
AC 2012-3364: DEVELOPING INTERNATIONAL EDUCATION OPPORTUNITIES FOR U.S. MANUFACTURING TECHNICIAN STUDENTS

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Developing International Education Opportunities for Students in 2-Year Manufacturing Technician Degree Programs

Prelude

Although study abroad programs are common within the 4-year bachelor degree programs in the United States, such program opportunities are not often available to students enrolled in 2-year Associate of Science (A.S.) degree programs. Two National Science Foundation (NSF) Advanced Technological Education (ATE) Regional Centers of Excellence, the Regional Center for Next Generation Manufacturing, RCNGM, and the Florida Advanced Technological Education Center, FLATE, are participating in an NSF Office of International Science and Engineering demonstration project to ascertain the merit of such an overseas study opportunity for A.S. degree students. This paper summarizes the construction of two programs, one in Spain and the other in Germany, with a focus on the lessons learned and faculty identified differences between in the United States community college technical education system and its counterpart in these two European countries. The paper outlines the curriculum development rationale and its resultant course of study the A. S. degree seeking students will experience during their time in these two countries in 2012. Finally, the recruitment strategies to attract both traditional and non-traditional students into this program will be discussed. It is anticipated that these demonstration project international interactions and exchanges with institutions in the manufacturing regions of Spain and Germany will be the basis for the creation of long term student and faculty interchange partnerships as well as institutional international collaborations to enhance technical education for these targeted technology education sectors.

Background

Traditionally, there have been a number of federal and state government supported programs for bachelor degree seeking college students to travel and study abroad. Similar programs have also been available for high school students but in a number of different formats as dictated by the need to adjust to the additional oversight required for high school students. There have been few, if any, organized programs for study abroad for students enrolled in 2-year technical degree programs. The initiative to alter this situation culminated with proposals submitted to the National Science Foundation (NSF) Office of International Science and Engineering (OISE). The aim of these proposals is to begin to construct a United States based cadre of future technicians with a global perspective of the technician expectations in the industry that they are currently preparing to be employed in. The objective is to have available to American manufacturers a select set of technicians who add specific additional value to their employment function within company environments and facilities that are driven by multiple nation operations and customer base. Two of the eight pilot projects awarded to NSF Advanced Technological Education (ATE) Centers to construct a high quality international educational experience for technology students in community colleges are presented.

This study abroad demonstration partnership between NSF-ATE and NSF-OISE is designed to take effective advantage of NSF-ATE Regional Centers of Excellence pre-existing strong long term collaborations with the community colleges, faculty, and industries they serve. Like other

NSF-ATE centers, RCNGM and FLATE have embedded strong communities of practice that strengthen the common commitment and involvement of faculty and students in similar programs and simplify the tasks involved in this demonstration effort. In this case, the project tasks at hand involved a new experience for both A.S. degree program faculty and students in a study abroad program that provides no previous history as a guide. Thus, FLATE and RCNGM conceived a 3 phase plan for their individual demonstration projects with the first 2 phases aligned with 2 trips to the corresponding European partner countries.

The first trip is an exploratory sortie for faculty of involved community colleges. Community College technical faculty members have no experience with or even knowledge of the structure of the technical education system(s) in Europe. This minimal knowledge base may include the facts that the American models for 2-year degree and post secondary adult vocational training do not exist in Europe. Thus, the first phase of the project is to put the American faculty in direct contact with their European counterparts in the same academic and training environments the traveling students will experience. The project's second phase is connected to the actual student study abroad experience (the second trip) and capitalizes on the first phase faculty first trip experience. In both the RCNGM and FLATE situations, the program of study for these students was collectively designed by the first trip faculty participants and the faculty at the host institution(s) in Europe. This design includes student training within small cohort groups of both American and European students and additional language studies for both groups.

The third phase is the integration of the cumulative experience of the faculty and students involved in the project. Objectives for this phase include assessment of the skill level improvements of participating students, identification of skill set instruction gaps and a formal delimiting of the similarities and differences between the American and European education practices with respect to the skill training and skill expectations presented. Phase 3 activities will also include a final debriefing of representatives from the projects of the two ATE centers to develop a strategy to strengthen the study abroad experience and expand its support base to include manufacturing companies that would employ these future technicians.

Project Status

Both FLATE and RCNGM are at the same point in their individual demonstrations of this study abroad project. Phase 1 has been completed. The results and lessons learned from the respective faculty trips are provided below.

COT-RCNGM Project in Germany

Building a skilled workforce is essential for Connecticut businesses to compete in the 21st century workplace. The CT College of Technology (COT) is a statewide collaboration that is ensuring that Connecticut's companies have access to a highly skilled workforce. In 2004, the COT received a National Science Foundation Advanced Technological Education grant to establish a Center for Next Generation Manufacturing (RCNGM). The COT and its RCNGM have implemented many innovations and assets include critical articulation agreements between secondary and postsecondary institutions as well as public and independent colleges and universities, career pathways and student recruitment tools, as well as the development of new academic programs responsive to employers needs.

