Land Surveying Bachelor Program at the University of Puerto Rico: A Vision for Success

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Key words: education, bachelor program, partnership, retention, research, leadership

SUMMARY

In 1979 the University of Puerto Rico began offering a bachelor degree in Land Surveying and Topography at the Civil Engineering Department, since that time there has been 250 graduates from this program. The department changes its name to Civil Engineering and Surveying Department in the year 2000. The academic requirements of the program, a profile of the students, ongoing research projects, publications, and success stories will be presented in this paper. Since the year 2000 the Land Surveying and Topography Program started a partnership with the "Instituto de Agrimensores del Colegio de Ingenieros y Agrimensores de Puerto Rico" with the purpose to increasing the enrollment of this program. Last August 2005 the enrollment for first year candidates was 105 students. The partnership is now focusing on retention. An overview of this partnership will also be presented.

RESUMEN

En 1979 la Universidad de Puerto Rico comienza a ofrecer el bachillerato en Agrimensura y Topografía en el Departamento de Ingeniería Civil, desde entonces han graduado de dicho programa 250 personas. El departamento cambio su nombre de Departamento de Ingeniería Civil a Departamento de Ingeniería Civil y Agrimensura en 2000. En esta ponencia se presentara los requisitos académicos del programa, un perfil del estudiante, investigaciones realizadas y en progreso, publicaciones, e historias exitosas de sus egresados. Desde el 2000 el programa de Agrimensura y Topografía comienza formalmente una alianza con el Instituto de Agrimensores del Colegio de Ingenieros y Agrimensores de Puerto Rico, con el propósito de incrementar la matricula en dicho programa. El pasado agosto del 2005, la matricula del primer año fue de 105 estudiantes. La alianza se ha enfocado ahora en la retención. Se presentara en detalle en que ha consistido esta alianza.

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1. ABOUT PUERTO RICO

Puerto Rico is located in the western hemisphere in the Caribbean Sea; it was discovered on November 19, 1493 by Christopher Columbus, on his second voyage to the New World, bound for Hispaniola. He came upon the Island, calling it San Juan Bautista. At the time of its discovery, Puerto Rico was a point of contact between the Taíno Indians of the Greater Antilles and ferocious Carib tribes that inhabited the Lesser Antilles. In 1508, a group of Spanish conquistadors arrived under the leadership of don Juan Ponce de León, who started the colonization and become the first governor. Near what is known today as San Juan Harbor, they founded San Juan, the second oldest city of the New World. On the Harbor of San Juan they built a walled city that, along with Cartagena de Indias of Colombia, became the great strongholds of the Spanish Main, and a leading defensive bastion of the vast empire. Puerto Rico was a point of departure for expeditions to colonize and explore America, as well as a depot for the trans-shipment of gold from the Indies to Spain.

As a result of the Spanish American War, Puerto Rico was ceded to the United States of America in 1898. The Jones Act of 1917 extended to the people of Puerto Rico United States citizenship and in 1952 Commonwealth Status was adopted. Since 1947, Puerto Rico has experienced a dramatic shift from an agricultural society to an industrialized one. This has resulted in significant economic growth that has positioned the Island as the showcase of the Caribbean. Its modern infrastructure, highly professional work force and industrial incentive programs have attracted foreign corporations to establish manufacturing facilities in Puerto Rico. To further stimulate Puerto Rico's economic growth new alternative are being forged to expand tourism activities to play an active role in the Caribbean and to diversify its industrial base. Puerto Rico is still developing new strategies to promote employment and economic growth. These efforts are led by the government and the private sector. Puerto Rico is one of the most pleasant and exciting places to live and visit that can be found anywhere.

2. ABOUT OUR UNIVERSITY

The University of Puerto Rico is a well established and a mature institution, with a total enrollment of over 69,000 students. The University consists of the Mayagüez Campus, the Medical Sciences Campus, and the Río Piedras Campus, which are dedicated to both undergraduate and graduate education; and the Colleges at Aguadilla, Arecibo, Bayamón, Carolina, Cayey, Humacao, Ponce, and Utuado which provide undergraduate education. Each autonomous institutional unit has a Chancellor as chief administrator and academic officer.

The University of Puerto Rico was created by an act of the Legislative Assembly on March 12, 1903 emerging as an outgrowth of the Normal School, which had been established three years earlier to train teachers for the Puerto Rican school system. In 1908, the benefits of the Morill-Nelson declared applicable to the island, fostered the rapid growth of the University. Eloquent evidence of that growth was the establishment of the College of Liberal Arts at Río Piedras in 1910 and the College of Agriculture at Mayagüez in 1911.

