

Developing the Global Design Curriculum in Latin America and the Caribbean through Multi-National Projects

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Abstract

The establishment of new regional economic alliances beyond the frontiers of a single nation has required that engineers be prepared to work in an economy that is now best seen as essentially international in nature. Therefore, it is becoming very important for engineering students to be exposed to international opportunities as part of their education. Consequently, recognizing the necessity of offering students that knowledge and skills required in the global economy, it is suggested to develop a global design curriculum by means of multi-national projects in Latin America and the Caribbean through Latin American and Caribbean Consortium of Engineering Institutions, LACCEI. The model proposed consists of introducing international experiences in design courses and projects. Since two or more institutions are necessary to form the multi-national teams, LACCEI can serve as the connecting bridge between the institutions for this program. The design projects should be selected preferably with the support of the local industry in one of the countries; however, the idea is to develop a product with an international projection. The students should be selected from similar course levels in the different countries involved in the project. International teams will be integrated using the technology available through e-mail, discussion rooms in the web, or course management systems, and at least one week of personal interaction during the semester is proposed initially.

Keywords

Global design, international collaboration, multinational projects, design education

1. Introduction

The establishment of new regional economic alliances beyond the frontiers of a single nation has required that engineers be prepared to work in an economy that is now best seen as essentially international in nature. Almost all major corporations now operate globally, and engineers are being challenged to design and develop new products that will impact a global market. The globalization of the market implies that the engineers must be now prepared to face the new trend. Because of this, the academic programs should reflect the globalization effect exposing the students to international experience. Most major universities in North America, Europe and Asia, has international programs for different majors including engineering. Most of these programs are related to the exchange of students to expose them to an international cultural experience while they are still expected to make normal progress toward their degree. However, the number of students participating in this initiative is still very low in comparison with the whole university population.

In the particular case of engineering, it is important to establish a consistent and productive international experience in the curriculum. One of the most effective ways to incorporate the international experience in the engineering curriculum is through multinational global design projects as can be seen in Ion et al. (2004), Pollard et al. (2002), Devon et al. (1998) among others. There are challenges in building trust in such teams (Jarvenpaa, et al., 1999) and in getting performance (Prasad et al., 2002), but they are here to stay. Global design means having more diversity and creativity in design and the ability to reach new markets. Innovation is not new and has a considerable history (Fagerberg, 2004), but it is of growing significance. *Business Week* (Oct. 11, 04) has recently referred to the new innovation economy, but there are considerable variations globally in the “invention map” (*Technology Review*, 2004). Increasingly, educational institutions in North America, Europe, and Asia understand this new tendency and have introduced global design projects in their courses and have established agreements with institutions abroad to expose the students to multi-national design teams and product development. These courses are tailored not only to teach the basic concepts in design, innovation and creativity, but also to introduce the concept of global design, and expose the students to other cultures. The methods used for this purpose include the integration of global design teams in class and out of class; virtual (distributed cross-national teams) and real collaborations; share teaching resources using the web and other collaborative tools, faculty visits, workshops, and conferences.

However, it has been observed that while universities in developed countries are beginning to teach global design and forming alliances and consortiums to establish international design collaborations, most of the educational institutions in Latin America and the Caribbean are behind in this type of initiatives with far fewer international projects. Therefore, recognizing the necessity of offering students that knowledge and skills required in the global economy, it is suggested to develop a global design curriculum by means of multi-national projects in Latin America and the Caribbean through LACCEI. The model proposed consists of introducing international experiences in design courses and projects. Since two or more institutions are necessary to form the multi-national teams, LACCEI can serve as the connecting bridge between the institutions for this program. The design projects should be selected preferably with the support of the local industry in one of the countries; however, the idea is to develop a product with an international projection. The students should be selected from similar course levels in the different countries involved in the project. International teams will be integrated using the technology available through e-mail, discussion rooms in the web, or course management systems, and at least one week of personal interaction during the semester is proposed initially. While there are some useful collaborative tools that are free such as MSN Messenger 6.2 (AV and chat), Skype(VOIP), and Alibre Design (CAD), significant funds are needed to support real student travel and faculty time. This initiative should be supported by the institutions, the private industry, governmental agencies and international organizations.

