

# COOPERATIVE INTERNATIONAL ENGINEERING EDUCATION

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## A New International Environment

Since its inception, the traditional form of co-op has filled a vital need in education theory. However, the need has expanded much further during recent times. One reason is that today's young professionals are exposed to a much different world than that of their parents.

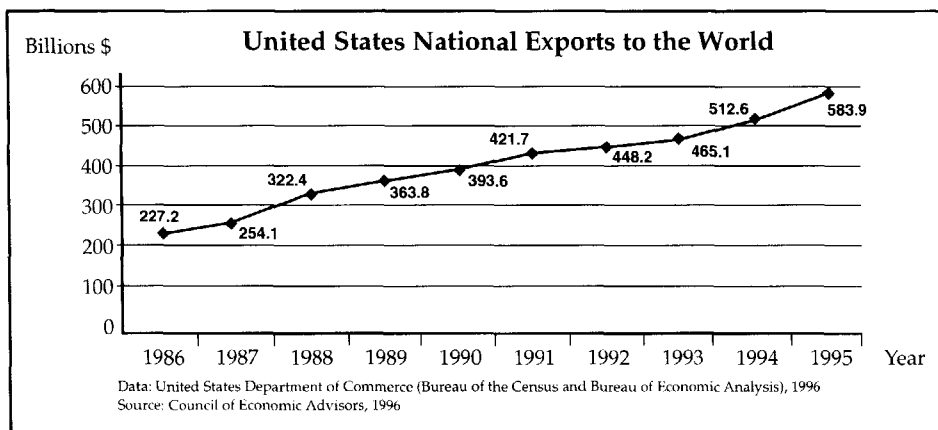
As commented on by the American Council on Education in its 1995 report, *Educating Americans for a World in Flux: Ten ground rules for internationalizing higher education* (American Council on Education, 1995), the cold war has ended; isolationism is no longer popular; minimization of regional trade barriers is fashionable; and in Europe, economies are joining together. While the United States continues to be a major player in international events, influencing every territory of the world, its domestic culture remains insular. Fueling this is the narrow viewpoint of some American university graduates that this country's market is essentially domestic. But the reality is that present-day engineering graduates face much more than a local market. Directly or indirectly, engineers are sure to come in contact with technology developed abroad. Though formerly this was a challenge faced only by large corporations, things have changed. Today, universities and businesses of all sizes are involved in overseas enterprises.

Data collected by the United States Department of Commerce indicates that American national exports to the world have more than doubled in the period from 1987 to 1994. (Please see Figure 1). Behind these figures of phenomenal growth are numerous establishments that have recognized the world market as a necessary and lucrative place to do business in the 1990's and beyond.

In the same report by the American Council on Education, the Council recommended a change in thinking by educators, suggesting that, "The [American] nation must commit itself now to providing all students with the kinds of knowledge it once provided to only a few — a powerful, deep-rooted understanding of other languages, diverse cultures, and global issues. This kind of competence needs to be provided not as something extra in the curriculum, *but as an integral part of the educational experience.*"

(Italics added). One realization of this admonition is in the form of cooperative international engineering programs.

**Figure 1**  
**Change in American International Export of Goods**



### **The Role of Cooperative International Engineering Education**

Overseas co-op programs play a role in addressing the need for multicultural competence in an interdependent world by sending individuals abroad to work for anywhere from a few weeks to a year. The experience of living in a foreign country has limitless possibilities. Not surprisingly, participants usually return home with some appreciation for how today's international environment operates. This insight should exceed that gained solely from vacation travel, which is normally brief and centered around tourist attractions.

Students have discovered that after living abroad, their tendency was to look at foreign societies less with preconceived notions and more with factual-based judgment. How is this of value to an engineering graduate in a professional career? S/he may be more inclined to consider a society's culture as directly affecting its reaction to American goods and services, rather than rushing to make unfounded conclusions based on viewpoints originating in cinema or other media.

While this paper centers around the benefit to engineers, globalization theory, as exemplified through cooperative international education, should be of interest to all professionals, not just those with technical backgrounds.

