

**A DECADE OF PARTNERSHIP**  
**A Success Story of the University of Puerto Rico at Mayagüez**  
**And Raytheon Corporation**

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**ABSTRACT**

*“Industry and academe share the same goals – better curricula, better graduates and better future employers” [Payne, 1998]. There are many ways in which industry and academia can collaborate, however in order for the relationship to succeed there has to exist a special synergy between them. Such is the case of the University of Puerto Rico at Mayagüez (UPRM) and Raytheon. This paper describes the close relationship this company has developed over the last 10 years with this Campus of the UPR system, in particular, with its College of Engineering. Collaboration ranges from student recruiting, creation of an Industrial Affiliates Program at the Electrical and Computer Engineering Department, cash and*

*equipment donations, partnerships in research proposals to the US National Aeronautics and Space Administration (NASA), and support for technical conferences. This paper will also discuss the elements that have made this collaboration a success. Other institutions and industry can use the model presented here.*

**INTRODUCTION**

It is well documented in the literature that industry-academia collaborations result in multiple benefits for both parties. These collaborations range from very specific projects or one-to-one interactions, to more broad, well thought and planned institution-wide affiliations. The industry-academia partnership that this

paper describes - the University of Puerto Rico at Mayagüez and Raytheon Corporation - started ten years ago, and has benefited both institutions significantly during those years. The authors present a brief history of the relationship and describe the many aspects it entails. The views of the university administration, faculty and students, as well as the industry perspectives are included. Finally, we conclude presenting some of the conditions that have made this partnership a success.

### BRIEF HISTORY OF THE UPRM AND RAYTHEON COLLABORATION

The UPRM-Raytheon history of collaboration begins in 1988, when the Raytheon-Puerto Rico operation started recruitment efforts in Mayagüez. Since then, there have been multiple and diverse collaborative activities, which range from student recruitment to partnering in R&D grants to sponsoring conferences and seminars. The Table 1 shows most of the activities during these 10 years.

Table 1. History of Collaboration

DATE	ACTIVITY
1988	College student recruiting
1989	Raytheon becomes Charter Member of UPRM Electrical & Computer Engineering Department Industrial Affiliates Program (IAP)
1990	Raytheon volunteers to help develop the IAP strategic plan
1991	Raytheon becomes corporate recruiter for new IAP companies
1992	Corporate donation: Microwave Design Software
1993	IAP project sponsor
1995	Raytheon co-hosts of Remote Sensing Conference in San Juan
1995	Raytheon becomes business partner: NASA University Research Center CAN won
1995	Raytheon chosen for Board oversight: NSF-MRCE Program
1996	INROADS program sponsor
1997	Raytheon becomes business partner: SMES Feasibility grant from PR Economic Development Administration
1997	Discussion begun on PRT
1995-97	Equipment donations
1997-98	Human Resources development seminar for faculty and staff

### STRATEGIC PLANNING & THE VIEW OF THE ADMINISTRATION

The University of Puerto Rico at Mayagüez is a land, sea and space grant institution founded in 1911. Total enrollment in its four colleges (Engineering, Business Administration, Agricultural Sciences and Arts and Sciences) is about 12,600 students (Figure 1). In 1997 the UPRM granted close to 1900 degrees (bachelors, masters and

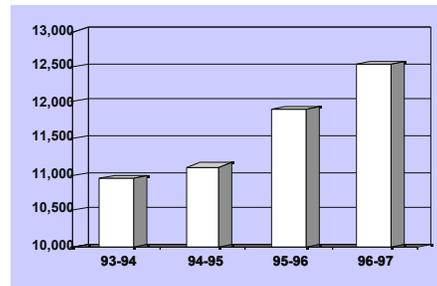


Figure 1: UPRM Enrollment

PhD's). The College of Engineering currently has six programs accredited by the ABET and 4600 students (see Figure 2) and graduates an average of 800 engineers every year. Female student population is about 38%, well above US averages.

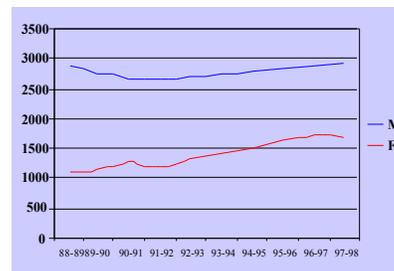


Figure 2: College of Engineering Enrollment

Due to the nature of its programs, the Campus and College of Engineering have a long history of collaboration with industry. In 1996 the UPRM Campus developed its Strategic Plan and wrote its mission statement. Among other things, the Campus mission states UPRM will "...provide (students) with the adequate education and technical training in order to develop their commitment with the solution of problems that affect Puerto Rico, technology transfer..." We understand that we cannot carry on this mission alone: we need all our constituencies involved in our educational endeavor. Thus, we must provide means by which industry, government and the community become integral partners. We realize that

quality students are the essence of a quality workforce and that both industry and academia share the same goals: better prepared citizens and employers, better facilities, better opportunities for professional development.

