THE INTERNATIONAL ENGINEERING STUDENT EXCHANGE PROGRAM
AT THE UNIVERSITY OF WATERLOO

Joseph H.G. Howard
Mechanical Engineering Department

Herbert C. Ratz
Director of Engineering Exchange Programs
University of Waterloo
Waterloo, Ontario, Canada

ABSTRACT

The importance of international engineering student exchange programs in today's increasingly global marketplace is well accepted. This report describes aspects of the experience of the University of Waterloo with such a program which involves 26 institutions in 14 countries. A major element in a successful link is close collaboration between faculty coordinators at the two institutions.

INTRODUCTION

Engineering expertise is no longer confined by national boundaries in the way it was in the past. Global communications are such that ideas, intellectual property, designs and processes, as well as the capital for their implementation move easily all over the world. The trade in natural resources and heavy manufactured goods has given way to engineered works, engineering services, and high-valued artifacts with great technical content. A detailed account of many aspects of this engineering activity may be found in a paper by Valenti (1996).

The engineering graduate with experience and knowledge of other cultures and languages, and ways of doing things, is at a definite advantage in the global trading economy. Many institutions have responded to this educational need. A survey of international engineering education and work experience programs organized by North American institutions has been prepared by Saikali and Jain (1996). They note that "Today, universities and businesses of all sizes are involved in engineering enterprises and are finding that profitable competition requires a combination of cosmopolitan thinking and cross-cultural sensitivity".

In Canada, in response to the perceived need, the National Council of Deans of Engineering and Applied Science, and the Canadian Council of Professional Engineers, have adopted the following statement concerning the "Development of Competencies in Languages and Culture":

"Engineering students should be provided with opportunities to develop their competencies in at least one language and culture other than their own at a level appropriate for engineering practice. This objective may be achieved by a combination of formal studies and work in Canada and abroad".

INTERNATIONAL ENGINEERING AT WATERLOO

The University of Waterloo (UW) has a Co-op Engineering program for all undergraduate engineering students, consisting of alternating four-month terms of academic studies and work experience. Some programs have two streams, one on an academic term while the other is on a work term and vice versa. Thus some flexibility is possible by stream switching or the use of an eight month study or work term. A normal four year undergraduate program (eight terms, designated 1A, 1B etc. to 4B) extends over a period of four years and eight months. The present engineering undergraduate enrolment is approximately 3300 including both on campus and work term students.

The present administration of the Faculty of Engineering Exchange Programs has three main objectives. The first is to increase the interest and awareness of Waterloo students in overseas study and work opportunities, through increased publicity activities. Secondly, there has been an increase in the number and variety of exchanges, to provide ample opportunities for University of Waterloo students. Thirdly, the program office can offer consistent Faculty-wide guidance on important aspects of exchange program implementation; for example, the application process, health insurance, selection criteria, registration, etc.

The Waterloo Engineering Student Exchange Programs provide opportunities for engineering students to work and study...
Table 1 - University of Waterloo Faculty of Engineering Exchange Programs

