THE GLOBETECH INTERNATIONAL SIMULATION: PRACTICAL TOOL TO TRAIN ENGINEERS - LEADERS FOR THE GLOBAL ECONOMY

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

Abstract

The 21st century will require engineers not only technically well prepared in their chosen fields, but also able to understand the managerial, ethical, financial, etc. implications of their work. They will have to become effective leaders in the context of a complex, fast changing, highly competitive global economy. To achieve this, more emphasis should be given to well designed engineering management training in the undergraduate division. The practical side of solving engineering management issues, building students' essential management skills can be emphasized through collaborative inter-collegiate projects that deal with up-to-date global technical, management, and financial issues. The Globetech International Simulation, offered free via the Internet for the past five years by Cooper Union, is such a project. It has widened the managerial perspective of many engineering students here in the USA and abroad. A larger participation in this or similar projects will ensure, at a minimal cost, that our future engineers are well prepared for the managerial challenges that lie ahead of them.

1. Introduction

"Using the power of information technology, engineering education activities will become increasingly global. Engineering education must become more encompassing, with an eye to the many new industries that will be served by engineers. To accommodate these changes, we must broaden the base of our education to keep the doors open to opportunities that cannot possibly visualized now". This is what Ernest T. Smerdon, the ASEE President, urged all of us to consider and do, in a 1999 letter to engineering educators[1].

Now, in the first year of a new century and millenium, we should pause for a moment and consider the meaning of his words. We should ask ourselves what kind of engineers our society will need in the next twenty to thirty years. What will engineers do? What will motivate them? How will they manage their lives and careers? What skills will they need to be successful, to make a lasting and meaningful contribution to society?

Considering the rapid pace of technological and scientific growth, the substantial political, economic, and social changes of the past fifty years, the accelerating pace of change in our society, we, at Cooper Union, are of the opinion that we will need a totally new type of engineer.
The world will need engineers:

- with great flexibility, able to understand and adapt to rapid technological and societal change,

- technically strong in the chosen field, and in the same time understanding the complex, interdisciplinary aspects of their profession and work,
- able to work in diverse teams and to lead others,
- articulate, self sufficient, self motivated, exhibiting initiative and entrepreneurship,
- eager to learn and keep up to date in their profession all their lives,
- with deep understanding of their times and vision for the future.

All above characteristics are those of strong, effective leaders. Our engineering education has to produce not only technically competent engineers, but also engineers-leaders embodying above traits, who can become highly effective contributors to the global economy, with strong ethics, respect and empathy for their fellow men and the environment. The rest of this article discusses some of the ways in which Cooper Union has addressed this need.

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

With the goal of educating future engineers-leaders in mind, the Nerken School of Engineering at Cooper Union has, since 1994, developed an elective interdisciplinary engineering management course entitled Global Perspectives in Technology Management (EID-372). The course is open to juniors, seniors and graduate students.

The aim in developing this course was to use as much as possible relevant current international issues and technological and managerial developments as course material. We chose to address the following main themes:

a) Political, social, economic, and technology developments around the world from the perspective of the United States engineer:

* Paths to economic and technology development in various parts of the world (i.e.: the free market economies of North America, Australia, etc.- versus the various degrees of government planning in Europe, Japan, Korea, China, etc.).
* Current economic and technology strengths/weaknesses of various industrialized and emerging countries.
* Customs and cultural traditions: their role in succeeding in business.

b) The frameworks for industrial international collaboration and competition:

* Main international economic organizations: WTO, NAFTA, ASEAN, EU, MERCOSUR, etc., their role in economic growth.
* Analysis of the international industrial collaboration/ competition in several major industries important for the United Sates: airplanes, automobiles, electronics, telecommunications equipment, etc.
* Intellectual property issues in global technology related trade.
* International sourcing, standards, quality control.
* Labor training, worker benefits issues for global companies.
* Global environmental issues, global "good citizen" issues.

c) Career related issues:

* Working in the United States for a foreign multinational corporation - corporate culture, parent company involvement, management's expectations, paths to advancement, etc.
* Working abroad for a multinational corporation - adaptability to local culture, management's

expectations, ways to succeed, etc.

- Entrepreneurship, why it is important, how to become an entrepreneur.

d) Future global trends:
* Major political, social, and economic trends for the beginning of the 21st century.
* Existing and new technologies holding the promise of substantial growth in the near future.
e) International business negotiation issues:
* The purpose of negotiations, why are they important?
* How to negotiate: some of the main features of negotiations.
* How international negotiations differ from domestic ones.
* The main principles and dynamics of international negotiations.
* How "macro" events influence "micro" decision-making.