It was in the College of Agriculture where the Mayagüez Campus as we know it today had its origin. Credit for the establishment of the College is given to the joint effort of D. W. May (Director of the Federal Experiment Station), José de Diego, and Carmelo Alemar. A year later, the school received the name that it wore for 50 years: the College of Agriculture and Mechanic Arts. The strengthening and diversification of the academic programs at Mayagüez were recognized years later when, in 1942, as a result of university reform, the campus was organized with a considerable degree of autonomy into the Colleges of Agriculture, Engineering, and Science under the direction of a vice-chancellor. The expansion continued through the 1950s when many programs flourished in the University. The College of Arts and Sciences and the Nuclear Center were established in Mayagüez. The Colleges of Humanities, Natural Sciences, Social Sciences, and Business Administration emerged in Río Piedras. The Schools of Medicine, Odontology, and Tropical Medicine were established in San Juan.

In 1966, the Legislative Assembly reorganized the University of Puerto Rico as a system of autonomous campuses, each under the direction of a chancellor. The College of Agriculture and Mechanic Arts became the University of Puerto Rico, Mayagüez Campus.

Today, the Mayagüez Campus of the University of Puerto Rico continues its development in the best tradition of a Land Grant institution. It is a co-educational, bilingual, and non-sectarian school comprising the Colleges of Agricultural Sciences, Arts and Sciences, Business Administration, Engineering, and the Division of Continuing Education and Professional Studies. The College of Agricultural Sciences includes the Agricultural Experiment Station and the Agricultural Extension Service. At present, the campus population is composed of 12,136 students, 1,336 regular staff members and 1,026 members of the educational staff.

Figure 1 - The University of Puerto Rico at Mayagüez is located in the city of Mayagüez on the western side of Puerto Rico.

2.1 The College of Engineering

The College of Engineering was founded in 1942 (although the University of Puerto Rico at Mayagüez has been offering engineering degrees since 1913) and comprises six academic departments. The undergraduate population of the College of Engineering is approximately 4,899 for the 2005-2006 academic year. It is the largest undergraduate of the four colleges at Mayagüez Campus of the University of Puerto Rico. Of these, 35% are women. This makes the College one of the schools of engineering with the highest enrollment of women in the United State of America. The College of Engineering has around 371 graduate students, 32% of which are women. The College of Engineering consists of 185 full time faculty members and 125 staff employees.

The six academic departments at the College of Engineering are: General Engineering Department, Mechanical Engineering Department, Industrial Engineering Department, Chemical Engineering Department, Electrical & Computer Engineering Department, and Civil Engineering and Surveying Department. General Engineering is a service department composed of professors with an interdisciplinary background from different fields of engineering. It is responsible for offering courses that provide common foundation to all engineering programs. The Chemical, Mechanical, and Industrial Engineering Departments offer a Bachelor of Science Degree in their respective areas. The Electrical and Computer Engineering Department offers a Bachelor of Science Degree in both Electrical and Computer Engineering. The Civil Engineering Department also offers a bachelor degree in Land Surveying and Topography besides the Bachelor of Science Degree in Civil Engineering. The General Engineering department does not offer any degree. The Bachelor of Science degrees require from 168 to 179 credit/hours of course work. This means that for most programs, the degree can be completed in 5 years. On figure 2 is show the distribution of undergraduate students for the academic year of 2005-2006 at the College of Engineering by bachelor programs: AGTO (Land Surveying and Topography), INQU (Chemical Engineering), INCI (Civil Engineering), INEL (Electrical Engineering), ININ (Industrial Engineering), INME (Mechanical Engineering), ICOM (Computer Engineering).

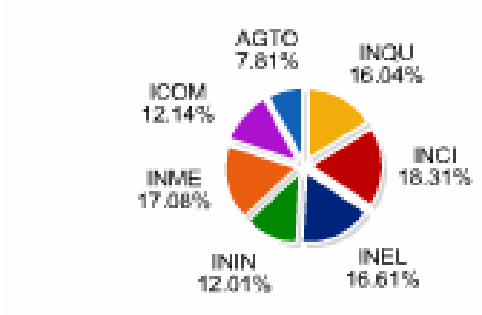

Figure 2 - Distribution of undergraduate students for the academic year of 2005-2006 at the College of Engineering by bachelor programs.

