Internationalizing an Industrial Energy Management Course

Authors:

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Abstract *— For a number of years internationalizing the curriculum at the University of Florida (UF) has been an area of great interest. The College of Engineering (COE) at UF is currently exploring and investing on it. In this work we discuss the recent experience on internationalizing the curriculum in the COE, particularly in the Department of Industrial and Systems Engineering (ISE). Two new avenues that relate to a course in Industrial Energy Management (IEM) are discussed. The first approach was to give an international component to the IEM course through a module that showed to the student energy audits performed to industries in Chile and Ecuador. These case studies were done through a grant from the president of the University of Florida. The second instance has been the creation of a new course: International Industrial Energy Consulting. This course, framed as an study abroad one, focuses in Latin America's economy, climate, and energy usage patterns in particular, all narrowed down to Chile. In the middle of the semester, and for 2 weeks, the students are taken to Santiago -Chile to perform 2 industrial energy assessments (i.e., industrial energy consulting). The students experience, implications and consequences of these two programs are discussed in this work. The impact perceived by the students as an international learning experience in their field is also addressed. Finally, the generation of new programs at the undergraduate and graduate levels in IEM at the University of Florida College of Engineering, influenced by these international approaches, is discussed.*

Index Terms *— International Energy Consulting Course, Latin America Economy*

Introduction

In today's world, far more so than in previous generations, the level of preparation required in higher education have increased dramatically, especially for engineers. We believe that the development of an International Engineering Program at the University of Florida will have a tremendous impact in the success our students will have, and on the UF-COE as well.

For any higher education institution, internationalizing the curriculum in engineering is now days a natural part of the curriculum, as we live in a world that demands each day that new engineers have a broader education/vision of the world. Many schools around the world are pursuing this goal offering study abroad opportunities. They must be able to interact with partners and competitors who speak different languages and view the world from different cultural perspectives. The success that they and their companies achieve will depend on research, development, and manufacturing carried out collaboratively with colleagues around the globe. Because of this, engineers must acquire international skills along with expertise in business, science and technology. This sends us a clear message for what multinational companies require from their new engineers, this is, that they not only be able to communicate in a different language, but also to have an understanding of the culture and the countries they will do business with.

Knowing more than one language as well as other cultures will put our students in significant advantage. In other words, by gaining valuable work experience in an international setting, our students will improve their marketability in today's competitive global economy. With an international component in their education students will get to network with leaders of top technical companies and like-minded students from around the world.

Often, when people return from a trip, they admire and reflect on many aspects of the places they visit. The urban setup, the food, the transportation system, the citizen's friendship, the sense of community, their history, their environment, pollution, … industries are part of this environment. In Latin-America some governments have embraced a number of economy management policies that affects their industry, and consequently their society. Some of these ideas have not been imagined before, or simply been considered impractical by other more developed countries. Students can benefit from seeing how Latin-Americans have implemented these different ideas on their Industries, cities and communities.

In this context, our understanding on what needs to be done to achieve these goals has improved dramatically. As a consequence many universities around the globe have study abroad programs, where students generally travel and stay for one semester in a foreign country with the purpose of not only take courses in the local language, but also to learn the

customs, the culture, new ways of thinking, living, local history, etc. There is no question on that this new environment at which they are confronted, this new world, provides a broader vision of the world for our students. The modes today available for students to attain international experience in their careers are many, varying from their own colleges, passing through others, up to especial companies that offer special study abroad programs, etc. In the College of Engineering (COE) at the University of Florida (UF) we believe that the students that put themselves through the hard work required by an International Engineering Program, are precisely the engineers of the future that will lead the companies and industries of the future.

However, and even if these are fine goals, we should be able to offer our students additional alternatives. These new avenues should be oriented to the future professional aspects of their careers and future life as engineers. Something that will allow us to plant an extra seed into our student's mind that will trigger their imagination and open their appetite for wondering, to learn and know more, but also to prepare them for the challenges of the engineers of the future. We decided to start a program that will offer something different in those lines. For this, we recognize that every engineer is, or will be at some point of his professional life, confronted with the issue of providing private services. Consequently, we choose 'consulting'. But it cannot be any type of consulting. This will have to be at the national and international level. The subject was the challenge, it has to be an area that, regardless the specialty of engineering that student have choose, it will have to put the student, and the engineering concepts and ideas she (he) has learned to the test. The area we decided will fulfill our expectations was precisely "Industrial Energy Management". The main reason is that experience tells us that students from all departments at the UF-COE can apply what they have learned in an industrial environment.

