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ERDC/UPRM Partnership: A Model for Educational and Research Initiatives

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Abstract

Alternative learning has become one of the most important resources for the achievement of the educational objectives in modern engineering educational systems. The University of Puerto Rico at Mayagüez Campus (UPRM) and the US Army Engineer Research and Development Center (ERDC) have developed a unique learning model through an Education and Research Partnership Agreement (ERPA). Since 1991, about 200 students from UPRM have participated in the ERDC Summer Research Internship Program. Employment of summer students from this top minority institution by ERDC has contributed to their education by providing them with valuable research experience within their chosen technical fields. Moreover, exposure of these students to the ERDC has enhanced the reputation and visibility of ERDC within a talented minority group that is underrepresented in the Federal workforce. The program has contributed greatly to increasing Hispanic representation in the ERDC professional workforce. It is also a pathway, promoting research and technology transfer in engineering and science. The success of this partnership can be used as a model for similar programs between other universities, government agencies, and/or industries.

Keywords

Education and Research Partnership Agreement; Historically Black Colleges and Universities/Minority Institutions; Summer Research Internship Program; Engineering Research.

1. **Introduction**

In 1991, the US Army Corps of Engineers' Engineer Research and Development Center (ERDC) entered into a verbal agreement with the University of Puerto Rico at Mayagüez (UPRM). In 1999, the agreement was officially written as an Education and Research Partnership Agreement (ERPA), which allowed the pursuit of both educational and research opportunities between the ERDC and the UPRM (Figure 1). The purpose of the agreement was to formalize a relationship between these two institutions, to help them both achieve mutually beneficial goals. This agreement establishes the basis for mutual understanding as partners in both education and research (Office of Counsel, 1999). This relationship recognizes the importance of engineering education to the future political and economic well-being of the Nation, as well as the importance of the UPRM to the business, industrial, and governmental institutions in this region.

For the ERDC, the ERPA allows the recruitment of UPRM students for summer employment, as well as permanent employment, helping the ERDC achieve its strategic goal of recruiting a high-quality, diverse workforce from a prestigious engineering university. Exposure of these students to the ERDC has enhanced its reputation and visibility within a talented minority group that is underrepresented in the Federal workforce. The program has made a major contribution to increasing Hispanic representation in the ERDC professional workforce. It is also a pathway, promoting research and technology transfer in engineering and science for UPRM students. The agreement also allows the ERDC to collaborate on research with UPRM, which helps achieve another strategic goal of partnering with Historically Black Colleges and Universities/Minority Institutions (HBCU/MI's) in an effort to enhance their research capability. Finally, the agreement allows ERDC to hire UPRM faculty to participate in ERDC research, and allows ERDC research personnel to serve as adjunct faculty members and advisors at UPRM, teaching courses, serving on graduate school committees, and participating in external advisory boards.

For UPRM, the ERPA provides an avenue for students to enjoy a valuable research experience within their chosen technical fields at a prestigious engineering research facility. The UPRM also benefits from the ability to collaborate on mutually beneficial research opportunities, and to gain adjunct faculty members to teach specialized courses to their students. The ERPA has also created an excellent alternative learning experience for UPRM students. Alternative learning has become one of the most important resources for the achievement of the educational objectives in modern engineering educational systems.

The ERDC and the UPRM have both benefited greatly from the relationship. This paper will outline how some of those benefits have been manifested at ERDC and UPRM.

2. Background

The relationship between ERDC and UPRM actually began several years before the ERPA was established in 1999. In 1986, Dr. Robert Whalin, former Director, Waterways Experiment Station (WES – a precursor to ERDC); former WES Commander, Colonel Allen F. Grum; and former WES researcher, Major Hiram González, initiated an effort to hire minorities and start a partnership program with UPRM. This initiative started with the Civil Engineering Department under the direction of Dr. Felipe Luyanda (Santoni, unpublished). Under the direction of Dr. Robert Whalin and Dr. Carlos Ruiz, researcher and Program Liaison at ERDC and Prof. Ismael Pagán-Trinidad, Program Coordinator at UPRM, a more formal educational partnership was developed, and the initiative was not only expanded to several other disciplines at UPRM but also various research initiatives were developed beginning in 1994. This development is contained in the aforementioned ERPA, better known as the 1999 Memorandum of Understanding (MOU), developed under the leadership of Dr. Bill Marcuson, former Director of the Geotechnical Laboratory at WES and Program Coordinator at ERDC. This partnership has been governed by this MOU ever since.