2.1.1 Civil Engineering and Surveying Department

The College of Engineering offers a five-year degree of Bachelor of Science in Civil Engineering (179 credit/hours of course work) and a four-year Bachelor of Science in Land Surveying and Topography (148 credit/hours of course work), which are administered by the Civil Engineering and Surveying Department. The Bachelors degree program precedes a well-coordinated graduate study program, which offers Masters and Ph. D. degrees in Civil Engineering. The Civil Engineering Bachelor Program started in 1913 with the fundamental purpose of supplying quality Civil Engineers in order to satisfy the immediate and future technological demands of the Puerto Rican and other societies. The importance of Land Surveying in the social and economical development of our Island, the very high cost of the real estate on the Island of Puerto Rico and the highly sophisticated modern instrumentation used today motivated, on 1979 the creation of the Bachelor Program in Land Surveying and Topography at the Civil Engineering Department. The program has been designed to meet the needs and the qualification criteria of the Board of Examiners of Engineers, and Land Surveyors of Puerto Rico, and the land surveying profession itself. Since the beginning there has been 250 graduate of the program. The department changes the name to Civil Engineering and Surveying Department on 2000, responding to a request of the Professional Land Surveyors of Puerto Rico. After that initiative, the department and the land surveyors start a partnership.

2.1.1.1 Land Surveying Curriculum

The land surveying students are enrolled in a program that covers a wide spectrum of activities from the very basic plane surveying, to cartography, photogrammetry, geodesy, and astronomy. The students have the opportunity to apply theory into practice, through the laboratory sessions and a summer camp. The four-year Bachelor of Science in Land Surveying and Topography program has 148 credit/hours of course work, in a semester system (16 weeks/semester). The coares of the courses are on: mathematics, sciences, socio-humanistic, Spanish, English, Physical Education, Specialization courses, professionals' electives and free electives.

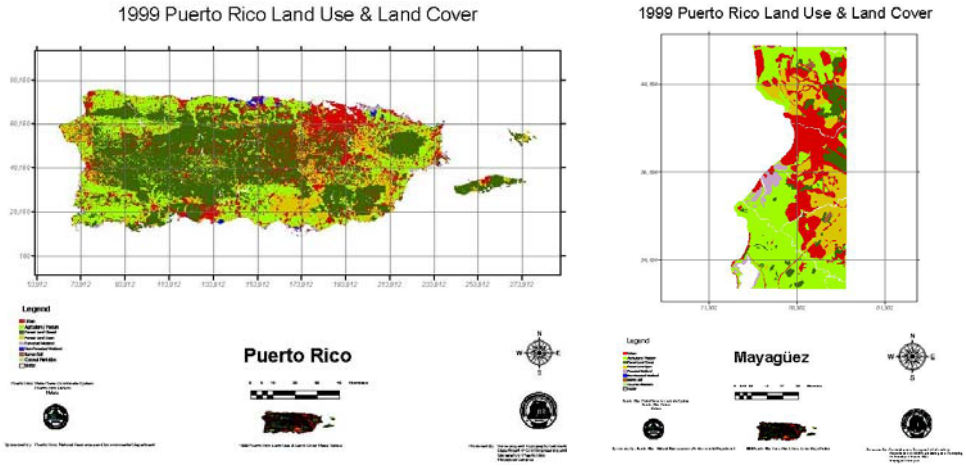

Figure 3 - Land Use & Land Cover Maps

2.1.1.2 Publications

In the category of Research Report, they have been published over docents for the concerned agencies. The 1999 land uses and land cover map of Puerto Rico, and the Mayagüez quadrangle are included in Figure 3, are examples of the addendums that are part of the research report publication. The references at the end of this paper are other examples of the publications of the research initiative at the Land Surveying program at the University of Puerto Rico.

2.1.1.3 Student Profile

The land surveying student is a young person between the ages of 17 to 22. He or she has entered to study land surveying directly from the high school. Many have entered the program with the idea to change, and when finding that it pleases them, they finish it successfully. He or she may complete the total credits required for graduation in an average of 5 years.

2.1.1.4 Research at the Land Surveying Program

Several research projects on Remote Sensing, Geographic Information Systems (GIS) and Global Positioning Systems (GPS) with federal and local agencies have been performed. As an example are: the location of the centroid of Puerto Rico (Olivieri, L. and Vélez, L. 2002), the establishment of horizontal control points using GPS technology (Vélez, L. 2001), and the mobile mapping system for the Añasco River area (Rivera, J., Rodriguez, C, and Vélez, L. 2004). New technology, and students participation have been applied in those researches.