In this work we discuss our experience with a course in "Industrial Energy Management" (IEM) in two modes. We first added an international module to it, and then created, as a natural extension, a new course called "International Industrial Energy Consulting". The first one provides a general view of what can be done in any manufacturing facility at the national and international levels through the presentation of universal concepts and of case studies presented in the IEM class. The second one, allow the students to put to the test what they have learned in at UF-COE by performing the work themselves, this is, industrial energy consulting, but now in a different country, in a different culture.

In this work we present and discuss our experience with our International Industrial Energy Management program. We will elaborate on the importance of international component in today's education (not only in engineering), as the existence of this meeting is more than enough proof of it. We rather show a different approach that is different from the very typical study abroad format. We actually take students abroad to perform real world engineering work.

The International Industrial Energy Management Program

Study Abroad Programs in other colleges and departments at the University of Florida are semester-long programs (or summer sessions), that are designed to *replace* coursework that can be taken at UF. These programs are highly respected and very valuable to UF students. However, none of them is currently offered in the college of engineering (COE).

The International Industrial Energy Management program consists mainly of two phases. First, the students learn the basics of Energy Management through the different Department courses offered at the UF-COE. Should they decide to take the one offered to Industrial and Systems Engineering Department, this is, Industrial Energy Management, they will be exposed to the course that provides a module of international case studies. The second phase is to have the students taking a new elective course: 'International Industrial Energy Consulting', which will take them abroad to perform energy audits to manufacturing facilities by themselves. In the next section we briefly discuss the current IEM course, and to later on the new International Industrial Energy Consulting (IIEC) course.

The Industrial Energy Management Course

Energy Management is the use of engineering and economic principles to control the cost of energy to provide needed services in buildings and industries. Most savings in energy costs will come from improvements in energy efficiency. Some savings will come from changing the patterns of energy use, and possibly shifting to other sources of energy.

The IEM course studies the objectives, design, implementation and management of energy management and energy efficiency efforts. Scope includes energy efficiency, choice of energy sources, examination of new and improved equipment and technologies, examination of energy efficient processes, and alternative energy sources. Application areas include homes, institutions, businesses, large buildings and industry. The emphasis is on energy efficiency applications. The format that the students have to follow to perform the energy audits is given in the diagram shown in Figure 1.

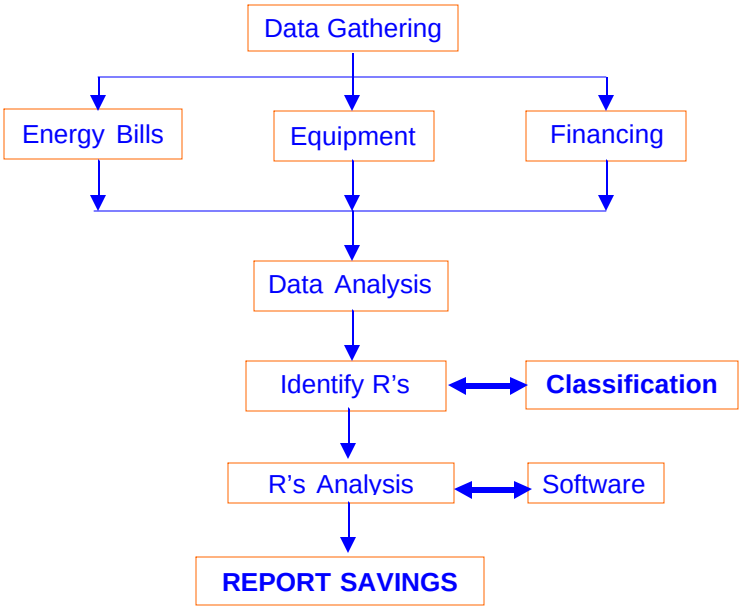


FIGURE 1.
The Energy auditing process. R's stands for Recommendations.

As described above, the course teaches the students how to perform energy audits to manufacturing facilities mainly. In this context, and before the International Module was presented to the students, a case study is presented to the class: an Energy Audit performed to a Cardboard Boxes manufacturing facility here in Florida. This first part of the module included a detailed process description (with photos), general information about the client, energy consumption and usage, equipment list and energy balance, plots and pie charts, and recommendations made for energy savings. At that point the students seemed to be enthusiastic about what they will learn to do in the course. A few pictures (3) of the cardboard boxes manufacturing process are shown in Figure 2.

FIGURE 2.
A few vies of part of the process shown to the class as a case study of a cardboard boxes manufacturing facility in the US. The Corrugator is shown on the left, and the Flexo machine with the final product are shown on the right.

The International Module

A proposal was presented to the President of the University of Florida so to modify the course syllabus and introduce an international module that will provide an international component to the course through two international case studies. The proposal considered the modification of the currently given Industrial Energy Management course, in the Department of

Industrial and Systems Engineering. The new module considered the inclusion and in-depth energy consumption analysis of two manufacturing facilities, one in Guayaquil, Ecuador, and the other one in Santiago, Chile. Both were presented to the class as case studies. The universities contacted do not have a similar course in their curriculum, but agree to collaborate in the program. Ecuador and Chile in particular are underdeveloped countries with an emerging industry that has certainly many challenges and virtues in energy management.

