

STUDYING ENGINEERING ABROAD: THE NOTRE DAME EXPERIENCE IN LONDON

Eugene W. Henry¹ and John J. Uhran, Jr.²

Abstract *This paper presents a University of Notre Dame program which provides its engineering students with the opportunity to study overseas in London, England during the first semester of their junior year. It describes how the program was motivated by issues at the international, university and college levels, the limitations that exist, the accommodations and courses offered, and the variety of attributes which have produced a highly successful and popular program. It also gives an historical account of the development of the Notre Dame London Center at Trafalgar Square and a description of its current faculty and staff, as well as facilities such as computer laboratories and living quarters. This program allows each participating student to complete his/her degree program in a seamless manner within the normal four-year period. Over time, this program has become enormously popular, with participation being limited only by the facilities available.*

Index Terms *London, Notre Dame, Study abroad.*

INTRODUCTION

In the last decade the globalization of the marketplace has become a reality, with education being one of its many components. This phenomenon has its roots in the two world wars that took place in the 20th century. But it was only after World War II that the real process of globalization began, with the driver being the continual improvement of travel and communications, and the associated economies which arose. Another more subtle phenomenon that entered into the process was the almost universal acceptance of English as a means of communication. Why this latter phenomenon occurred is at this time best left to other scholars. Today, we have instant communications at virtually no cost through e-mail and the Internet, and relatively rapid, economical travel by air. All of these things, plus the importance of understanding cultural differences in the marketplace, have spurred the concept of educating university students in another country for some period during the four-year college experience. Let us examine some general and particular issues more carefully.

GENERAL ISSUES

Studying abroad is not a new phenomenon. A small segment of the US population has always studied overseas, particularly during the summer, so as to be exposed to other cultures and to practice language skills that were learned in

the classroom during the academic year. In the past 50 years, study abroad has slowly increased in popularity and importance. Foreign exchange programs have evolved slowly both at the high school level and at the university level, but has accelerated in recent years. In the past, it was not uncommon for students from other countries to come to the United States for graduate studies. In many cases, they stayed and applied for citizenship. We are now at the point where there are over 216,000 international graduate students and 236,000 international undergraduate students in the United States [1]. The number of international students coming to the United States to do undergraduate studies for a full four years has most recently been increasing drastically. It has been less common for United States students to study abroad (117,000 in 2000-2001) [1]. But this has been changing as more and more college and university students from the United States study overseas for a summer, a semester or even a year. There are many variations of how these students study abroad, but we would like to focus specifically on Notre Dame students and the constraints and attributes of our engineering program in London.

NOTRE DAME ISSUES

The University of Notre Dame established foreign study programs over 30 years ago [2]. These programs started very modestly, with a small number of students. The original locations available for a year of study were in Angers, France and in Innsbruck, Austria. From the outset, the University has insisted on several important criteria:

- Each program will be a Notre Dame program for Notre Dame students.
- The curricula will be established by the faculty at Notre Dame and, where possible, that faculty will be intimately involved in part of the instruction.
- If adjunct professors were required, they will be hired by the regular faculty of the university
- Whether it is a semester or a full-year program, it must be a seamless process, so that every student is able to graduate in four years in the major of interest.
- Living accommodations for students and visiting faculty will be arranged and supervised by the University of Notre Dame and, where possible, an on-site director will be present at all times.
- If appropriate and necessary, a program can be affiliated with a local university.

¹ Eugene W. Henry, University of Notre Dame, 384 Fitzpatrick Hall, Notre Dame, IN 46556, ewh@cse.nd.edu

² John J. Uhran, Jr., University of Notre Dame, 257 Fitzpatrick Hall, Notre Dame, IN 46556, jju@cse.nd.edu

This concept has proven successful for the University of Notre Dame over the years, and has now expanded to over eleven sites throughout the world, each of which has unique and special characteristics. Table I shows data on some these sites. Note that the engineering (Eg) and total (Totl) enrolments in Table I are only for the Fall 2000 semester. Special arrangements are facilitated in five other locations. Many of the regular programs have grown to the extent that they are always oversubscribed, and Notre Dame currently has the largest percentage of undergraduate students studying abroad among all the research universities in the country [1]. It should be noted that the Notre Dame overseas undergraduate programs are not open to students of other universities.