2. Rationale for the Global Design Curriculum

As mentioned before, the world is changing rapidly. Regional economic alliances and major corporations working in a global market and dispersing their operations around the world are changing the role of the professionals. Human and social capital are increasingly seen as a critically important resource of organizations and when those organizations are global, as most are, the most desirable features of the human capital changes accordingly. The profile for the new engineer includes knowledge of different languages, cultures, resources, markets, and how to manage social diversity. Additionally, some regions are losing their own identity and the products are now designed for wider and more diverse customers as compare to years ago when markets were more localized and the products impacted a population with similar backgrounds. Furthermore, the use of new technology in communications, in particular the Internet, is facilitating the formation of distributed design teams over the world as mentioned by Ion et al. (2004). Therefore, the academic programs have to adjust the curriculum to respond to those changes the students are facing. Global design collaboration is an excellent opportunity to allow the students and faculty to work with multinational teams and different cultures in the solution of worldwide engineering

problems. This international experience can be easily incorporated in the traditional engineering curriculum.

Design in engineering can be defined as the process of generating, analyzing and synthesizing ideas for the solution of problems for the benefit of the human community. Then, designers face several implicit constraints in the design process since they have to deal with different aspects impacting the solution and the community such as: cultural issues, politics, standards, environment, aesthetics, and so on. This is the traditional designer working for a particular community. But the globalization has forced the products to reach and impact different communities in different ways. It may involve, for example, designing a product in North America, manufacturing it in Asia, and selling it in Europe. Even services, such as telecommunications, cross national boundaries with ease. Now, designers deal with a broader community in developing and servicing consumer products. Therefore, global design is playing an important role in the design process. But, what is global design? Global design means to use the new technology in computers and communications to form teams distributed in different locations in order to design products for a global market. Using teams distributed in different locations over the world implies that the design team is representing a broader and diverse community and, therefore, making more significant, creative and widely accepted contributions to the final product. Global design also implies a commitment to create safe consumer products to benefit the international community, protecting the global environment, supporting cultural diversity, and respecting international agreements and standards.

It is evident that if the world is changing the academic programs should change also to reflect the new tendencies the future engineers are going to be facing. Most of the engineering programs have a design course or a capstone project requirement in the curriculum. Those courses or projects can be found at different levels depending on the institutions and the program itself. It is there where the global design experience should be introduced to start preparing the future engineers to work in the global market. The international design collaborations have different type of structures that will be discussed later as well as how to incorporate them in the courses. What is significant at this point is to reinforce the importance of the international experience in the curriculum. Many universities around the world have already established successful programs to expose the students to the international experience. The new instructional technologies have the potential to be used to internationalize the curriculum in innovative ways even without leaving the home institution can save money and traveling time.

The educational part of this initiative is probably one of the major challenges. International collaboration means students might be dealing with a number of concepts that should be properly addressed in the classroom such as design process, standards, basic technological issues, and communications. However, the global design and the international collaboration becomes a self-learning experience by nature. Creativity and innovation cannot be taught: different concepts and systematic methods can be provided by the instructor in the classroom but students decide how to proceed to generate, analyze and synthesize the ideas for the solution of the problem; cultural differences can be addressed but they have to be discovered by the students; communication problems might be anticipated but they have to be solved by the students. Students will decide also at which extent they will discuss a specific idea. Therefore, the teaching model has to be changed since the whole experience becomes more a coaching rather than a teaching experience as recognized by Ion et al. (2004). Becoming a coach implies to guide the student and to provide them the necessary information they might need, the technological tools they might need and set a feasible chronogram for the project but allow them to develop their maximum creativity potential.