Table 1  
Comparison of Twenty-Three Cooperative  
International Engineering Programs

Specific/Features Institution/Program	Includes Japan	Includes Germany	Includes France	Includes UK	Includes Other Countries	Language Study Required	Work Abroad Available	Study Abroad Available	(U) Undergraduate (G) Graduates (O) Other
Clemson University	x	x	x		x	x	x	x	U
Co-op Japan (Canada-wide)	x					x	x		U,G
Colorado School of Mines		x	x	x	x	x		x	U
Drexel University	x					x	x		U
GMI Engineering & Management Institute		x	x	x	x		x	x	U
Global Engineering Education Exchange		x	x	x	x	x	x	x	U
Massachusetts Institute of Technology	x					x	x		U,G,O
Michigan State University		x		x	x			x	U
Ohio Northern University		x				x	x	x	U
Rose-Hulman Institute of Technology	x	x			x	x	x	x	U
Syracuse University			x	x	x			x	U
University of Calgary					x	x	x		G
University of Cincinnati	x	x				x	x		U
University of Illinois (Urbana-Champaign)	x	x	x		x	x	x	x	U
University of Maryland (College Park)	x	x	x	x	x	x	x	x	U
University of Michigan (Ann Arbor)	x					x	x	x	U,G
University of Notre Dame				x				x	U
University of Pittsburgh	x					x	x	x	U,G,O
University of Rhode Island		x	x			x	x		U
University of Washington	x					x	x		U,G,O
University of Waterloo	x	x	x	x	x	x	x	x	U,G
University of Wisconsin (Madison)	x	x	x	x	x	x	x	x	U
Vanderbilt University	x					x	x		U

A Need to Summarize International Programs

Data concerning overseas engineering programs in the United States and Canada was gathered primarily using the World Wide Web. Search routines yielded 16 matches. Those schools that made no reference to their international engineering program at a Web Site at the time searches were initiated (early spring, 1996) were not captured. Other programs we were aware of were also contacted. Collected information from 23 institutions is briefly summarized in Table 1. Column headings suggest the kind of general information that was sought. (A complete description is too lengthy for this paper). The goal was to get an idea of what each program offers and then submit information to program directors for verification of accuracy and comprehensiveness.

Analysis of Results

The development and implementation of international engineering programs is still fairly new and growing. Few programs are alike. Over

time, as an abundance of different ideas are tried, some methods may prove more favorable than others. Being particularly familiar with challenges and successes encountered by the University of Cincinnati (UC) International Engineering Program (IEP), references to that unit will be made throughout this section.

The curriculum and features of overseas programs vary from school to school. There is also disparity in the intensity of structure. Some programs are loosely defined, where students are somewhat free to formulate their own agenda and timetable. Others conform to a formal model with designated course work and overseas placement arranged through the program. We suggest the latter as the preferred method. If engineering students were free to select which engineering courses to take, no doubt many of the more difficult, yet essential subjects would be avoided. In the same context, those involved in a program of international co-op could be inclined to shun some or all preparatory courses, figuring that a kindly disposition will suffice during an overseas assignment. This would be misleading.

If there is anything that every featured school has in common, it is a realization of the advantageous position students have after an international co-op experience. A unique type of educational enrichment is derived, something not obtainable through a traditional undergraduate degree, engineering or otherwise.

*Work Abroad or Study Abroad?* Not all international programs involve work abroad (co-op). Some are of a study-abroad nature, where participants take courses at a university overseas. How do the two compare?

While a study-abroad program may be able to rely on the “everlasting” presence of courses at the overseas school, work-abroad programs are more likely to have to re-solicit the sponsorship of overseas companies at frequent intervals (perhaps yearly). Nevertheless, according to one source, “Students . . . say that they are attracted to the internships because they are so different from traditional study-abroad programs. As interns, they are immersed in the day-to-day life of a foreign country. They go to work, shop for groceries, and hang out with their co-workers and neighbors.

“In a typical foreign study program, ‘you don’t really have much of an opportunity to meet people,’ says Casey Slamin, program coordinator for international work exchanges for Inter Exchange” (Rubin, 1996).

We endorse the opinion that work-abroad internships offer greater potential at a true living experience than do study-abroad. This is in accord with the founding concept of cooperative education.

At the same time, the practical value of an overseas co-op experience

is dependent on (1) the suitability of the work content for the student's academic level; (2) how challenging the assignment is; and (3) whether the student's work is an integrated part of the overall company operation. The purposes of cooperative international engineering should be discussed clearly with foreign employers.

*Countries of Focus.* Of the 23 programs surveyed, Japan is represented in 14, Germany in 13, France in 10, and the United Kingdom in 9. These are the most represented regions among the programs surveyed. That these four countries are also significant trading partners of the United States is no coincidence. Engineers can expect to come in contact with technology from these areas in one way or another.