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<thead>
<tr>
<th>Country</th>
<th>Institution</th>
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<tr>
<td>Australia</td>
<td>Monash University</td>
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<td>Australia</td>
<td>Queensland University of Technology</td>
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<td>Australia</td>
<td>University of Technology, Sydney</td>
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<td>Denmark</td>
<td>Technical University of Denmark</td>
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<td>England</td>
<td>University of Birmingham</td>
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<td>England</td>
<td>University of Leeds</td>
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<tr>
<td>France</td>
<td>Institut National Polytechnique de Grenoble</td>
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<tr>
<td>France</td>
<td>Institut National des Sciences Appliquées de Lyon</td>
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<tr>
<td>France</td>
<td>Université de Technologie de Complègne</td>
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<tr>
<td>France</td>
<td>Université de Nantes</td>
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<tr>
<td>France</td>
<td>Ontario/Rhône-Alpes Exchange</td>
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<tr>
<td>Germany</td>
<td>Technische Universität Braunschweig</td>
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<tr>
<td>Germany</td>
<td>Technische Universität Hamburg-Hamburg</td>
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<td>Germany</td>
<td>Universität Karlsruhe</td>
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<td>Germany</td>
<td>Universität Gesamthochschule Paderborn</td>
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<tr>
<td>Germany</td>
<td>Ontario/Baden-Württemberg</td>
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<tr>
<td>Holland</td>
<td>Delft University of Technology</td>
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<td>Japan</td>
<td>Tottori University</td>
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<td>Japan</td>
<td>Kyoto University</td>
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<td>Northern Ireland</td>
<td>University of Ulster</td>
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<td>Poland</td>
<td>Warsaw University of Technology</td>
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<td>Singapore</td>
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<td>Singapore</td>
<td>Nanyang Technological University</td>
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<td>South Korea</td>
<td>Pohang University of Science and Technology</td>
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<td>Switzerland</td>
<td>École Polytechnique Fédérale de Lausanne</td>
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<td>Ukraine</td>
<td>Dnipropetrovsk Institutions</td>
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<tr>
<td>Wales</td>
<td>University of Wales, Swansea</td>
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abroad through formal Exchange Agreements with a number of overseas institutions. At this time, about 40 students from Waterloo are involved and a larger number of overseas students are at Waterloo as part of the exchange program. Twenty-six engineering institutions from fourteen countries have agreements with Waterloo, and in addition two government funded programs are in place (Ontario-Rhône-Alpes and Ontario-Baden-Württemberg). These institutions and programs are listed in Table 1. As an alternative to these Engineering Exchange Programs, students are free to take advantage of other avenues for international experience, such as a Co-op Japan Program (work term in Japan), SWAP (Student Work Abroad Program), and IAESTE (International Association for the Exchange of Students for Technical Experience).

Exchange programs are with institutions of similar academic standing in order to maintain the student's progress through the curriculum. The quality of the partner institutions is established in a number of ways. In many cases, the exchange is the outcome of a prolonged visit by a professor from Waterloo working with a research colleague at the partner institution. Such a close contact provides an opportunity to evaluate the education given at the other institution and testify to the level of scholarship and research there. A more direct measure of the education acquired in engineering is the performance of the visiting students when they are at Waterloo, and the performance of Waterloo students after they return. Both confirm and give continual monitoring of the approximate equality of the curricula.

HISTORY

The Engineering exchange program was founded in 1980 by Professor Jerzy Pindera of the Civil Engineering Department through his close connections with Braunschweig. He was inspired by a long-held personal conviction of the necessity of developing closer international relations on a personal basis. Further institutions were included through connections established by other professors, frequently through contact during sabbatical leaves. These professors then act as voluntary Faculty Exchange Coordinators and the strength of the program depends strongly on the work of the exchange coordinators in all institutions.
OPERATIONAL ORGANIZATION

In some institutions abroad, exchanges are handled by a central institutional office for International Programs. However, at Waterloo, exchange programs are based in the Faculty unit, with administrative support spread throughout the departments according to the location of the individual volunteer Coordinators. At Waterloo, the administrative and secretarial support for Coordinators comes from their respective academic departments as it does for other professorial and professional activities. This has the advantage of being the usual source of support accessible to the Coordinator but it piggybacks the administrative load of exchange programs on an already fully-loaded staff. Also, some anomalies occur when one department provides support for an exchange in which students of other departments predominate.

Administration

Many people act together to enable the programs to operate. Co-operative Education allows our students to arrange work terms to enable them to schedule the exchange. The Registrar's Office smooths the procedure for exchange of credits and for registration of overseas students. Within each Engineering Department, the Undergraduate Associate Chair must approve each Waterloo student's course credit transfer proposals and may have to arrange adjusted programs after the student returns from the exchange.

The principal functions of the Faculty Exchange Program Coordinators are:

- academic counseling of participating students;
- advice to UW students from a knowledge of the particular exchange;
- administrative management of the exchange - scheduling of applications, selection of students and control of numbers;
- maintaining communication between the two institutions; the success of the exchange between them depends on the all-important contact between the two Coordinators at each end of the link.

The Faculty of Engineering also maintains a Faculty Exchange Office, with a part-time administrative secretary. The current activities of the Faculty Exchange Office include:

- acting as a first point of enquiry for UW engineering students contemplating participation in an exchange;
- providing a readily accessible library of data about all UW exchanges;
- arranging a welcome for new arrivals at Waterloo and assistance for them in registration, insurance, and numerous other such tasks;
- liaison with other offices within the university, such as the International Programs Office, Registrar's Office, Housing Administration, Financial Services, etc.;
- arranging the publicity events mentioned below;
- interviewing and advising students, both UW students and incoming exchange students;
- providing "emergency response" when something goes wrong with a student's program (e.g. architecture courses, serious illness, visa extensions, credit transfer problems).