Research experience was offered to UPRM students through a Summer Research Internship Program. Ten civil engineering students were hired for a Summer Research Internship under the initial agreement in 1991. By 2006, almost 200 students from UPRM had participated in the ERDC Summer Research Internship Program. In addition, 22 UPRM engineers and scientists have been employed in full-time permanent positions at ERDC. Team building and collaborative research and development in areas of mutual interest have been promoted between the two institutions, and faculty internships have been offered through a Summer Faculty Program.

Key Components of UPRM/ERDC Education and Research Partnership Agreement
(with examples)

- **Student's Summer Research Internship Program**
  Established in 1991; Ten- week summer program
  - *About 200 students hired since 1991*
  - *Typically ten to twenty students participate per year*

- **Employment Opportunities at ERDC Facilities**
  22 students hired for full-time employment
  - *Student contracts while at UPRM (4)*
  - *ERDC sponsored graduate degrees (MS-6, Long Term Training-5, PhD-1)*

- **Summer Faculty Program**
  UPRM faculty hired to work at ERDC for short-term assignment
  - *Four UPRM faculty members*
  - *Five summer internships at ERDC*

- **Research and Development Projects in Areas of Mutual Interest**
  - *Hydraulics/Hydrology modeling (Goodwin Creek, Texas; Yalobusha, Mississippi)*
  - *San Juan Bay and Mayagüez Bay hydrodynamic modeling, Puerto Rico*
  - *Environmental odor control – McCook Reservoir, Illinois*
  - *Sand liquefaction*
  - *Reinforced resin material*
  - *Explosive detection and ground water modeling*
  - *Geomorphology and Sediment Transport- Puerto Rico, Mississippi, Hawaii*

- **Visiting Faculty for Short Courses and Sabbaticals**
  - *ERDC faculty visits to UPRM (15)*
  - *Sabbaticals (1 semester, PhD Environmental Engineering)*
  - *Adjunct professors (3)*
  - *Short-term formal courses [UPRM curriculum (3)]*
  - *Continuing education courses [workshops (3), seminars (3)]*

- **Team Building Visits Between the Two Institutions**
  - *Research visits for young and senior faculty (7)*
  - *Development of joint proposals and projects*
    - *One NSF proposal*
    - *Earthquake resistant design (dams, bridges)*

- **Advisory Boards**
  - *ERDC liaison membership on UPRM External Advisory Board*
  - *ERDC participation on graduate student committees*

Figure 1. Key Features of ERDC/UPRM Education and Research Partnership Agreement

The ERPA was pursued by ERDC and UPRM to create a vehicle by which two research organizations with a long history of engineering research could assist each other. The ERDC is the US Army Corps of Engineers' research and development organization, headquartered in Vicksburg, Mississippi. Founded in 1929 to tackle the challenges presented by the Great 1927 Flood in the lower Mississippi River Valley, the ERDC (then WES) now consists of over 2,000 engineers, scientists, technicians and administrative staff, working in seven laboratories located in four states. The ERDC's mission is to help solve some of the Nation's and the warfighter's toughest challenges in civil, environmental, military, and geospatial engineering. The UPRM is one of the premier engineering and science institutions in the Caribbean. It is the second largest campus in the University of Puerto Rico system, with over 12,000 students enrolled in engineering, sciences, business, and agriculture. In the past few years, the majority of engineering graduates from UPRM have been women, a remarkable statistic in the engineering field (Wikipedia, 2006).

3. Motivations for Partnering

The US Federal Government has a serious commitment to HBCU/MI's. Several Presidential Executive Orders have been issued to promote development, provide quality education, and to increase opportunities for women, African Americans, and Hispanics. The Department of Defense (DOD) has entered into agreements with Historically Black Colleges and Universities (HBCU's), Hispanic Serving Institutions (HSIs), Tribal Colleges and Universities (TCU's), and other minority institutions of higher education. These agreements enable the DOD to provide technical assistance to minority institutions on the Department of Education's annual listing of Accredited Postsecondary Minority Institutions.