3. The GLOBETECH Simulation Project:

Besides class lectures and case studies, an important part of this course is a “hands-on” Internet based simulation project called GLOBETECH. The GLOBETECH International Technology Management Computer Simulation was developed for the first time in the summer of 1995 as a Gateway Engineering Education Coalition[2] funded project. The project was based on the very positive experience gained by Prof. Jacoby and the EID-372 students who participated in the ICONS[3] 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 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 also adds important practical dimensions of developing international joint-venture project 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 a duration of eight weeks. The main goal of GLOBETECH is to provide practical ways to enhance students’ global engineering management, and the other above mentioned 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: a) researching the political, business, technology, etc., conditions in one or several countries, b) getting in touch with various equipment and engineering services vendors to get price and technology information; c) finalizing the processes and equipment to be used, and project costs; d) writing complete, professional level, RFPs and Proposals.
- The 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.
- At the writing of this paper, the GLOBETECH-V simulation is still in progress, so we do not have yet its final results. However, based on the previous four simulations and the

preliminary feedback received from both students and faculty for this simulation, everybody is quite satisfied with being a participant, and with the way the simulation is conducted, the learning tools, and discussed subjects.

4. 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. Our latest simulation site, GLOBETECH-V, can be found at: **www.cooper.edu/GTK-V**

For the past five years the GLOBETECH project has succeeded to attract more than 250 students. Student teams from Carnegie Mellon, Rensselaer Polytechnic, the Drexel University (all three USA), 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, and of course, Cooper Union. 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.

5. Simulation Difficulties:

Our main difficulties in the GLOBETECH project 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 participating in the simulation had a good command of English and were eager to improve their language skills.

6. Main Benefits of GLOBETECH:

a) It is a practical, stimulating and interactive way to learn global technology management issues in specific engineering fields. b) Encourages creativity and innovation in both students and faculty in finding the best ways to treat each project. c) Creates an interdisciplinary learning atmosphere, since students and faculty with different specialties, strengths, and interests participate in the simulation. d) Encourages international cooperative learning via the Internet. Students work in teams representing various corporations and government entities. They interface via e-mail, Internet Chat, or teleconferences. e) Uses new long distance learning technologies for research and communication. f) Improves students' verbal and written communications, team work and

leadership skills, better preparing them for management roles in the global economy. g) It is free of any charge to all participants.

7. Accomplishments:

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 special projects, a majority of the students are very pleased to have elected the course. As a result of this course and our discussions with the students, many of the Cooper Union participating students decided to pursue graduate degrees in engineering management, or MBA's and were awarded scholarships at prestigious engineering schools. One of the students obtained a Fullbright scholarship to pursue environmental engineering studies in Venice, Italy.

Also, worthy to note, in the particular case of Cooper Union, due to the service oriented employment climate of New York City, many companies such as banks, investment firms, consulting services, etc., are eager to employ our engineering graduates for their knowledge and management skills acquired in this course and throughout the curriculum.

8. Plans for the Future:

Based on our positive experience with this course and the GLOBETECH simulation, we plan to continue teaching the Global Perspectives in Technology Management course 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.

Let us emphasize that the GLOBETECH simulation is only an eight to ten weeks exercise and could be used in connection with many types of engineering management, economics, or environmental courses, not necessarily a specific course in Global Technology Management. The simulation could also be treated as a one-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-V/. We will be pleased to collaborate with you in the future, or have your comments and suggestions.

9. Conclusions:

This article presents one of the practical ways in which Cooper Union, with the help and support of the Gateway Engineering Education Coalition, is preparing engineering students for the coming global practice of the 21st century. Students are given more of the tools to become better engineers, managers and leaders in the global economy.

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.

Bibliography and Notes:

1. President's Letter: "Serving Tomorrow by Understanding Today", Ernest T. Smerdon, Prism, May-June, 1999.
2. 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.
3. "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.

ROXANNE JACOBY

Since 1994 Roxanne Jacoby 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 a Professional Mechanical Engineer and an engineering consultant with many years of engineering and project management experience in the chemical industry and power plant fields. She holds an MME from Cooper Union and an MBA in International Management and Finance from New York University. She 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.