2.1.1.5 Success Stories

A great amount of students are chosen to do a dual degree program at the Civil Engineering and Surveying Department. The increase in the number of students has been enormous in the pass 10 years. After graduating with both degrees, they also apply for the engineering and land surveying professional examinations. During their studies, they have the opportunity to participate in extracurricular activities, which offer them the opportunity to establish relations with professionals. After graduated, they are employed in the private industry or the government, where they acquire professional experience. The great majority of them take the fundamental and professional examinations and when passing the join “Colegio de Ingenieros y Agrimensores de Puerto Rico”.

3. COLEGIO DE INGENIEROS Y AGRIMENSORES DE PUERTO RICO

In Puerto Rico all the engineers and land surveyors must belong by law to the “Colegio de Ingenieros y Agrimensores de Puerto Rico” or CIAPR by its Spanish acronym. In order to be called, presented or represented as an engineer, or land surveyor in Puerto Rico, you have to be: 1- Graduated from a recognized university; 2- Pass the fundamental and professional examinations; 3- Obtain a license or certificate from the Board of Examiners of Engineers,

and Land Surveyors of Puerto Rico; 4- Be a member of the CIAPR; and 5- Stay in good standing. The Professional Engineers and Land Surveyors Association of Puerto Rico was founded in 1938 with the purpose of guarding the public interest and serving the government as an advisor in technological matters, implementing cannon laws of professional ethics and defending the interests of engineering and land surveying professionals. The CIAPR groups professional engineers and land surveyors, licensed or certified (in training) by the Board of Examiners of Engineers, and Land Surveyors of Puerto Rico.

The Board of Examiners of Engineers, and Land Surveyors of Puerto Rico is a board authorized by law to offer, in coordination with the National Council of Examiners for Engineering and Surveying (NCEES), licensing exams and issue licenses or certificates that permit the exercise of the profession of engineering and surveying in Puerto Rico with reciprocity in the United States of America, in accordance to each state's laws and regulations.

The CIAPR has an average enrollment of over 11,000 professional engineers and land surveyors. It is divided in seven Institutes, which represent the members according to their discipline and specialty, and in eleven chapters, that represent the members by geographical region. Each institute manages the matters of its competence and each chapter attends the matters of its region. The Institutes are: Institute of Land Surveyors, Institute of Civil Engineers, Institute of Computer Engineers, Institute of Chemical Engineers, Institute of Electrical Engineers, Institute of Industrial Engineers, and Institute of Mechanical Engineers.

The geographical chapters cover the 78 municipalities of Puerto Rico and one at the United States, and are named by one of the municipalities of the region that serve. The eleven chapters are: San Juan, Bayamón and others 8 municipalities (Toa Baja, Toa Alta, Dorado, Cataño, Guaynabo, Vega Baja, Naranjito, and Corozal), Carolina and others 3 municipalities (Trujillo Alto, Loiza, and Canovanas), Humacao and others 11 municipalities with the Island of Vieques and Culebras (Río Grande, Luquillo, Fajardo, Ceiba, Naguabo, Las Piedras, Juncos, y Yabucoa), Guayama and others 5 municipalities (Maunabo, Patillas, Arroyo, Salinas, and Santa Isabel), Caguas and others 8 municipalities (Gurabo, San Lorenzo, Cayey, Cidra, Aguas Buenas, Comerio, Barranquitas, and Aibonito), Ponce and others 10 municipalities (Orocovis, Coamo, Villalba, Juana Díaz, Jayuya, Adjuntas, Peñuelas, Guayanilla, Yauco, and Guánica), Mayagüez and others 8 municipalities (Añasco, Las Marias, Maricao, Sabana Grande, San German, Lajas, Cabo Rojo, and Hormigueros), Aguadilla and others 6 municipalities (Isabela, Quebradillas, Moca, Aguada, and Rincón), Arecibo and others 10 municipalities (Barceloneta, Florida, Manati, Vega Alta, Morovis, Ciales, Utuado, Lares, Camuy, and Hatillo), and a Chapter at the United States. Figure 3 show the geographical distribution of the chapters, which served an area of 8,960 square kilometers and to a population of near 4 millions. Figure 4 show the logos of each Institute and the official seal of the "Colegio de Ingenieros y Agrimensores de Puerto Rico". The CIAPR is directed by the Board of Directors ("Junta de Gobierno del Colegio de Ingenieros y Agrimensores de Puerto Rico") whose members are: the president and two vice-president (one for each profession) elected each year at the general assembly in August. In addition to the president and the vice-presidents, a delegate from each geographical chapter is elected to

the Board of Directors, also the president and a delegate from each institute serves in the Board of Directors. Both the geographical chapters and the institutes have their annual assembly during May and June of each year.