The instructor traveled to these countries and performed the energy audits to one manufacturing facility in each country. Then, and before the end of the semester, the International Module was presented to the class in the form of two energy audits performed abroad to different manufacturing facilities. The first international audit-case study shown was the one performed to a Steel Pipe plant – IPAC - in Guayaquil – Ecuador (see Figure 3). The second international case study shown was the audit performed to copper-based pesticides and fungicides plant – QUIMETAL - in Santiago – Chile (see Figure 4).

FIGURE 3.
The Ecuador company used as case study. IPAC, Guayaquil – Ecuador. On the right part of the galvanizing process is shown.

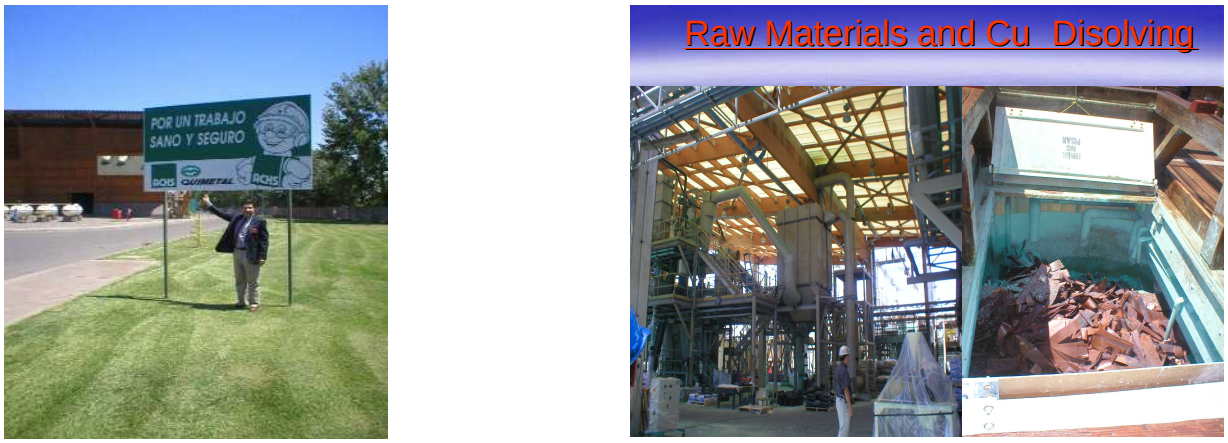


FIGURE 4.
The Chile company that served as case study. QUIMETAL, Santiago- Chile. The instructor is shown on the left during his first visit.

The presentations included the following:

- Introduction of the company, products, distribution, policies, operation background, working shifts, plant layout, etc.
- Engineering students show and describe the industrial process starting from raw materials until the final product is distributed, or stored for future shipping (supervised by the instructor and the local faculty).
- The company (client) provides energy bills (electricity, natural gas, propane, steam, diesel, etc.) of the last 12 months. Also, an equipment list and plant layout is shown.

For both cases the same analysis shown for the Florida case study was shown, i.e., energy plots and graphs, process descriptions, equipment lists photos of the processes, etc. As the presentation evolved, the class was asked to give any potential

energy savings recommendation they think would be in place to make. After they were written in the blackboard they were compared with those identified by the instructor during his visit to those facilities. It was a great surprise to see that the students make an excellent job identifying most of the recommendations that were pointed out during my instructor visit to the sites. This is not an easy task, especially considering that they did not visit the plant. Finally, figures in terms of money savings were presented and discussed in more detail. The presentations ended with a general discussion about the facilities visited, the energy dependence on the climate in those countries, the energy future, job possibilities in industrial energy consulting for industrial engineers, etc. At the end of the presentation of the module, the students were reminded on that these were all 3 different case studies, from very different countries. That they should understand and realize that they now have the minimum necessary tools to perform an Industrial Energy Audit for any company, anywhere, as the material learned in class is based on universal concepts. Finally three of the students in the class were so motivated that they decided to participate in the new course in 'International Industrial Energy Consulting'. This course, taught for the first time during the last 2004 Summer C term, and that considers going to Chile (2 weeks) to perform energy audits to two manufacturing facilities, is discussed in the next section.

As the spring 2004 semester ended the instructor feeling was that the students got a better grasp of the course and what was it enabling them to do as engineers at a national, and even an international, level. But to have a better grasp of their impressions a small survey was conducted. We shall return to the course evaluation later-on at the end of this work.