Through strategic articulation agreements, the COT-RCNGM saves college students time and money by enabling its programs to be implemented system-wide. For example, when the Board of Governors for the Department of Higher Education approves a new curriculum as part of COT offerings, any one of the 12 community colleges can implement it without having to go through a lengthy time and resource-consuming process. In addition, the programs are simultaneously articulated to both state and independent college and university partners ensuring that when students transfer they do not lose credit.

The COT-RCNGM articulation agreements also act as a college recruitment tool by easily and cost-effectively moving technical high school students through a 2 + 2 + 2 pathway. High school students can receive college credit for high school pathway courses. Students can also enroll in college courses while still in high school, saving both them and their family time and money.

The COT-RCNGM model not only moves students from one education level to another in a cost-effective manner for both students and colleges, it also provides industry with the well-prepared workforce it requires to remain competitive in a global economy. The COT-RCNGM in collaboration with the CT Business and Industry's Association (CBIA) and its industry partners have worked closely together to align the college curriculum with the skills that are needed in industry. A notable result of this collaboration comes from Asnuntuck Community College's Manufacturing Technology program. Ninety-five percent of its 2011 graduates, both certificate and associate degree students, were placed in jobs prior to graduation day. As a result of the strong collaboration between COT-RCNGM, business associations such as CBIA and industry and government partners, the companies that hire these students often commit to continue funding their education from certificate to associate degree to bachelor's degree and beyond.

Where the CT international initiative has the ability to provide best practices for the successful administration of a state-wide, decentralized academic program of study, Germany's DHBW has a wealth of best practices on how to engage industry in the education of the workforce it needs for the 21st Century. Baden-Wuerttemberg Cooperative State University (DHBW) enrolls over 26,000 students at one of 8 locations and four satellite sites. The DHBW is one of the largest universities in Germany with its headquarters in Stuttgart. The DHBW was established as a University in March 2009 and was an outgrowth of Baden-Wuerttemberg's Cooperative Education programs and is the first university in Germany to integrate academic skills with practical work experience. It has a unique organizational decentralized structure that is based on the state university system of the United States. However, unique to the DHBW is the requirement for all students to have a signed contract with an industry partner that provides them with work experiences throughout their 3 year program of study that culminates in a Bachelor's degree. The outcome of this collaboration will provide best practices benefiting both the community college in America as well as the newly formed German Cooperative State University.

First Phase

For the first phase of the Connecticut international program, a delegation of five representatives visited Germany in December of 2011. The objectives of the visit were (1) visit two of the DHBW sites that had committed in our proposal to partner with the CT College of Technology; (2) participate in a week-long international program that was organized by the DHBW at Mannheim; (3) learn about the German education system including the pipeline from middle

school, secondary school and higher education; (4) visit industry partners and (5) finalize the program for the CT students who will be participating in the exchange program in 2012.

Lessons Learned

Initially, there have already been lessons learned from the planning and preliminary implementation of the COT-RCNGM international study program. First both the CT College of Technology and the German Duale Hochschule (Dual Study-Double Success) programs share commonalities including being decentralized, state wide programs of study. For CT, the original objective was to learn from the German system and ultimately provide our students with a global, international educational experience. However, after our preliminary visit, we were excited to learn that the leadership of the newly formed Cooperative University wanted to learn from us as to how we managed a statewide collaboration and what they could possibly glean from our experiences. Next we also learned that both DHBW and the COT-RCNGM were established to provide the next generation of students who would be prepared for the workforce. For CT, the partnerships with industry in Germany provided models that the COT-RCNGM plans to share with its industry partners and glean some of the best practices for these partnerships that can be implemented at our institutions. For the DHBW, students must have a signed contract with an industry sponsor before they are admitted to the University. The program has a three-month class/three month industry format where at the completion of their bachelor's degree, the students are well prepared to enter the workforce; often obtaining employment at the company that sponsored them through their college program.

Finally, the visits to industry provided the CT delegation with an insiders view regarding how the German companies operate and also their involvement in the education of their workforce. At many of the companies, apprenticeship programs were in operation and often involved high school students who gained first hand experience in a company. In addition, several of the companies were very engaged in providing outreach activities to students, beginning with elementary schools. The German programs provided the students with the opportunity to participate in after school activities held at the company and in some cases, the programs were week-long camps held during school breaks or during the summer. In as much as CT provides outreach activities to engage students in STEM related projects, it is usually educational organizations and grant funded initiatives like the RCNGM that administers the programs. It was very surprising to observe first hand that for some of the companies, there actually was a position in the company for an individual to administer these outreach activities and that the program was also held at the industrial site.