Through progressive partnerships, the program's goal is to increase opportunities for HBCU/MI's to participate in, and benefit from, federal programs, and work with educational institutions to strengthen their capability to provide quality education.

The primary goal of the HBCU/MI program is to invest in the Nation's future by:

- investing in technologically-sophisticated research programs that will give technical personnel the decisive edge in their accomplishment of the agencies' missions;
- investing in a future workforce that will be trained to resolve the global security and technological challenges of the future; and
- investing in a dedicated educational structure willing to enhance academic and research environments at both the undergraduate and graduate levels to ensure future technical capabilities.

The ERDC has nine educational partnering agreements with HBCU/MI's for mutual technical understanding and cooperation that recognize the importance of science and technology education to the future political and economic well-being of the Nation, as well as to the business, industrial, and governmental institutions of communities (Executive Office, 2004). The ERDC proactively supports outreach focusing on HBCU/MI's with programs in civil engineering, environmental quality, and computer science.

Research and development activities tend to provide the greatest opportunities for involvement of HBCU/MI's. In 2004, over 80% of the total US Army Corps of Engineers' contracts with HBCU/MI's were awarded by the ERDC (Equal Employment Opportunity Office, 2006).

4. Program Outcomes for ERDC and UPRM

During the last sixteen years, over 200 summer student positions have been filled by 198 UPRM graduate and undergraduate students (some students participated more than one year) through the Summer Research Internship Program (Figure 2). The students work with an ERDC researcher who serves as both a technical supervisor and a mentor, to help the students gain experience in the fields of civil engineering, electrical engineering, computer engineering, chemical engineering, mechanical engineering, geology, biology, marine science, math, chemistry, computer science, and environmental health, as well as other research areas.

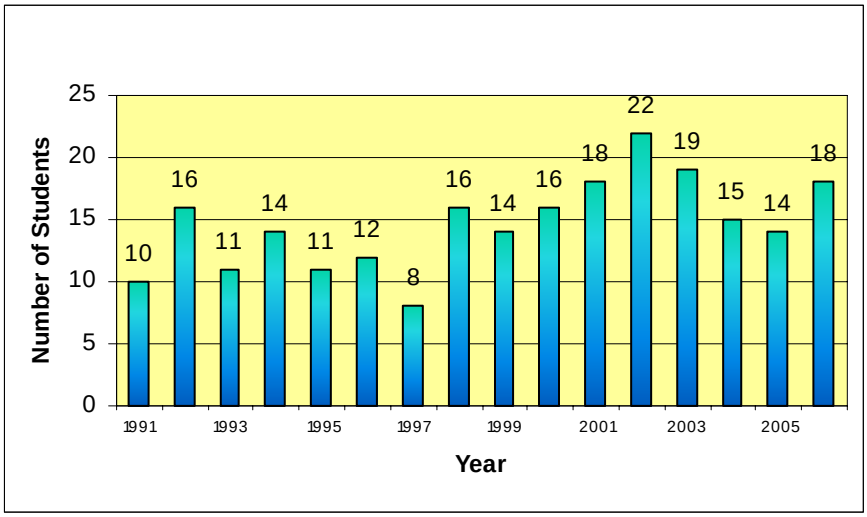

Figure 2: UPRM Summer Internship Participation for 16 Years

Figure 3 shows the summer students' distribution by academic departments. Civil Engineering is the predominant area of expertise requested by ERDC researchers, but ERDC has hosted students in other engineering and science areas. The learning experience started by considering only Master's degree students in Civil Engineering and through the years has expanded to other academic levels. Figure 4 shows the student distribution by degree.