TABLE I
NOTRE DAME OVERSEAS SITES

Location	Duration	Began	Eg	Totl	Programs
London, England	sem	1981	34	145	All
London, England	sum	1988	24	24	All
Angers, France	yr	1966	0	36	Bus, Hum
Dublin, Ireland	yr	1998	2	41	All
Fremantle, Australia	yr	1998	8	32	Bus, Hum, Sci
Monterrey, Mexico	sem		0	0	Bus, Hum
Nagoya, Japan	sem	1974	0	6	Bus, Hum
Innsbruck, Austria	yr	1964	0	22	Bus, Hum
Toledo, Spain	yr		0	35	Bus, Hum
Jerusalem, Israel	yr		0	0	Hum
Rome, Italy	yr	1969	0	52	Arch

All = Engr, Business, Humanities & Science. Eg & Totl are for Fall 2000.

ENGINEERING ISSUES

For many years, the University of Notre Dame has offered six engineering programs, all accredited by ABET. As a professional degree program, engineering brings certain special problems to a study-abroad experience. Many courses in an engineering curriculum are dependent upon a sequence of prerequisites. This dependence is not only upon the basic sciences, such as mathematics and physics, but also upon previous introductory engineering courses. For example, a structures course in civil engineering is dependent upon a course in statics followed by a course in solid mechanics. Courses thus build on each other throughout the entire four years, and if any of them is misplaced, this has the potential of forcing a student into additional semesters.

The placement of an overseas experience also becomes critical. It certainly cannot be in the first year of a four-year program and it is not a particularly good idea to have it in the second year since this puts an enormous burden on the student during the first year of university life to make very difficult and complicated decisions. The Notre Dame College of Engineering has determined that the junior year is the appropriate time for its students to study abroad. This allows the student two years to prepare properly for the experience and one year afterwards to integrate it into the final year of studies before graduation. A problem immediately arises for any engineering school offering

engineering programs in junior year. If one were to look at various engineering curricula in a typical university during third year, as shown in Tables II-V for Notre Dame, it would be obvious that they vary considerably from discipline to discipline. The courses being taken by a junior mechanical engineer are totally different from those of a junior electrical engineer, as shown in Tables II and III. These wide discrepancies would also exist between any of the other disciplines as well, as shown by the computer engineering and chemical engineering programs in Tables IV and V. Thus each of the opportunities that Notre Dame provides for its engineering students in study-abroad programs must be specifically tailored for the location and its available facilities, and to match those at home.

TABLE II
MECHANICAL ENGINEERING

Fifth Semester	Cr	Sixth Semester	Cr
MATH 325: Differential Eq	3	CHEG 225: Materials Sci	3
EE 222: Electrical Science	3	AME 332: Fluid Mech Lab	2
AME 331: Mech Solids Lab	2	AME 340: Mech Design	3
AME 334: Fluid Mechanics	3	AME 437: Controls	3
AME 339: Mach Kin/Dyn.	3	AME 439: Heat Transfer	3
Arts and Letters Course	3	Arts and Letters Course	3
Total Credits	17	Total Credits	17

TABLE III
ELECTRICAL ENGINEERING

Fifth Semester	Cr	Sixth Semester	Cr
Math 325: Differential Eq.	3	Math 323: Probability	3
EE 344: Signals & Systems I	3	EE 354: Signals & Systems II	3
EE 347: Semiconductors I	3	EE 357: Semiconductors II	3
EE 348: Fields and Waves I	3	EE 358: Fields and Waves II	3
Arts and Letters course	3	EE 342: Electronics II	4
		EE 330: Engineering Design	1
Total Credits	15	Total Credits	17

TABLE IV
COMPUTER ENGINEERING

Fifth Semester	Cr	Sixth Semester	Cr
Math 325: Differential Eq.	3	Math 323: Probability	3
EE 344: Signals & Systems I	3	EE 354: Signals & Systems II	3
CSE 321: Computer Arch I	4	EE 322: Computer Arch II	4
CSE 331: Data Structures	3	CSE 341 Operating Systems	3
Arts and Letters course	3	EE 242: Electronics I	4
Total Credits	16	Total Credits	17

TABLE V
CHEMICAL ENGINEERING

Fifth Semester	Cr	Sixth Semester	Cr
MATH 325: Differential Eq	3	CHEM 324 Physical Chem	3
CHEM 333: Analytic Chem	2	Free Elective	3
CHEM 333L: Analytic Lab	2	CHEG 225: Materials Sci	3
CHEG 343: Thermo II	3	CHEG 358: Chem Engr Lab I	3
CHEG 355: Transport I	3	CHEG 356 Transport II	3
Arts and Letters course	3	Arts and Letters course	3
Total Credits	16	Total Credits	18