The International Industrial Energy Consulting Course

Related to Latin America (LAm), the technical background for the course as known in IEM will be kept, with an increase in the reading material. The technical part of the course focuses on hands on problems solving through discussions and case studies of real manufacturing facilities. At this point the international case studies shown in the IEM class are used to reinforce the material needed, helping to set a general background level of discussion.

On the other hand, Chile was chosen because of its recent inclusion in the North American Free Trade Agreement (NAFTA) with the USA, Canada and Mexico. Chilean industry and economy has shown to be in much better standing than the rest of the majority of the other Latin American countries. The Chilean industries relate to the American style, having a significant European component, with a great deal of Chilean style. These characteristics make the Chilean industry a worthwhile interesting energy management case.

Some of the questions to be addressed are: Why is the Chilean industry different from the rest of Latin America and the USA? what is the power generation and service quality?, what about the power regulation and policies ? What is the industrial technology standing? Are there any benefits for the industry; are there any power losses due to power steeling? etc.

Brief Course Description and Objectives

The main objective of this course is to enhance, and contextualize the student knowledge of industrial energy management at an international level. These will blend the material learned in Energy Management (and similar courses) in a global context. This is to enable the student to develop overall global energy awareness, and energy efficiency ethics which can be used to help themselves and the organizations they will work for. Focused in Chile – South America, students will be exposed to international industrial energy consulting. To understand this new environment, participants will study the region and the country's economics, energy policies, energy usage, costs, examination of new and improved equipment and technologies, examination of energy efficiency processes, alternative energy sources, energy sciences in other country, renewable energy resources, climate dependence, etc. Speakers from local universities and utilities will provide additional insight.

A very important goal of this course is to work with the student in a very different academic environment. From the very beginning it is to make clear to the class about the different nature of this particular course. Namely that, one of the main goals of this course is to take them to the world of International Industrial Energy Consulting. This particular setup for the student is clearly established from the beginning, and is defined as follows:

a) You are not considered to be a student anymore, but a professional engineer.
b) This is now an international consulting company in industrial energy management.
c) The instructor is the president of the company, and you work for him.
d) As engineer working in international consulting, the most of you is the minimum expected.
e) You will work with the instructor (president) as a peer, not as a student anymore.
f) There will be regular meetings and work will be assigned. You cannot miss a meeting or a deadline.
g) Additional considerations: Remember that, by traveling and working abroad, you will be an ambassador of your country. Hence the most is expected from you, and you must conduct yourself in a professional manner always!

The Trip to Chile

The summer 2004 International Energy Consulting course is a semester long one and it includes a 14 day short term study abroad tour in Chile, offered by the Department of Industrial and Systems Engineering to all UF-COE students. Three undergraduate or graduate credits are granted to students who successfully complete the program. The tour takes place during the 2004 summer break. Most of the time will be spent in Santiago (Capital), Valparaiso (central coast), and Rapel (2.5 hours south of Santiago) in excursions to other industries. Before the student trip, the instructor visited Chile to confirm industrial contacts, establish dates for student's visits, complete and confirm agreements, visit to manufacturing facilities, gather general background information about the facility, etc.

The program is first and foremost an academic one. There will be lectures delivered in the hotel before visiting sites. The bulk of the tour will take place on site traveling to the manufacturing facilities, local utilities, universities, and the cities, giving on site lectures. Guest lectures will be given by guests in all industries and universities visited. Museums of History and of Science and Technology, and exhibits featuring the historical development of Latin-American industries (mostly Chilean) will be visited.

The average day will consist of a morning briefing/lecture about the sites to be visited that day at the hotel while eating the standard continental breakfast. Then the group will travel to the day's sites. Lunch will be a group meal not paid for by the program. According to the program schedule, time will be built into the day to ensure students have adequate time to reflect on the day's experiences, and to visit other sites of personal and professional interest.