3. Developing International Collaboration

There are some fundamental developmental steps for international collaborations that should be followed. The model presented here is similar to that successfully used by Penn State and The Universite d'Artois at Bethune up to stage four as reported in Hager (1998):

1. Identify a partner institution:
 - Identify institution interested in international collaboration.
 - Identify faculty interested in international design collaboration.
 - Check compatibility of academic schedule.
2. Familiarization with institution:
 - Exchange administrators, faculty and key individuals associated with the anticipated development of the international program.
 - Become familiar with partner institutions: goals and mission, facilities, level of commitment to the international partnership.
 - Friendship established.
3. Identification of common interests:
 - In-depth exchanges with specific focus on instruction and/or research activities.
 - Identify common interests.
 - Additional familiarization activities might take place.
4. Development of cooperative projects and activities:
 - Previous identified projects and activities are conducted and evaluated.
 - Additional activities might be identified as a result, or, conversely, activities might be modified or cancelled.
 - Instruction of common courses.
 - Instruction or exchange of selected courses, modules of courses, or common classroom sessions, seminars, workshops.
5. Institutionalization:
 - Successful projects and activities are institutionalized within the home institution.
 - Final goal is sustainability of these projects and activities.
 - Cooperative or common degree programs.
 - Development of common curricula and degree programs. In the most developed state this result in a common or dual degree for the participating institutions.

Stages one through three are related to the establishment of a relationship between the institutions and the faculty at those institutions. It is important to use these stages to know very well the partner institutions and faculty. The Latin America and Caribbean Consortium of Engineering Institutions (LACCEI) should serve as a connecting bridge between all the institutions members and interested in international collaboration. Preliminary talks might occur during the LACCEI meetings or using the e-mail list to start the initial contact.

After a relationship has been established between two or more institutions, the next step is to develop the cooperative project. There are different methods of structuring international projects and the complexity and resources required to carry on them vary from simple and minimum cost to more complex and expensive. The different types of projects have been described by Jenkinson et al. (2000) as follows:

1. Case studies:
 - The single reporting of the final result of a design project to their opposite group.
 - This would be a one-time, in-class experience
2. Show and tell:
 - Work in separate projects in the different countries and come together to progressively explain to the other teams how the work is developing.
 - This would be a short-term, in-class experience.

3. Parallel teams:
 - The student teams in each country work independently on the same design proposal.
 - Students are encouraged to share data and ideas.
 - This would be short, multi-teamed projects running as part of a regular module.
4. Integrated teams:
 - Students in each country work together on a joint design project.
 - These would be long long-term, out-of-class professional projects.
 - Usually involve a single team with high levels of staff and students commitment.
 - This could be single or multi-disciplinary.

The type of project selected should be of interest for all the institutions involved, and should be selected according to the technical facilities and resources available for the projects.

Even though many authors have recognized the benefits of international collaborations, they have also mentioned a set of possible difficulties that might appear implementing this initiative (see Ion et al. (2004), Marchman (2002) and Devon (1998) among others). Learning from previous experiences reported in the literature will make the whole process easier to carry out.

4. Collaborative Design Projects

The model that is being proposed here for international collaboration among engineering institutions consists of incorporating collaborative design projects in the curriculum. As explained before, there exist different methods to structure the collaborative design projects. The idea is to use different types of projects at different courses in different levels. With this model it is ensured that the students are exposed more than once to the international experience and they will go from simple case studies to more demanding integrated teams progressively. Case studies and show and tell projects should be introduced in freshman engineering design course. Students will start becoming familiar with the technology required for communication and they will have the first opportunity for and international experience. Parallel projects can be used later in other courses. For instance, a course named Global Design can be introduced in the curriculum to continue the international program. This could be a freshman or sophomore course with more emphasis in diversity and more interaction between the multinational teams. This type of project can be also used in existing engineering design courses, honor courses or as independent studies for those students more interested in the international projects. Finally, the integrated teams' projects can be used for more advance courses in design or for the senior design project. The completion of the whole sequence, combined probably with some courses in international economy or global diversity might become a minor in any engineering program. Table 1 shows different types of projects and courses at different levels where they can be incorporated.