## **IMPACTING THE EDUCATION ENDEAVOR: CURRICULUM, R&D, FACULTY & STUDENTS**

### **Raytheon and the Electrical and Computer Engineering Department**

The Department of Electrical and Computer Engineering (ECE) was founded in 1928 where its first program, a Bachelor of Science in Electrical Engineering (BSEE), was established. The Computer Engineering Program (BSCpE) was established in 1981. Both programs are ABET accredited. The Department also offers a Master degree programs in Electrical Engineering, established in 1967, and in Computer Engineering, established in 1995. The Department is composed of approximately 1400 undergraduate students of which 850 are in the EE program and 550 are in the CpE program; 84 graduate students of which 42 are in the EE program and 42 are in the CpE program. The EE program has 20% woman enrollment and the CpE has 30%. The graduating class is approximately 150 students/yearly (100 EE and 50 CpE). The relationship with Raytheon has been fruitfully one, and the major activities have been in the areas of laboratory and curriculum development, and the Industrial Affiliates Program. In laboratory development, they helped in the development of the Advanced Communications Laboratory with the donation of equipment and software for microwave circuit design. In curriculum development, they provide advice in some of the courses offered in the telecommunications area. In IAP, they are a key component in the success of the program by helping in company recruitment, development of a contingency fund, development of the strategic plan, and sponsoring the industry representative in the IAP board. In research, the major contribution has been our partnership that enabled us to win a cooperative agreement award from NASA a multi-million dollars project to establish the Tropical Center for Earth and Space Studies where one of the major trust is on use and processing of remote sensing data. Raytheon and UPR co-sponsored the International Remote Sensing Symposium where representatives from different Latin-American countries and the U.S. discussed potential applications of remote sensing.

In summary, Raytheon's relationship with the ECE department has been instrumental in achieving our goal of offering our undergraduate and graduate students the

best quality education with good balance between theory and practice. This kind of relationships has made our department the second department in external funds of the entire University of Puerto Rico at Mayagüez with nearly \$3M per year.



### **Raytheon and the Industrial Affiliates Program (IAP)**

The Industrial Affiliates Program (IAP) at the Department of Electrical and Computer Engineering of the University of Puerto Rico Mayagüez Campus is an organization that is geared toward enriching and enhancing the educational experience of interested undergraduate students. IAP offers creative research and development experiences to complement the University's strong Engineering curriculum. The program was founded in 1989 and is fully sponsored by several global corporations working in tandem with the Faculty at the University of Puerto Rico. The 1997-98 industry sponsors are:

- Bell Communications Research
- Biometrics Imagineering
- Digital Equipment Corporation
- Eastman Kodak Co.
- Eaton Corp.
- Raytheon Co.
- Sun Microsystems Lab.
- The MITRE Corp.
- XEROX Corp.
- Texas Instruments



Their joint collaboration has resulted in the ability for many of our students to gain increased exposure to the field of engineering through direct involvement in educational outreach opportunities, technical projects, and research efforts. Students thus acquire a broader knowledge and practical working expertise in state-of-the-art technologies. Coupled with their formal academic studies, undergraduates expand their intellectual and personal breadth and scope. Sponsoring Companies are interested in recruiting these unique talents. The program has brought over \$300,000 in cash and equipment donations that have resulted in significant

improvements to curriculum and facilities at the ECE Department and the Engineering School.

Raytheon was one of the founding members of IAP in 1989. Since that time, they have been active supporters of the program on-campus and off-campus. They have promoted the program with their peers at several industrial organizations such as the United Way that has resulted in at least 8 to 9 companies in the course of the last 9 years. They have also helped us with strategic planning in providing their managerial experience and helping us defining goals that balance the academic and industrial interests in the program activities. They have also been key in obtaining support from the UPR chancellor and other strategic administrators. A representative from Raytheon is the current industry representative in the IAP board. Another important aspect of Raytheon's participation in IAP is their support in equipment and cash donation. A transition fund of \$15,000 was established with a donation from Raytheon to give an early start to research projects while waiting for the other company donations. Over \$40,000 in equipment donations have been used to enhance laboratory facilities being used by IAP students.

Our collaboration has been a fruit full one due to the involvement of faculty and Raytheon employees who have put a significant amount of time, economic resources, and effort in developing a unique undergraduate research education program. Next year we are 10 years old and certainly reaching this goal is due to the active participation of industrial partners like Raytheon.