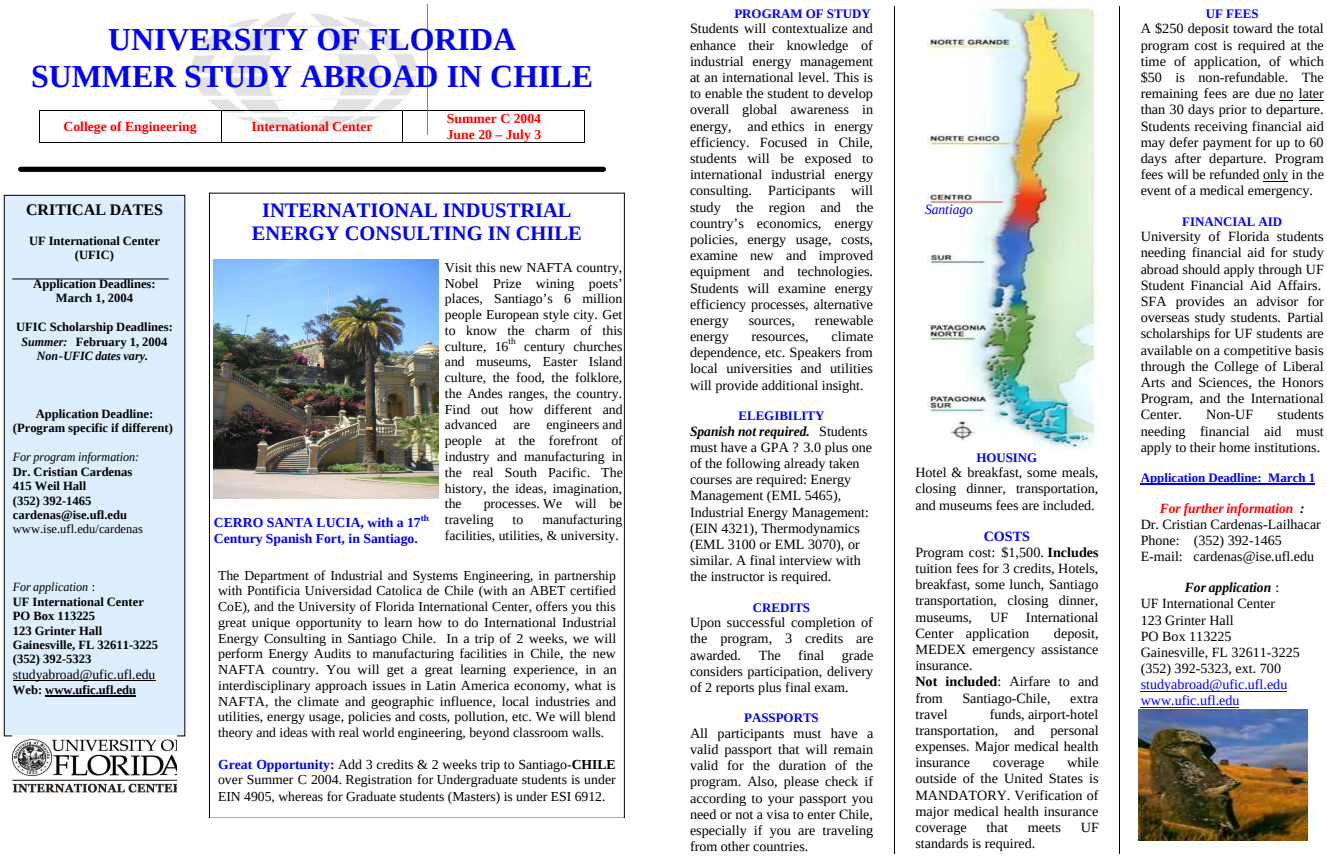
Benefits for Participating Students

The course advertisement gives the general background of the course. The web-site with all the academic background provides in depth about all details regarding objectives, itinerary, requirements, literature, etc (see Figure 5). Some of the

FIGURE 5.

The advertising of the International Industrial Energy Consulting course to students, and the course web-site (down to the right).

most important issues is to let them the interested students that, besides the experience in international consulting, they will get a UF-COE Certificate of participation, a polo shirt from the UF-COE, give a lecture to engineering students in one of the most respected universities in Chile (with an ABET certified program) and Latin America, and also be ambassadors of the UF-COE and their country. Not less important is the added benefit to show this work in their resume and future careers. The University of Florida International Center provided an excellent support for this course (and others at UF) through a general distribution flyer with extensive information for interested students (see Figure 6).



UNIVERSITY OF FLORIDA
SUMMER STUDY ABROAD IN CHILE

College of Engineering | International Center | Summer C 2004 June 20 – July 3

CRITICAL DATES

UF International Center (UFIC)

Application Deadlines: **March 1, 2004**

UFIC Scholarship Deadlines:
Summer: **February 1, 2004**
Non-UFIC dates vary.

Application Deadline: **(Program specific if different)**

For program information:
Dr. Cristian Cardenas
415 Weil Hall
(352) 392-1465
cardenas@ise.ufl.edu
www.ise.ufl.edu/cardenas

For application :
UF International Center
PO Box 113225
123 Grinter Hall
Gainesville, FL 32611-3225
(352) 392-5323
studyabroad@ufic.ufl.edu
Web: www.ufic.ufl.edu

UNIVERSITY OF FLORIDA
INTERNATIONAL CENTER

INTERNATIONAL INDUSTRIAL ENERGY CONSULTING IN CHILE

CERRO SANTA LUCIA, with a 17th Century Spanish Fort, in Santiago.

