, long distance access for all GLOBETECH participating students.

The GLOBETECH simulation is only an eight to ten weeks long exercise and can be used in connection with many types of engineering management, economics, new energy or environmental courses, not necessarily a specific course in Global Technology Management. Participation in the simulation can also be treated as a credit project in itself, or as an extra curricular project. You can find more about this course and the GLOBETECH simulation by visiting our latest WWW site at www.cooper.edu/GTK-7. We will be pleased to collaborate with you in the future, or have your comments and suggestions.

Conclusions

A recent NSF funded study⁴ showed that business and industry still perceive substantial curricular gaps in the people communications and business management skills of our recently graduated engineers. Returning to our initial question of how we can better prepare our students and ourselves for a globalized world, one of the possible answers is obvious in this article. By developing innovative collaborative projects that discuss practical, state of the art issues related to global practice, or by participating in this type of projects, we ensure that we, the faculty, keep pace with the latest technical and educational developments, learning from each other's work, moving forward together. As for the students, by giving them the opportunity to participate in interesting collaborative projects that simulate the real business world they will enter, they acquire precious skills enabling them to succeed in the highly competitive, rapidly changing professional

climate of the 21st century.

Education in Global Technology Management is a new field, still in its infancy. Based on our experience and very promising results, we feel that it holds a great educational potential, and it will grow in the coming years. We would like to encourage the engineering education community to experiment more with similar programs for both undergraduate and graduate students. Most important, it is vital to encourage your students to participate in future simulations. We welcome your participation.

NOTES AND BIBLIOGRAPHY:

1. Nerken School of Engineering at Cooper Union, located in New York City, is a member of the Gateway Engineering Education Coalition, one of the coalitions sponsored by the National Science Foundation. Engineering colleges from the following institutions participate in the Phase II of the Gateway Coalition: Columbia U., Cooper Union, Drexel U., New Jersey Institute of Technology, Ohio State U., Polytechnic U., U. of South Carolina.
2. "Negotiation training through simulation: The ICONS International Negotiations Seminars" by Brigid A. Starkey, Associate Director Project ICONS, Univ. of Maryland. Published in the Educators' Tech Exchange, Spring 1994.
3. Simulation numbers changed from Roman to Arabic (normal) notation for ease of identification.
4. "Refocusing our efforts: assessing non-technical competency gaps" by Ronald L. Meier, Michael R. Williams, and Michael A. Humphreys. Published in the ASEE Journal of Education, July 2000.

BIOGRAPHIC INFORMATION:

ROXANNE JACOBY

Since 1994 Roxanne Jacoby, a consulting engineer, is an Adjunct Professor at Cooper Union, teaching Engineering Management courses. She has developed the Global Perspectives in Technology Management course and the GLOBETECH simulation with the help and advice of Prof. Le Mee. Prof. Jacoby is interested to further global technology management and distance education.

JEAN LE MEE

Jean Le Mee is Professor and Chair of Mechanical Engineering at Cooper Union and Director of Curriculum Development and Innovation. He is also the Institutional Activity Leader for the Gateway Engineering Education Coalition at Cooper Union, and a member of its Governing Board. He is also an active supporter of new educational initiatives and collaborative projects.