Table 1: Types of projects and courses were they can be incorporated

| TYPE OF PROJECTS | LEVEL | | | |
|------------------|---------------------|-------------------------|---|--|
| | FRESHMAN | SOPHOMORE | JUNIOR | SENIOR |
| Case Studies | Int. to Eng. Design | Int. Global Eng. Design | | |
| Show and Tell | Int. to Eng. Design | Int. Global Eng. Design | | |
| Parallel Teams | Int. to Eng. Design | Int. Global Eng. Design | Int. Global Eng. Design Innovative Eng. Design Ind. Studies | Ind. Studies Innovative Eng. Design Senior Project |
| Integrated Teams | | | Int. Global Eng. Design Innovative Eng. Design Ind. Studies | Ind. Studies Innovative Eng. Design Senior Project |

Besides the model adapted, another important aspect of this international collaboration is the selection of the project. Since the model proposed here is for Latin America and the Caribbean, it is recommended to select projects which will have a direct impact in the community but understanding that the diverse team will contribute for the final product to have an international impact or a potential for broader markets. It is important to emphasize to the students that the completion of the project is not a personal solution that only interest them but a solution to some specific problems affecting a larger and diverse community.

The students participating in this initiative should be in the same academic level. At this point, it is important to understand the difference between the US and the Latin America engineering programs. The US differs from the Latin America and the Caribbean in regard to the length of a bachelor degree program. Whereas the US requires four years of study, Latin America and the Caribbean require five years. This might cause difficulties for multi year projects between the US and Latin America students but it is not a problem for collaboration among institutions with the same length of programs, or for one time projects. However, the difference between the US and Latin America can be easily solved just by handling the student progress properly at both sides. It is recommended to initiate this program by keeping at least one team on each institution working together through the different types of projects to evaluate the progress of the group during this collaboration. This final remark might be difficult to attain since student might change majors or drop the international program but it will be worth it to try it.

The resources required for this initiative are basically for communication. Therefore, initially, a computer with a microphone, speakers and a web camera with access to internet is required for each team at each location. Most of the software that can be used for audio-video conference can be downloaded free from the internet. It will be necessary also to have a webpage administrated by one of the participating institutions. For more advance collaboration a CAD package such as ALIBRE can be used to handle the documentation of the design models. In terms of technological resources is important that all the participating institutions has similar capabilities. It also important that the students are properly trained to use the communication tools and additional software required. This initiative should also receive monetary funds to accomplish some of the initial personal contacts between the faculty and administrators and also to support the exchange of students for more advance collaboration.

5. Conclusion: Developing the Global Design Curriculum

Global design projects can be easily incorporated in the engineering curriculum at any institution. These international projects are not only an important tool to teach engineering design but they are also an excellent opportunity to educate the future engineers for the global market. It is important to have support from the institutions, the governmental agencies and the private industry for this initiative. Although, initially the cost is not significant to establish the relationship between the institutions and to start the simplest projects, down the road the cost might increase for exchanging of students and building prototypes when more ambitious projects will be considered. The academic institutions, the government and the private industry must recognize the importance of preparing the future engineers for the global market. Free trades agreements are being discussed and it is imperative to prepare our community for the future: better professionals, for a more competitive industry, for new markets over the world.

The level of compromise among the institutions depends on the particular interest of each one. It is ideally recommended to reach the maximum level of collaboration and attain the level of dual degree programs that has been mentioned in several meetings of LACCEI. Finally, it is important to recognize the students contributing to this initiative; therefore, it is recommended to establish a session in the annual conference of LACCEI were students participating in international projects can present their work, and interchange ideas with students from other countries. The teams will be judged by a panel determined by the organizing committee of the conference and the best group in international collaboration will be recognized with an award from LACCEI.

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