That is why London has been chosen as the focus for this discussion. It is also why engineering has been among the last programs at the university to arrange for students to

study abroad. Trying to provide a meaningful experience in the junior year among all the disciplines, and provide proper facilities and curricula at modest cost, has proven to be an overwhelming problem. While this problem still provides significant challenges, we believe that we have a reasonable and workable solution. Each of the overseas programs for Notre Dame students is unique, with specific eligibility requirements as shown in Table I. The London program stands out as the largest, and one of the oldest programs, in which engineering students can continue their rigorous curriculum and experience a new and exciting environment, without prior proficiency in a foreign language.

The London program has proven to be very successful and popular with engineers. Both the summer program and the fifth semester program have been highly regarded by students and faculty alike. Note in Table I that the summer program is the oldest of the engineering programs. From that experience, we were able to create the programs in London, Dublin and Fre mantle.

NOTRE DAME IN LONDON

One of the oldest and certainly the largest of the Notre Dame study-abroad programs is in London, where today some 500 students a year study at the Notre Dame London Center, including undergraduates, MBA and Law School students. The Law School offers the only yearlong ABA-approved international study program, as well as the only LL.M. program offered by an American university abroad, focusing on international comparative law and open to lawyers from around the world. The undergraduate program hosts about 200 Notre Dame students each semester, mostly from the Colleges of Arts and Letters and Science. Some 35 juniors from the College of Engineering participate only during the Fall semester, and are balanced by a similar number of students from the College of Business who participate only in the Spring semester.

Undergraduates who participate in the one-semester London programs pay the same tuition and board fees as if they were on campus, and are provided transportation to and from London as well as lodging in an apartment building two miles from the Notre Dame London Center.

Notre Dame London Center

The Marian Kennedy Fischer Hall on Trafalgar Square became a greatly expanded and newly renovated site of the Notre Dame London Center in 1998, replacing a much smaller site on Albermarle Street near the Royal Society. The current facility at 1-4 Suffolk Street at Pall Mall East, adjacent to the National Portrait Gallery at the northwest corner of Trafalgar Square, provides 27,000 square feet on five floors to accommodate the most popular undergraduate study-abroad program, as well as graduate programs in Law and Business Administration.

The original building on this site was constructed by the United University Club in Ionic and Doric styles at 1 Suffolk

Street in 1823. It was the center of fashionable club and coffee house life. In 1904, the property was rebuilt in a Baroque style with a French flavor, incorporating ten bedrooms for club members. The United University Club leased Numbers 2, 3 and 4 Suffolk Street, and expanded the building northward in 1924. Amalgamation of the New University Club with the United University Club in 1939 resulted in an eastward expansion of the building to provide extra bedrooms and social space, as well as two squash courts. In 1971, deficits due to monetary inflation drove the United University Club to consolidate with the Oxford & Cambridge Club and move to the latter's premises, leaving the bankers Coutts & Co in control of 1-4 Suffolk Street. The British School of Osteopathy acquired the property in 1983, and relinquished it to Notre Dame in 1997.

After extensive renovation, many of the original features of an elite gentlemen's club remain, including an impressive staircase, mahogany doors to the main rooms, intricate ceiling moldings and ornate fireplaces. The building now contains all of the classroom, computer, recreational and library facilities needed by the students, as well as housing for visiting professors from the home campus in Indiana. The central location, within walking distance to theaters, art galleries, financial institutions and colleges of the University of London, makes it attractive to students, as well as the adjunct and visiting faculty

Facilities and Staff

The London Center has separate facilities and staff for each of the academic programs, in addition to common support for shared activities. Most of the staff are British citizens who live in the London area.

- **Common:** Senior Common Room for Faculty and Staff, two common rooms for students, cafeteria, chapel, two gymnasium/basketball courts, four flats for visiting faculty, six classrooms, gallery/assembly hall;
- Building Services Manager residing in the Center, Facilities Coordinator, Facilities Assistant, Computer Services Technologist, Finance Officer.
- **Law Program:** Law Library, classrooms, computers;
- Law Director, Law Administrator.
- **MBA Program:** Executive rooms, computer facility;
- MBA Director.
- **Undergraduate Program:** Library, 3 computer labs;
- Program Director, Program Administrator, Residence Director, Librarian.