Requirements for Students Wishing to Participate

The responsibility for much of the detailed planning for participation in an Engineering Exchange Program is left to the student. While the program is only available in upper years, it is worthwhile for the student to investigate the opportunities during the first and second years. Students are advised on the following points:

- Plan well ahead; plan to complete the first two years (up to 2B inclusive) at Waterloo. An official application is made at least six months before going abroad.
- Obtain better than 70% consistently, at least from 1B onwards. This means roughly the top half of the class.
- Develop language capability early, if it is required. (In most cases, the equivalent of 3 courses are needed, or a senior high school level plus one.)
- Watch the selection of Complementary Studies/General Studies/Non-Technical Studies Electives.
- Keep an eye out for double (i.e. sequential 8 month) work terms to go with double study terms (customarily found abroad), in the sequence of terms.

The form of advice provided to the student and procedure for approving the individual's program is outlined below.

Application Procedures and Course Credit Arrangements

An application by a student to participate in an Exchange Program requires several elements:

1. A copy of the applicant's resume; the type used for work term employment purposes is suitable;
2. A copy of the most recently available transcript, or Grade Report, covering all academic terms to date;
3. A term-by-term sequence plan that shows, from IA onwards, the position of academic terms and work terms; this will demonstrate how the required work terms are to be completed, and show any "stream jumping" involved in eight month study or work sequences;
4. A proposal for subjects to be studied abroad, and the corresponding request for credit ("CR") against specific courses in the applicant's degree program at Waterloo; this will require comparative course descriptions from the two institutions. This is a very important item since it becomes part of the academic degree program at Waterloo, and usually requires some "research" into subject descriptions.
5. A letter to the Associate Dean explaining motivation and expectations.
6. The application form has spaces to collect the required signatures signifying approval of the various components. For example:
- Co-Op Ed is primarily concerned with the work term sequence;
- the relevant Department Associate Chair is concerned with the details of the course credit transfers;
• the Program Coordinator looks at the applicant’s preparation for a particular exchange, including language requirements;
• the Associate Dean, Undergraduate, certifies official sponsorship;
• and the Registrar will require post-dated checks for fees on “Home-Fee” exchanges.

7. In some cases, additional documents may be required. These might include:
• Letters of reference;
• Certificates of language capability;
• Statements of subject interest in the case of work-term exchanges where the work abroad is as a Research Assistant.

8. Finally, it is the students’ responsibility to ensure that they are properly registered at Waterloo for those academic terms in which studies are being taken abroad.

The question of the transfer of course credit is taken up on the application form, and requires the most time for the applicant to arrange. Options are available to the student’s Department of registration in their evaluation of courses at the host institution. For example, a course may be approved for credit (if passed) or approved subject to a report on its content upon the student’s return. Many times there will exist matching pairs, a subject for a subject abroad. A minimum fraction, say 2/3 or 3/4, of overlap between the subject descriptions is usually sufficient for the Department to recognize a match. To do this, fairly detailed descriptions are required for both the Waterloo subjects and for those taken abroad. In more complicated cases, a set of courses taken abroad will be accepted to cover a set of Waterloo courses by identifying matching segments in each in a matrix so that the total is equivalent to the required overlap, even though the individual courses do not coincide. Other options, such as recognizing enrichment electives, are also possible.

The approximate equality of transferred credit is required, (a) so that the student has the prerequisites to complete the program at Waterloo without unusual difficulty, and (b) so that the student’s completed curriculum retains the necessary components for professional accreditation.

Since exchange students usually have unique individual programs, they cause extra work for Departmental Associate Chairs and Administrative Assistants. It is very important to reduce the load on Departmental Associate Chairs and the volunteer Coordinators, a large part of which comes from analyzing each student’s course credit transfer proposals. One way to do this is to develop “packages” which have been found satisfactory and to reuse them. Several initiatives are being undertaken to do this; it will also be more attractive to prospective students since they can more easily see how a plan comes together.

There is a distinction between translation of grades and transfer of credit. At UW, there is no translation of grades achieved abroad, so that the cumulative average of a UW student depends only on the work done at UW. Satisfactorily completed courses taken elsewhere under the exchange program result in a course credit only. This recognizes the fact that study in a different environment and/or in a different language affects grades and that other evaluations may use different grading scales. In reverse, the Waterloo grade reports provide individual subject averages, rank in class and class size in addition to the mark achieved.