*Admission.* Most overseas programs are open only to matriculated students (and specifically those attending the school where the program exists). This can be indicative of the value placed on combining an international experience with some kind of traditional academic curriculum. If a participant is already in an educational environment at the time of the overseas experience, s/he may be more inclined to view it as an academic undergoing, reflecting on how domestic studies of language and culture combine with the international experience.

There is a second advantage to restricting admittance to enrolled students. The tendency is for these programs to be associated with exemplary individuals. The reputation and future of a program could be compromised by the poor performance of even one student. If an applicant is at least matriculated, an achievement record evaluation may give some indication of suitability for overseas placement.

Another measure of attainment is scholastic achievement. At least a few programs have made 3.0 (on a 4.0 scale) the minimum grade point average (GPA) for admittance. While all but one of the international programs surveyed are open to the undergraduate population, about a third also accept graduate students, and three are accessible by alumni or the industrial sector.

*Language.* Nineteen of the 23 programs require a measure of foreign language study prior to a participant going abroad. While some allow students to obtain language learning within the university's regular framework of classes, others have preferred to create their own language course(s) customized to the needs of the program. If international engineering participants are only expected to learn everyday greetings and expressions of courtesy in the foreign tongue, then standard language classes may be sufficient. But where a more extensive overview is desired, custom-built language tracks have proven their worth.

In our discussions with IEP students and overseas employers, we have found that foreign language training was deemed of immense value. Even in cases where the student's work-mates understood English, some knowledge of the native language was important to the student's ability to interact with other people, such as those outside of work. The fact that a student made the effort to learn the language of another country exemplifies commitment and discipline, two qualities that overseas employers value greatly.

With Germany and Japan as the countries of focus for the UC IEP, the program has one language track for German and one for Japanese. IEP students study one of these languages in three consecutive periods:

- For six weeks during the summer preceding the junior year, language is studied intensively for six hours daily, five days per week. (No prior study of German or Japanese is assumed). This leads directly to the beginning of autumn quarter.
- From the beginning of autumn quarter to the end of winter quarter, 20 weeks in total, students have three hours per week of language maintenance. Primarily, the purpose is to reinforce material covered during the summer.
- Finally, two to four weeks of intensive study occur at the beginning of spring quarter, after which participants embark on their assignments in Germany or Japan.

*Incorporating Culture.* As important a role as language plays in this discussion, culture can not be overlooked. The impact of an international co-op experience is sure to be enhanced if the traveler has some advance understanding of the culture s/he will be visiting. All too often, simple misunderstandings occur when forms of gestures, eye movement, common phrases, and other communication (normally taken for granted when both parties are in the same native domain) are unfamiliar. When the visiting party is already aware of cultural idiosyncrasies, instances of misinterpretation may be lessened.

In addressing the need for cultural knowledge, some international programs have integrated a period of daily culture study in their language track. For example, the Co-op Japan Program devotes 1.5 hours per day of its four-week immersion course to study of Japanese culture, cross-cultural communication, and etiquette.

Inviting former participants of the international program to a language/culture class can provide for stimulating conversation, practice of cultural routines, and a refreshing change from the normal classroom regiment. Showing movies made in the foreign tongue lets students test their

comprehension of the language and recognition of cultural norms by following a plot. Whatever methods are used, it is vital that those involved make regular, frequent use of what they learn and recognize the value of doing so.

A requirement of the language training portion of Clemson University's program is that students sign a pledge to use their immersion language exclusively during the course's five-week period. Furthermore, in addition to daytime classes, students eat all meals together and are involved in a total of 80 hours of evening and weekend activities all in the immersion language.

*Supplementary Courses.* Several programs use courses in the humanities and social sciences related to the country of focus, to both satisfy the Accreditation Board for Engineering and Technology's requirements for undergraduate engineering curricula and to diversify students' understanding of their target countries. The more knowledge students take with them on an overseas co-op assignment, the greater the potential of the living experience.

Students ought also be prepared for the work environment they will enter. It should not be assumed that a dose of common sense will be enough. They should understand the sort of unexpected challenges they may face at the workplace. What methods of communication are appropriate and what cultural protocol should be followed? Questions related to work hours, appropriate dress, and so forth ought to be considered too and can reduce orientation time during the early part of an assignment. Our experience shows that overseas employers welcome students having pre-familiarity with their country's business culture.

*Overseas Work Assignments.* Successfully sending undergraduate students to work assignments abroad is a very involved procedure. The UC IEP invests heavily in organizational and recruiting services.