Visit this new NAFTA country, Nobel Prize wining poets' places, Santiago's 6 million people European style city. Get to know the charm of this culture, 16th century churches and museums, Easter Island culture, the food, the folklore, the Andes ranges, the country. Find out how different and advanced are engineers and people at the forefront of industry and manufacturing in the real South Pacific. The history, the ideas, imagination, the processes. We will be traveling to manufacturing facilities, utilities, & university.

The Department of Industrial and Systems Engineering, in partnership with Pontificia Universidad Catolica de Chile (with an ABET certified CoE), and the University of Florida International Center, offers you this great unique opportunity to learn how to do International Industrial Energy Consulting in Santiago Chile. In a trip of 2 weeks, we will perform Energy Audits to manufacturing facilities in Chile, the new NAFTA country. You will get a great learning experience, in an interdisciplinary approach issues in Latin America economy, what is NAFTA, the climate and geographic influence, local industries and utilities, energy usage, policies and costs, pollution, etc. We will blend theory and ideas with real world engineering, beyond classroom walls.

Great Opportunity: Add 3 credits & 2 weeks trip to Santiago-**CHILE** over Summer C 2004. Registration for Undergraduate students is under EIN 4905, whereas for Graduate students (Masters) is under ESI 6912.

PROGRAM OF STUDY
Students will contextualize and enhance their knowledge of industrial energy management at an international level. This is to enable the student to develop overall global awareness in energy, and ethics in energy efficiency. Focused in Chile, students will be exposed to international industrial energy consulting. Participants will study the region and the country's economics, energy policies, energy usage, costs, examine new and improved equipment and technologies. Students will examine energy efficiency processes, alternative energy sources, renewable energy resources, climate dependence, etc. Speakers from local universities and utilities will provide additional insight.

ELEGIBILITY
Spanish not required. Students must have a GPA ? 3.0 plus one of the following already taken courses are required: Energy Management (EML 5465), Industrial Energy Management: (EIN 4321), Thermodynamics (EML 3100 or EML 3070), or similar. A final interview with the instructor is required.

CREDITS
Upon successful completion of the program, 3 credits are awarded. The final grade considers participation, delivery of 2 reports plus final exam.

PASSPORTS
All participants must have a valid passport that will remain valid for the duration of the program. Also, please check if according to your passport you need or not a visa to enter Chile, especially if you are traveling from other countries.

NORTE GRANDE
NORTE CHICO
CENTRO
Santiago
SUR
PATAGONIA NORTE
PATAGONIA SUR

HOUSING
Hotel & breakfast, some meals, closing dinner, transportation, and museums fees are included.

COSTS
Program cost: $1,500. **Includes** tuition fees for 3 credits, Hotels, breakfast, some lunch, Santiago transportation, closing dinner, museums, UF International Center application deposit, MEDEX emergency assistance insurance.
Not included: Airfare to and from Santiago-Chile, extra travel funds, airport-hotel transportation, and personal expenses. Major medical health insurance coverage while outside of the United States is MANDATORY. Verification of major medical health insurance coverage that meets UF standards is required.

UF FEES
A $250 deposit toward the total program cost is required at the time of application, of which $50 is non-refundable. The remaining fees are due no later than 30 days prior to departure. Students receiving financial aid may defer payment for up to 60 days after departure. Program fees will be refunded only in the event of a medical emergency.

FINANCIAL AID
University of Florida students needing financial aid for study abroad should apply through UF Student Financial Aid Affairs. SFA provides an advisor for overseas study students. Partial scholarships for UF students are available on a competitive basis through the College of Liberal Arts and Sciences, the Honors Program, and the International Center. Non-UF students needing financial aid must apply to their home institutions.

Application Deadline: March 1

For further information :
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Phone: (352) 392-1465
E-mail: cardenas@ise.ufl.edu

For application :
UF International Center
123 Grinter Hall
PO Box 113225
Gainesville, FL 32611-3225
(352) 392-5323, ext. 700
studyabroad@ufic.ufl.edu
www.ufic.ufl.edu

FIGURE 6.
This the flyer for the International Industrial Energy Consulting course in CHILE, as provided by the University of Florida International Center.

Many UF students speak or know some Spanish, most of the local Chilean CEO's and engineers at facilities, university students and faculty do speak English, hence Spanish is not a requirement for this course, although it is recognized as a plus.

Topics to be Covered

Topics to be covered in the course will relate to several areas of Industrial Energy Management, Economics, etc. A summary of the syllabus is shown in Table 1. Students are evaluated in four basic areas: Attendance/Discussion, Participation, Final Report, and an Exam.

The course is divided in three main parts. The first one is mainly devoted to analyze the Economic and Energetic environment in Latin America, the climate influence, narrowing the subjects down to Chile, to discuss its characteristics of being the new NAFTA member, etc. The manufacturing facilities to be visited in the trip to Chile, and their operations and energy profiles, were extensively discussed before the trip. The second part considers the trip to Chile itself. Finally, the technical energy audit reports to the facilities (clients) audited in Santiago are prepared and submitted as the third part of the course.