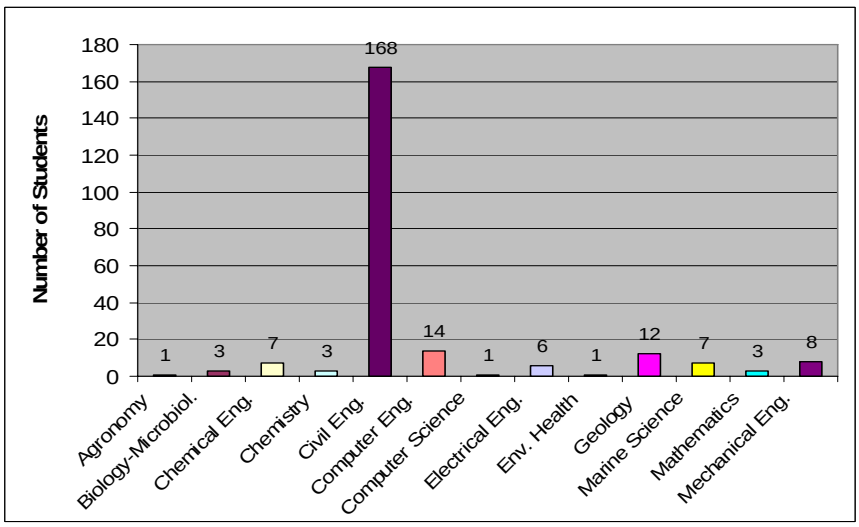

Figure 3: UPRM Summer Student Distribution by Academic Department

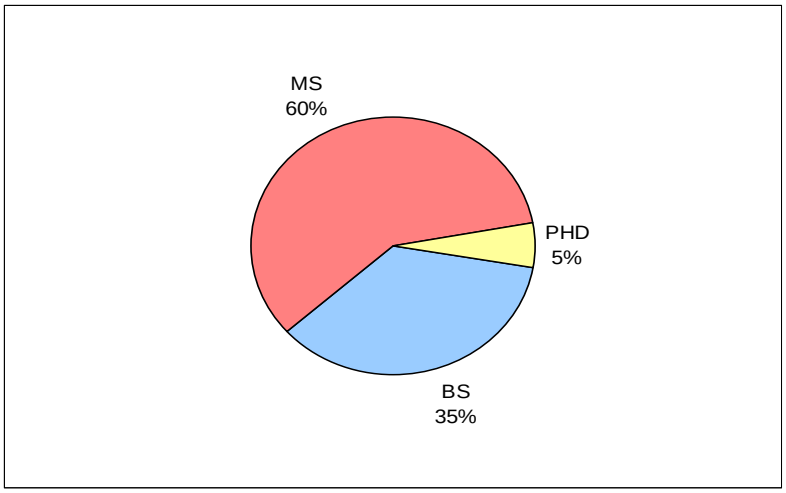

Figure 4: UPRM Student Distribution by Degree

The relationship with UPRM has helped ERDC meet its recruitment goals. The ERDC has hired 22 UPRM students directly from Mayagüez to work as full-time employees (FTE), six of these having been through the ERDC Summer Internship Program. While the majority of the UPRM students hired by ERDC did not attend the Summer Internship Program, most attribute an increased situational awareness of ERDC to their interaction with students who have been through the program. The UPRM graduate hires helped to improve the diversity at ERDC, representing almost half of the Hispanic FTE's hired (Equal Employment Opportunity Office, 2006).

Of the 22 UPRM graduates hired by ERDC, ten are still working at ERDC (Table 1). Of these ten UPRM alumni, five were products of the Summer Internship Program. In fact, attendance at the Summer Internship Program appears to improve the retention rate for UPRM alumni FTE at ERDC. Over 80% of the UPRM graduates who participated in the Summer Internship Program before coming to work at ERDC are still working at ERDC, while only 30% of UPRM graduates who had not participated are still working at ERDC.

Table 1: UPRM hiring at ERDC.

	UPRM Summer Student	Not UPRM Summer Student (Direct Hire)	Total
Still working at ERDC	5	5	10
No longer working at ERDC	1	11	12
	6	16	22

Forty-five percent of the UPRM alumni are still working at ERDC. Sixty-eight percent of them are currently with the Federal Government, and the other 32% are working either in private industry or have returned to graduate school (Table 2). Most of the UPRM FTE's have either begun graduate studies at the ERDC Graduate Institute or attended graduate schools at other universities through the ERDC Long-Term Training Program. In December 2005, a milestone was reached in the program, with the first

UPRM alumnus ERDC FTE completing his doctorate degree in Civil Engineering through the ERDC Long-Term Training Program.