Students in the German track of the IEP are placed via two mechanisms: an in-house specialist who coordinates with companies and arranges assignments; and the CDG (formerly known as Carl Duisberg Gesellschaft), an organization sponsored by the German government to place American students in business and engineering internships in Germany. The IEP's Japanese track has an in-house specialist who coordinates with companies and arranges assignments.

Securing overseas corporate interest in the IEP is an ongoing process. New contacts must continually be initiated, and existing ones need to be maintained. The College also requires assurance that students are given suitable projects for their level. It is important that participants — all of

whom will have invested their time and effort in a lengthy study of Germany or Japan-be placed in productive, challenging work assignments.

Finding overseas co-op assignments for students has proved easier where a company has both domestic and international locations, and where the student has already completed co-op work for the domestic office. In such a case, the overseas location is more likely to participate in the international program at the recommendation of the American counterpart.

In these cases, student and company benefit in a variety of ways. For example, by the time the student leaves the United States, s/he will already have some familiarity with the company's products and systems (as a result of co-op work at the U.S. location), so the initial learning period at the overseas location could be shortened. Additionally, companies tend to take pleasure in the international perspective of their business that would be gained by a co-op student after working at an associated office or plant abroad, especially when the student is hired for a permanent position following graduation.

*Participant Feedback.* One measurement of the success of a tool lies in the opinion of those who have used it. Year after year, the responses of IEP graduates is resoundingly positive. A recent class was asked to comment on cooperative international engineering and how involvement has affected them. The following are representative student comments.

Industrial engineering major Michael Kraeutle, whose internship was in Germany, noted that, "In my opinion, the IEP . . . is probably one of the toughest challenges anyone can face (who has had little or no previous experience with the German or Japanese language) at the University . . . level. The IEP challenges a person to become globally conscious, responsible, open-minded, a quick thinker, and a person who is willing to take risks (socially and sometimes physically). . . . The experience has definitely enhanced my understanding of the business world and global trade . . ."

Chris Suhar, whose major was mechanical engineering, worked for Leblond-Makino throughout his four quarters of domestic co-op and then parent corporation Makino (located near Tokyo) for his international appointment. He comments, "I got everything I ever expected out of the program and 10 times more.

"I adapted very well to the business environment. I studied quite extensively the business tactics, idiosyncrasies, and laws that should be followed when dealing with the Japanese. When I was in Japan, I was able to put these methods into use.

"The IEP experience has opened new doors. Every interview that I have had since then, I have talked about my trip. It has gotten me



three job offers. . .”

Aerospace engineering student Martin Lambrecht spent five months at Daimler-Benz Aerospace in Munich and feels that, “. . . participating in the IEP is an excellent preparation for working on an international level. If we think about it, pretty much all professions today involve working with people and companies in different countries. In the engineering college, we are lucky to have a program like the IEP that helps us out in the job search overseas . . .

“I think that it has been very useful to find out how engineering is practiced in other countries. . . . In the aerospace business, a lot of programs will take place as joint efforts between different countries (the costs and technical difficulties for new developments are in fact very significant), and the IEP has provided me with invaluable training in this respect.”

Civil Engineering student Martin Wilhelmy spent his overseas work period at CTI Technologies in southern Japan. He says, “. . . If one learns the basics before visiting the country, one will first of all avoid shock over the unusual. Secondly, one will be able to experience the country in greater detail in the same amount of time.

Industrial engineering major Bill Finke worked for Kolbenschmidt AG near Heidelberg, Germany. He comments on how participation in the IEP affected his search for a full-time job after returning to the United States:

“My experience of working in Germany and learning the German language was the biggest factor in getting my [post-graduation] full-time job. The company has a large facility in Germany and needed an engineer who was able to speak German. Without the International Engineering Program it would have been very difficult for me to get that job.”

### **The Value of Cooperative International Engineering Education**

The graduate of an international co-op program offers more to potential employers than a postsecondary degree. As valued as a traditional engineering degree may be, an international engineering student has all the more experience to add to academic accomplishments. “Students believe that on-the-job experience in another country even if it is unpaid can make them more marketable to prospective employers back home”. (Rubin, 1996).

Nearly every student at the UC College of Engineering who gradu-

ated from the International Engineering Program has indicated that this program,

- Provided an extra opportunity for a unique, enriched education;
- Was a rich living experience in many ways;
- Opened broader opportunities for further education and career choices; and
- Has given them better job offers.

Students at other schools have expressed similar thoughts, suggesting that the rewards earned from participation in cooperative international engineering are limitless. This is experience that an employer with foreign business dealings of any kind will value immensely.

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