1.-	Introduction
2.-	Industrial Energy Management Review
3.-	The Energy Auditing Procedure Overview
4.-	Companies to be Audited: - General Background - Energy Bills Analysis
5.-	Latin America Economic Environment
6.-	Energy Consumption in Latin America
7.-	Chile, a New Member of NAFTA
8.-	Geographic Influence: The Climate
9.-	Preparing the Trip to Chile
10.-	Local Industries
11.-	Utilities and Incentives, Policies
12.-	Industrial Energy Distribution/Consumption
13.-	The Trip to Chile: - Safety Issues and Notes of Caution (clothing, equipment, etc.) - Recommendations from UF International Center - Interview and work with Faculty and students at PUC - Visit to Local Utilities - Auditing the Clients - Industrial visits - Getting Started with the Reports - Environmental Effect – Pollution - Give lectures at Pontificia Universidad Catolica COE
14.-	Work on, and Submit Reports
16.-	Exam

TABLE 1.
A summary of the Syllabus for the International Industrial Energy Consulting course.

The course is divided in three main parts. The first one is mainly devoted to analyze the Economic and Energetic environment in Latin America, the climate influence, narrowing the subjects down to Chile, to discuss its characteristics of being the new NAFTA member, etc. The manufacturing facilities to be visited in the trip to Chile, and their operations and energy profiles, were extensively discussed before the trip. The second part considers the trip to Chile itself. Finally, the technical energy audit reports to the facilities audited in Santiago are prepared as the third part of the course

The proposed study abroad program will be the first of its kind offered by the Department of Industrial and Systems Engineering at UF. Intended for senior students, this study abroad program fits well into the ISE Masters Degree Program. Since few courses are offered during the summer, students may wish to pair this class along with other classes offered in the department towards their elective requirement. Topics to be covered during the time abroad tie in with nearly all specializations offered by the UF-COE departments.

Additional Considerations

The program will be based on the instructor experience, notes [1-3] and contacts with local Universities, manufacturing facilities, utilities, etc. Additional studies performed by the University of Florida Latin American Studies Center [4] will be used as references.

During the trip to Chile and after 2 days of acclimatization in Santiago, the team of 6 students (five from ISE and one from Environmental Engineering departments) performed 2-days visits to two facilities: El MERCURIO (a newspaper facility, equivalent to the New York Times), and QUIMETAL (a copper based pesticides and fertilizers plant) (see Figures 7-9). In addition, three additional facilities were visited (not audited): a Pork Feeding Pellets plant, a Pigs breading facility (136,000 pigs; with a Biodigestor facility), and Viña Ventisquero, the biggest Vineyard in the Country. In addition, the students, divided in 3 teams, gave 3 talks to students and faculty in the College of Engineering at Pontificia Universidad Catolica (PUC) de Chile (see Figure 10), an ABET certified COE and one of the most prestigious universities in Chile and Latin America. This last activity was an excellent experience for the students as they were exposed to a different, but very demanding, academic environment where they have the opportunity to interact with local students and faculty, and to practice their Spanish.

FIGURE 7.
A view of Santiago - CHILE

FIGURE 8.
The team at El Mercurio

FIGURE 9.
The team during the visit to QUIMETAL with plant engineers.

FIGURE 10.
The UF team with some Pontificia Universidad Catolica de Chile students after they deliver their talks.

It is worth to mention that the photo in Figure 8 was published in a especial issue of EL Mercurio on its July 24, 2004 special edition in its Section B: VIDA EMPRESARIAL (Manufacturing News). El Mercurio is the Chilean equivalent of The New York Times.

Besides all the work, the team was exposed to the local culture, tour Santiago (a 7 million people city), learn some history and stories about it, visit an old fort (dated 1612), visit museums and old churches, etc. In addition, the team went to the beach and try typical Chilean seafood, visit a ski resort in the Andes, etc. They also discover some country side food, Chilean arts and crafts, pottery, etc. Finally, and as an end of the trip, a closing dinner was held at a local Polynesia restaurant. A detail on the side, is that the team brought UF-COE polo-shirts as gifts to our hosts at each facility and university visited. They were provided by the UF-COE office of the dean.

The third and final part of the course considers the write-up of the technical energy audits reports for the clients. The reports were delivered to the clients 50 days after the plant visits.