#### **Raytheon and R&D Efforts: The NASA-URC Grant**



Raytheon and the University of Puerto Rico joined forces to put together the *Conference for Remote Sensing and Environmental Monitoring for the Sustained Development of the Americas* that was held in San Juan, Puerto Rico, during the 21<sup>st</sup> through the 22<sup>nd</sup> of March, 1995. The conference was chaired by Prof. Rafael Fernández-Sein, of the Electrical and Computer Engineering Department of UPR-Mayagüez, and organized by CoHemis, an organization within UPR that has arranged collaborations with twenty-seven institutions in North, Central, and South America. There were 128 attendees from Argentina, Brazil, Canada, Chile, Costa Rica, Mexico, Puerto

Rico, United States, Uruguay, and Venezuela. There were several members of the Instituto de Pesquisas Espaciais, INPE, representing Brazil. In short, the Conference was an utter success.

Very shortly after the conference, Raytheon again joined UPR as a business partner to bid on a NASA proposal for a University Research Center (URC). This effort resulted in the *Tropical Center for Earth and Space Studies* (TCESS), which has become an even more impressive success. We have installed a small 1-meter dish to capture NOAA and SeaWiFs imagery, and a 5-meter parabolic to service The Johns Hopkins University's Far Ultraviolet Spectroscopic Explorer (FUSE) satellite. Shortly we will install and commission a 4.3 meter S-band station to capture RADARSAT, LANDSAT 7 land-based imagery and CalTech's Galaxy Evolution Explorer (GALEX) UV imagery. Other groups within TCESS are studying the effects of UV radiation on seagrasses and mangroves, monitoring the crustal deformations in the circum-Caribbean, developing efficient methods to process and compress imagery, and researching different sensor materials. This year, for example, TCESS collectively presented 57 papers, published 39 papers in refereed journals, and supported 22 undergraduate students, 20 masters students, and 3 doctoral students.

#### **The student perspective**

Students are one of the reasons universities exist. Their well being and development lies in the hands of those who drive academia. Therefore, their opinions are very valuable to us. One of the authors of this paper is Luis Rodríguez, a senior in the Electrical and Computer Engineering Department at UPRM. What follows is his perception and view of this unique collaboration.

*How have the students at UPRM benefited from this collaboration?*

- They have access to the latest technology on Campus.
- They have hands-on experience with real-life problems through industry-sponsored projects.
- Students mature as they interact with professional engineers.
- Able to build engineering skills through experience.
- Qualifications upon graduation are more attractive and appealing to hiring companies.

*How has Raytheon benefited from student involvement in their programs?*

- Provides an opportunity to probe future prospects for their company.
- They are able to participate more directly in the formation of young professionals.

- It is an excellent public relations activity, as the students speak of their experiences with them.
- Provides a means to obtain new ideas from students in solving real problems from industry.

*Why should other industries follow Raytheon's example?*

- It is a win-win-win situation for the university, the students and industry.
- To come in contact with developing skilled young professionals of the best caliber.
- So that they do not miss out the opportunity to hire high quality Hispanic engineers and impact their company's strategies in the global markets (globalization).

## RECOMMENDATIONS AND CONCLUSION

We believe that the success of the UPRM-Raytheon collaboration is due to various factors, but stems from the zealous nurturing of key people on both organizations. Other elements in developing a fruitful relationship that play a critical role include the following:

- ***Strategic Planning and nurturing.*** The existence of a strategic plan helps all those involved understand and work towards the goals. Continuous revision and assessment of goals and strategies ensures that all parties involved are provided for.
- ***Having clear goals and expectations.*** Both industry and academia must have an understanding of what is it that each expects from each other. Be it recruitment of top students, or partnering for a specific research and development project.

- ***Being sensitive to each other's needs:*** Each partner must understand the nature and way of conducting business. Response time in an industrial environment is different from a university environment. Faculty is used to work alone more than in teams, in contrast to industry.
- ***Contact person(s).*** The existence of a contact person(s) at each organization warrants continuity and clear understanding of the status of the collaboration.
- ***Involvement at all levels.*** It is extremely critical that there is involvement at all levels from both organizations in the partnership. This will guarantee support both financial as well as programmatic.
- ***Existence of multiple and diverse collaborative activities.*** Having diverse collaborative activities will enhance and maintain relationship for all constituencies: students, faculty and industry representatives. These may be, for example, internships (both for students and faculty), faculty professional development grants for equipment, workshops, and dialogues about education issues and R&D areas.

In conclusion, the UPRM and Raytheon partnership has been nurtured for ten years. The fruits of this enterprise range from multi-million dollar grants for R&D to recruitment of students to faculty development workshops and seminars. But the success of this collaboration would have not occurred would it not be for the continuous watch of key individuals at each organization.

## REFERENCE

Payne, R. *Common Goals*, ASEE PRISM, January, 1998