The visit to Germany also provided the COT-RCNGM and its representatives with the ability to strengthen the relationships that were established for the international program through the internet and social media. However, in as much as the internet provided a platform for the initial discussions of the CT-Germany partnership, it was essential that we met in person with the key individuals to solidify our partnerships and flesh out how our collaboration and the student program was going to be implemented.

Student Recruitment Strategies

Recruitment for the three and half week student international study program, scheduled for early summer of 2012, is in progress. The College of Technology has created a brochure and will use its Site Coordinators Council to assist with the identification of students for the program. Students who have been selected for participation in the program will enroll in a special topics course where they will receive three college credits towards their A.S degree. Students will also participate in late spring in a series of lunch and learn seminars where they will be introduced to the German culture as well as learn conversational German. It is also planned to have webinars with our German partners and their students, so that we can begin the exchange and establish relationships before the actual program begins in Germany.

Students who apply for the international program need to be enrolled in the College of Technology and one of its A.S. degree programs. Student applicants should have completed at least 30 credits towards their program of study and must have a letter of recommendation from the faculty advisor at their community college. Students also will be required to write a short essay on what they hope to learn from the experience and how the German program will assist them in their career path. A selection committee will be established to choose the final candidates for participation in the international program.

FLATE's Project in Spain

The Basque region is a small bilingual (Spanish and Basque) region in the north west part of Spain that is the home for 60% of Spain's production of computer controlled tools and large scale manufacturing equipment. Independent of what ranking survey examined, Spain is one of the world's top 10 producers of such equipment and always listed just two or three notches below the United States in such national rankings. Thus, the demonstrated successful manufacturing and technical education practices of a geographic region considerably smaller than the bilingual (English and Spanish) state of Florida are of particular interest to FLATE.

FLATE's state wide college and industry service area includes 12 colleges supporting the A.S. Engineering Technology degree and 14,000 high tech manufacturers. These manufacturers contribute 36 billion dollars to the state's gross domestic product and are the major contributor to the state's significant international exportation activities. To support this global element of Florida's economy, Florida's technology education structure needs to include an international focus to effectively service this growing component of Florida manufacturing. One of these companies, Harris Corporation, already recognizes the importance of a technical workforce that can perform in such an environment and is an industry participant in this project. The first phase of FLATE's pilot project took full advantage of this direct input from an American manufacture.

TKNIKA, an innovation institute for technical education established by the Vice Ministry of Education of the Basque region in Spain, has a mission analogous to FLATE's with a significant difference. TKNIKA is a physical educational entity of the Basque region education system with its own campus that is responsible for the professional development of the faculty in the technical colleges within the Basque region that produce the technicians needed to support its manufacturing sector. Neither FLATE nor TKNIKA provide direct instruction to students but unlike FLATE, TKNIKA's role includes direct partnerships with the manufacturers in the region

to assure that the faculty will be prepared to provide student instruction related to next generation equipment to be used in or manufactured by these partners. FLATE's funding and NSF-ATE structured mission includes the targeted professional development of faculty in the Florida Community and State College system but not the creation of an actual campus with the sole responsibility of delivering extended skill training on state-of-the-art equipment to these faculty.

The TKNIKA model does not exist in any Community or State College system in the United States. Therefore as FLATE becomes more involved with TKNIKA, its expectations of gleaming new instructional methods that can be imported into Florida continue to rise. This current study abroad pilot project is envisioned to be the first step in the formation of an Iberian Partnership for a Technician Excellence alliance mutually managed by TKNIKA and FLATE with the express mission of strengthen student and faculty exchange among TKNIKA's technical institution partners and FLATE's academic partners in the Tampa Bay region of Florida; Hillsborough Community College, St Petersburg College, the State College of Florida and the University of South Florida. The goal of this partnership is to expand the technical education interactions between Spain and Florida to develop and share best practices that included technical program guidance, curriculum content creation and technical college faculty professional development.

First Phase

During phase one, or the exploratory phase, of FLATE's study abroad project an eight member Delegation composed of industry (Harris Corporation), educators, and/or program directors from Florida's community college (Hillsborough Community College and Brevard Community College), State College (the State College of Florida), and University (the University of South Florida) systems embarked on a week-long working visit at TKNIKA in July 2011. Prior to this visit, a three component strategy was developed by FLATE and TKNIKA with TKNIKA coordinating the visit's itinerary with its corresponding activities to assure a successful execution of that strategy. Succinctly stated, the approach was to initially consult with key manufacturers in the Basque region and then interact directly with college candidates for the student portion of the project. The final step was to then work directly with TKNIKA to create the course of study at the selected college that best matched the industry and institution resources available with the Delegation's expectations for the student experience. Manufacturers that provided extensive detailed facility visits and direct on site access to engineering and technician personnel included the MCC-Mondragon Cooperative Corporation, the ALECOP cooperative, and SMC International. The Usurbil College-GLBHI in Usurbil and the IMH College in Elgoibar provided equivalent intensive access to their laboratories and faculty.