A private office is allocated to each staff and visiting faculty member. Adjunct faculty use the Senior Common Room for interaction with students and other faculty outside of class. All computers in the building are connected both to an internal network and to the Internet. Engineering students use a laboratory containing nine Sun workstations which access a local Sun60 server to download analysis and design programs including MatLab, XSPIM, and Mentor Graphics

tools ModelSim, Leonardo and DA. All other computer rooms in the building contain Dell or Macintosh PCs.

The Undergraduate Program Curriculum

The semesters in London begin earlier and ends later than the on-campus semesters to provide for two one-week breaks. The breaks allow students time to enhance their study abroad experience through extensive travel.

The following 3-credit courses were taught by adjunct professors during the Fall semester of 2000:

- Great Age of European Painting, Sculpture, and Architecture, 1750-1939
- Economic Policy in the United Kingdom since 1945
- The European Nation
- Shakespeare and His Contemporaries
- Criticism and Culture: The British Tradition of Literary Theory, 1902 to Present
- Victorian Literature
- The British Imagination
- Ethnic Conflict Regulation in Ireland, Northern Ireland
- The Government and Politics of Britain
- The Conquered and the Proud: Rome World Empire
- British History 1900-1990
- The English Civil War 1640-1660
- A Philosophical Introduction to the Mind
- The Philosophy of Religion
- Introduction to Metaphysics
- Influences on Early Social and Cognitive Development
- Developmental Disabilities: Integrating Theory, Practice
- The Shaping of the English Christian Mind
- Knowing God Through the Liturgy

The tripartite division of the semester provides a unique opportunity to offer 1-credit mini-courses in the fine arts, each with a duration of one third of the semester. Each of these courses augments lectures with attendance at appropriate local theatres, concert halls, opera houses, museums and historic sites which abound in London. The following mini-courses are directed by adjunct professors:

- The British House, Town and Country: 18th and 19th Century Architecture in Context
- Medieval Art and Architecture
- Contemporary Art in Great Britain
- Post-Modernism
- An Introduction to the Theatre in Britain
- Opera as Drama
- Concert Life in London
- The Art of the Ballet
- In Shakespeare's Playhouse

The College of Engineering sends two professors and one graduate student to London each Fall to conduct three or four courses and the laboratory associated with Computer

Architecture. The College of Science sends one professor to teach a basic physics course for students in the life sciences. All other engineering courses are taught by local adjunct professors. All courses in the following list have 3 credits except for Computer Architecture which has 4 credits because of an associated laboratory.

- CSE 321 Computer Architecture I
- CSE 331 Data Structures
- CE 336 Structural Mechanics
- EE 344 Signals and Systems I
- EE 348 Electromagnetism I
- ME 321 Differential Equations & Applied Mathematics
- ME 334 Fluid Mechanics
- PHYS 221 Physics I

The ME 321 course has the greatest enrolment among the engineering courses since it is equivalent to MATH 325 which is required of all students in engineering. Advanced students who have already taken MATH 325 have the opportunity to take an additional elective. The other engineering courses are required for students in at least one of the degree programs, and may be electives in other programs. As an example, Computer Architecture is required for Computer Engineering and Computer Science, and is normally taken as an elective by Electrical Engineering students in London.

The visiting graduate assistant teaches the Computer Architecture laboratory, and assists the visiting faculty by grading assignments, conducting tutorial sessions, and providing times for consultation with students.

The engineering students at the London Center have expressed high satisfaction and regard for their adjunct and visiting faculty, and the faculty show commensurately high esteem for their Notre Dame students.

SUMMARY

From the preceding discussion it is evident that many of the characteristics of these foreign studies programs are peculiar to the University of Notre Dame. However, the principle of giving students a seamless experience with respect to their classmates on campus, while allowing them to graduate in four years, is fundamental. Extensive resources have gone into each of the programs, but the payback has been commensurately rewarding. Students almost to a person greatly appreciate the experience and consider it an important part of their education, as does the university. We continue to update, refine and modify programs to meet the increasing demand for this activity and at the same time to improve and be responsive to the needs of our students. Whether it be for a summer, a semester, or a full year, a great effort is expended to insure that all students receive the proper information and guidance to make this program an important, rewarding and integral part of their Notre Dame education.

REFERENCES

- [1] *Chronicle of Higher Education*, November 17, 2000, pp. A74-A77.
- [2] Uhran, J. J., Jr. "Providing an International Experience for Engineers", *ICEE1999 Conference Proc.*, Ostrava, Czech Republic, Aug., 1999.