Table 2: UPRM hires in ERDC, current employment and graduate studies status.

Year	Current Employer	Government	Private	Grad. School	Grad. Studies ERDC
1986	ERDC	x			x
1986	ERDC	x			x
1989	Private Co.		x		
1992	ERDC	x			x
1992	ERDC	x			x
1993	CoE, Jacksonville	x			x
1993	EPA	x			
1994	US-Army	x			x
1994	ERDC	x			x
1994	CoE, Jacksonville	x			
1994	PhD-Michigan			x	x
1994	UPR-M			x	
1994	ERDC	x			x
1995	ERDC	x			
1998	US-Navy	x			
1998	PhD-UW-Madison			x	
2000	ERDC	x			
2002	Private Co.		x		
2004	Private Co.		x		x
2004	Private Co.		x		x
2005	ERDC	x			
2005	ERDC	x			
Total		15	4	3	11
Percentage		68	18	14	50

The UPRM/ERDC Education and Research Partnership Agreement exposes students to an invaluable alternative learning experience. It gives students a brief research experience in a world-class engineering research and development organization. This learning experience enriches the students' traditional classroom education by creating a more realistic professional learning environment but still keeps them within a formal educational framework as they are required to register in a research course. The students are required to develop a research proposal, submit regular progress reports, and present a final oral and written report to the ERDC, to the UPRM Program Director, Professor Ismael Pagán-Trinidad, and to their classmates as part of their final grades. The students are also immersed in a cultural environment different from their own. In addition to their technical reports, the students share their personal learning experiences by writing a final essay and submitting it with their technical reports. These reports are shared with other UPRM students to increase their familiarity with ERDC and the Summer Research Internship Program. (Formal electronic proceedings are collected including all the Summer Internship experiences by student.)

Participating students are required to apply and compete for the internship opportunities. They are qualified by their academic merits, their level of studies (PhD, MS, BS), the number of credits approved, their major, and the priority they select among all the job opportunities. Demonstrated interest in research and graduate studies greatly enhance their opportunities. Students are oriented and trained for this unique experience by exposing them to technical communication skills and strengthening their job skills before they arrive at ERDC. The ERDC, likewise, orients and guides students by group advising and personal mentoring by assigned mentors and supervisors at ERDC. Continuous follow up and support have greatly helped students' performance and achievements at ERDC.

Among other initiatives of the ERPA, the UPRM and ERDC have established a summer faculty program, where UPRM faculty members practice summer internships at ERDC. Members of ERDC leadership serve as liaison members of the Educational Advisory Board of the College of Engineering at UPRM. As

such, they advise the Dean and the Faculty of the College of Engineering on matters affecting engineering education and student development at UPRM. This agreement also gives great positive visibility for UPRM and marks successful collaboration on research projects (Figure 1).

5. Future of the Program

The ERDC is working to expand this program to other elements of the Corps of Engineers and The Army. For instance, the Corps' Vicksburg District has expressed interest in the program and sent a representative to UPRM in January 2004 with ERDC to recruit for all Mississippi Valley Division Districts. In addition, the Space and Missile Defense Command has expressed interest in the ERDC's program with UPRM.

The ERDC plans to continue the summer and full-time employment of UPRM students since they have been very successful in acquiring high quality, talented students. Both organizations plan to increase research collaboration and research program development. For instance, ERDC and UPRM are exploring the formation of a Tropical Environmental Research Center, which will be located in Puerto Rico and provide research opportunities for both ERDC and UPRM researchers.

6. Conclusions

The UPRM and the ERDC have developed a unique learning model that has been in place for two decades. The partnership formalized under this agreement brings mutual benefits to both organizations. The learning experience has proven to be an excellent opportunity to motivate and prepare students for graduate school and to pursue research careers. It has also helped identify excellent candidates for ERDC research positions. This model has been used by ERDC and UPRM as a very effective student program and is envisioned as a model for other agencies and laboratories in the Federal Government.

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