Program Evaluation

This program consists of two separate courses, Industrial Energy Management and International Industrial Energy Consulting. Both consider industrial energy audits to manufacturing facilities in Chile and Ecuador. The first is a set of three energy assessments performed in three countries: Chile, Ecuador, and the USA. They were presented as case studies to the class. The second one is an independent, elective, course in which the students are taken to Chile to make two energy audits themselves, accompanied by the course instructor, in an international consulting environment. In this section we offer a set of qualitative and

quantitative measures of the results expressed by the students themselves. The second one is some statistics coming from the teacher evaluation, as conducted every semester in every course at UF.

The IEM Module Evaluation

As the spring 2004 semester ended, and to have a better grasp of the students impressions on the impact that the International module presented had on them, a small survey was conducted. The class was composed of 62 students, out of which 56 responded to this non-mandatory and anonymous questionnaire. The results, shown in Table 2, clearly indicate that these programs are very much on the interest of the students.

QUESTION	YES	COMMENTS
1) Were useful/interesting as international cases ?	100	Yes, especially because they are real world examples.
2) Do you believe that these case studies will help you with your project ?	98	Yes, it gives us ideas on what to look for.
3) Where they useful so to provide a Global Perspective to the course ?	98	- Yes but what about Europe ? - It is important to learn about other countries. - Energy Affects us all
4) Did these examples and the one in the US help you to better understand the course ?	98	- Yes because it puts pictures to words - Gives us a good idea about how to do audits
5) Did these examples provide you insight on Energy Consulting abroad ?	96	- Makes me understand the subject more - Most definitely
6) Do you feel that you could go to other countries and perform energy audits with what you learned in class and the case studies shown ?	90	- I might need some extra help, but I think I have a good idea on how to do it - Yes but with guidance

TABLE 2.
Results of the survey regarding the International Module presented to students in the Industrial Energy Management class.

Table 3 below shows the teacher evaluation for the 2001 to 2004 spring terms. The values listed shows the evaluation reports for the UF-COE, the ISE Department, and finally for the Industrial Energy Management Section. For IEM, and for the years 2001 to 2003 the evaluation was always on the low side as compared to the rest of the ISE Department, and of course with the College. However, during the 2004 spring term when the module was introduced, the evaluation increased by an amazing average of 25%. All measured parameters moved up from an average of 3.59 to 4.5.

	Report for College			Report for Department			Report for Section		
Spring Term	**Instructor Evaluation**	**Instructor Overall**	**Course Overall**	**Instructor Evaluation**	**Instructor Overall**	**Course Overall**	**Instructor Evaluation**	**Instructor Overall**	**Course Overall**
2004	4.06	4.12	3.97	4.01	4.08	3.95	**4.56**	**4.73**	**4.52**
2003	3.98	4.01	3.90	3.97	3.99	3.92	3.59	3.55	3.26
2002	3.99	4.03	3.92	3.89	3.92	3.82	3.79	3.89	3.62
2001	4.01	4.06	3.95	3.81	3.85	3.79	3.56	3.53	3.50

TABLE 3.
Comparative results of the IEM course teacher evaluation. The incredible increase in the 2004 evaluation is shown.

It must be pointed out that, in addition to the module, additional changes were made during the semester in terms of presentation, examples, problem solving sessions, etc. Despite of this, there is no question on that the insertion of the modules played a tremendous dramatic role in the increase of the class evaluation. As described above, its impact is evident.

Conclusions

A program to internationalize the curriculum in the area of Industrial Energy Management in the College of Engineering at the University of Florida has been presented. The program, divided in mainly two parts, shows that the insertion of international case studies in the curriculum of an already existing course, and the addition of new courses is an excellent path to follow, as shown by the opinions expressed by the students themselves, and by the instructors evaluation as compared to previous years. The international program presented in this work appears to be an ambitious one considering that the students get exposed to work in the real world of international consulting. However, we believe that this kind of approach will certainly meet the needs of our future students, as it represents a challenge for students and instructors as well. While ambitious and demanding, not even to attempt to put this type of program at work it is, at the University of Florida College of Engineering, no longer an option. It is expected that in the near future other countries will be added to the program. Also, and

although no evaluation has been obtained yet from the students, the addition of the International Industrial Energy Consulting course has certainly benefited the students, open their minds and exposed them to the real engineering world of industrial energy consulting at the international level. As mentioned by themselves (unanimously) to the author, they would love to see more courses of this type offered in the UF-COE, and the IIEM course they took more than satisfied their expectations

Another goal of the program and its further expansion is to have students from the visited countries to come to the United States and replicate this study abroad program performing energy audits. The University of Florida College of Engineering will be their host, providing the necessary background information. The additional goal is to have some of these international students that will eventually participate in this program, become interested on coming to the University of Florida College of Engineering to pursue a graduate degree. Work in this direction is currently undergoing.

Finally, the project calls for a strength on the existent collaboration agreements between the University of Florida, Chilean and Ecuador Universities. Other countries will hopefully soon join the program

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