FINANCES
A key part of most agreements is that the student registers and pays tuition fees at his or her home university and is exempt from paying tuition fees at the host institution. For this reason, efforts are made to keep a balance in the student numbers with each institution. The question of cost balancing is frequently a major concern of senior administration during the setting up or renewing of the exchange arrangements. The host University is not responsible for any expenses of the participants.

There is real pressure from abroad to accept more students into Waterloo, and the major challenge is to maintain a balance in numbers. One way of obtaining balance is to include work terms abroad, either alone or in conjunction with study terms, in return for study terms at Waterloo. A second way of compensating for an imbalance in numbers is to draw up the agreement on a "host fee" basis so that students pay tuition at the institution that they are actually attending.

Finally, experience has underlined the necessity of making available adequate health insurance, covering the entire period during which the student will be away from his or her home country.

INTERNATIONAL STUDIES IN ENGINEERING OPTION
Students from Waterloo involved in an Exchange Program are encouraged, but not required, to fulfill the requirements of an Option in International Studies in Engineering. This option is an endorsement added to a student’s academic degree to acknowledge the enrichment that exchanges bring to individuals’ programs. This is a Faculty Designated Option, which provides recognition to students who complete the requirements for International Studies in Engineering (ISE), along with their BASc degree program. It is an enriched program which probably requires extra academic material on campus, and certainly requires overseas study and/or work. It provides a life-long benefit for those students who are inclined and able to seek enrichment in their education.

Three UW courses are normally required before leaving for abroad. These subjects will be specified according to the country of destination, and include literature, history, and regional studies, as well as language preparation (for example, Far Eastern Studies or European History).

The second part of the program is an overseas experience of at least two terms, including study terms or work terms or both. It is possible to fulfill this by arrangements other than those of the Engineering Student Exchange Program. An acceptable written report is required, and earns the equivalent of a course credit towards the requirements of the Option. The student registers for this equivalent course in the first academic term after return.

The final part of the program is at least three UW courses, or the equivalent, from the approved list. These courses must be approved by the Option Coordinator, and would be directed towards integrating the overseas experience into the broader perspective through courses in international economics, history, or
ENCOURAGING STUDENT INVOLVEMENT

Publicity initiatives are of first importance in awakening engineering students to the possibilities for study and work abroad. Initiatives currently in place at Waterloo include: admission package flyer, exchange program week, class professor hour presentations, the hallway bulletin board, welcome reception for incoming students, information on the university computer system for easy student access, and finally the information "library" in the Exchange Program office which has bulletins, flyers, curricula, and student reports on all exchanges. These publicity events and information resources are coordinated by a secretary who provides an invaluable focus point both for Waterloo students, and for incoming exchange students. These activities are in addition to her normal responsibilities.

Exchange Program Week is the fourth week of the Fall and Winter terms. It starts on Monday with open information sessions by the Exchange Director and is followed by noon-hour sessions in a public gathering place in a main Engineering building on the remaining days. Each day features a different country or group of countries. Returned Waterloo students from the designated countries are in attendance and can reply to queries from other Engineering students who may be contemplating participation in an Exchange.

The "exchange" database is easily accessible to students via computer, giving them access to information about all the exchanges as well as general information about the International Studies in Engineering Option, fees, application procedures, alternative overseas experiences and so forth. Returned students from the designated countries are in attendance and can reply to queries from other Engineering students who may be contemplating participation in an Exchange.

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CONCLUSIONS

The experience with international engineering student exchange programs at the University of Waterloo has indicated the importance of:
- close collaboration between Faculty Coordinators at the two institutions.
- student involvement in individual study/work exchange proposals.
- publicity to encourage timely student interest and extensive and easily available information to allow student planning well in advance of the actual exchange.
- a central coordinating role. As the program grows, this is necessary to ensure cooperation of the various administrative groups in all institutions.
- clear financial arrangements. The most important of these concerns tuition fees. The payment of fees at the home institution with waiver by the host institution has proven to be successful in most cases.
- adequate health insurance. Experience has underlined the necessity for attention to this.
- continual program development. At this time, extension to graduate programs shows promise.

REFERENCES