Lessons Learned

In addition to the Delegation's complete emersion into: the metric system at the commercial and professional level (an impossible experience within the United States); a completely different but equally effective working schedule (again an impossible experience in the United States); the unique and absolutely delicious Basque diet, (an extremely limited experience in the US), other contrasts as well as two important similarities were identified. The first and most encouraging similarity recognized by all Delegation members was the fact that TKNIKA and FLATE have

identical missions. Both Centers work with the "local" industry to advance the skills-set of incumbent and/or future technicians. Both Centers have an extensive high technology based manufacturing sector that these education skill development tasks are directed to and both Centers must now address the fact that their industry service base is deeply involved in international manufacturing and needs at least a fraction of their technician workforce to be able to deal with manufacturing in a more global environment. The significance of this similarity recognition was a Delegation shift from a project might work skepticism to project will work attitude. A shift that immediately increased the effective and efficient use of the limited time verses extensive expectations associated with the visit.

The second similarity recognized by the Delegation is the fact that both Florida and the Basque region have a significant OEM manufacturing infrastructure with increased equipment automation requirements. This reality is coupled with the fact that such operations demand a corresponding upgraded technical workforce to support this modernization. This recognition of common ground and mutual need lead to the Delegation unanimous agreement that the student abroad project will:

- lead to a better understanding of vocational and educational program structures in the Basque region that can translate into a significant improvement in Florida's approach to high skill content technical education,
- generate significant opportunity for faculty to work together amongst themselves as well as with European institutions to develop curriculum that will strengthen both the Basque region and Florida's technician education programs,
- expand (at an international level) an existing international network of vocational training colleges, technology centers and European associations to facilitate the ability of all NSF-ATE Centers to share tools and knowledge about the latest field of innovation and technology.

The most significant contrast between the Basque region technical education and its counterpart in Florida is imbedded in the 20th century political history of the region. The region's isolating mountainous geography merged with Spain's post world war II economic recovery policy lead the Basque region to develop its own economic strategy that was a distinctive blend of capitalistic and socialistic practices. Today the results of that approach are clearly identified in the Mondragon Cooperative. This registered and internationally recognized corporation serves as an umbrella organization for smaller companies that offer specialized services ranging from consumer goods production through transportation and construction to engineering manufacturing and teaching services. The Mondragón Cooperative Corporation (MCC) focuses its organizations on cooperation, empowerment, innovation, and social responsibility. Its cooperatives are renowned worldwide for their business management and sense of social responsibility with emphasis in innovation, promotion and internationalization. This MCC model was used to develop the economy in the Basque region and continues to help the region survive current economic crisis.

As might be expected, the Basque region approach to supporting its focused manufacturing sector is mirrored in Basque region's educational system. A mirrored model would not be practical in Florida but a model that does have components of value to Florida's technical education system. One specific example is the easy interaction among companies and colleges

that includes popular successful region wide multiple company participation "learn and earn" policy. Thus, the Delegation recognized this as a major contrast but also acknowledged the possibility that the study abroad project might open a new awareness of how the elements of a cooperative system could enrich Florida's manufacturer's contribution to the economical, educational, and social support to their host communities.

Student Recruitment Strategies

Recruitment for the three week student training program, scheduled for May 2012, is currently underway. Florida Engineering Technology students heading to Spain will enroll in a three credit hour "special topics" course for the summer semester at Hillsborough Community College (HCC) that will apply to their degree at which ever college they are currently enrolled in. Working directly with faculty and instructors, students will be trained at IEFPS Usurbil GLBH Institute for approximately six hours a day. Students will be trained in alternative energy (solar photovoltaic, solar thermal, biomass energy and hydraulic energy power systems) and control of automated energy systems. Students will also have 4-5 hours of Spanish language training every week and tour 3 regional industries as part of the course. Students will be required to do a course project that will be presented to an audience of local industry representatives and educators. The presentations will be repeated back in Florida during the summer of 2012 to Engineering Technology educators and professionals.

To qualify and participate in the structured technical education and training experience at a IEFPS Usurbil GLBH, students need to be enrolled in the engineering technology (E.T.) A.S. degree program in any of the ten state or community colleges in Florida. Student applicants are expected to be in the second year of their degree program preferably having completed at least 23 credits of technical courses (not including general education) before the trip. Applicants are also required to have an average GPA of 3.0 or higher, have the endorsement from an E.T. degree faculty, complete the training application form, and provide a 500 word summary of their intention to participate in the project. At the conclusion of the trip, the entire delegation to Spain will contribute content and skills assessment for developing tangible tools and solutions to improve ET-related curriculum and instruction materials within the Florida educational system.

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