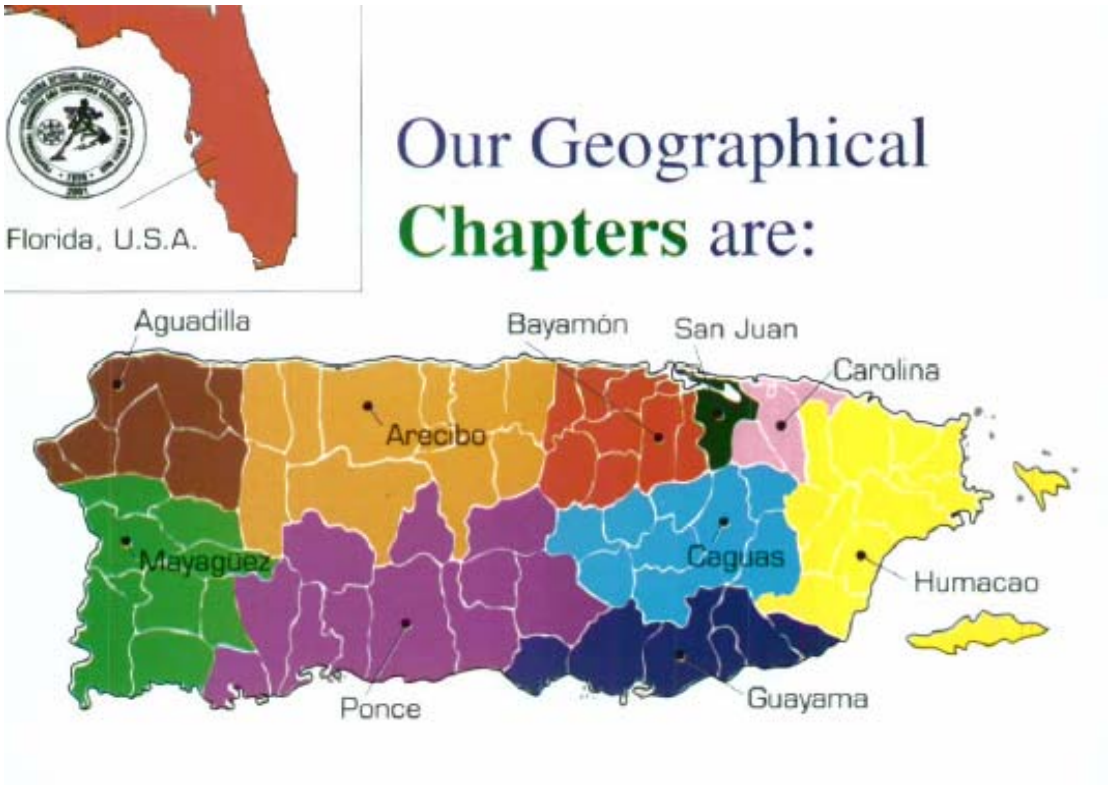

Figure 4 - The geographical distribution of the Chapters, which served an area of 8,960 square kilometers and to a population of near 4 millions.

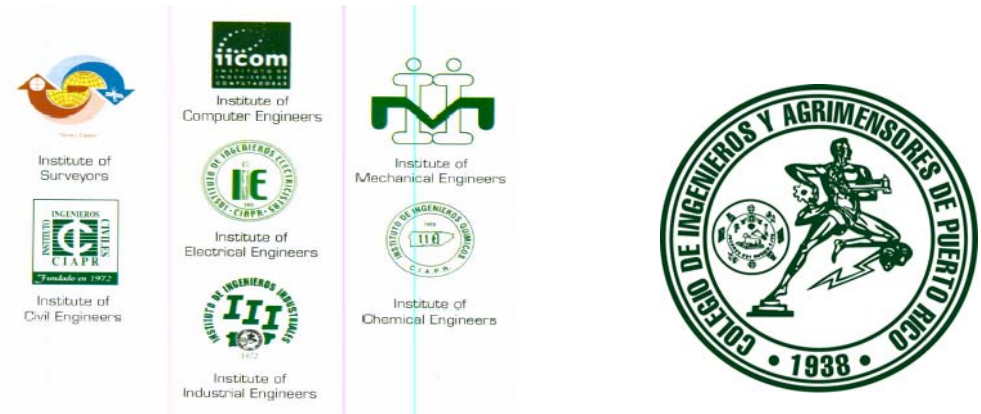

Figure 5 - The logos of each Institute and the official seal of the "Colegio de Ingenieros y Agrimensores de Puerto Rico".

3.1 Instituto de Agrimensores del CIAPR

In Puerto Rico, although many works constructed during the time of the Spanish Empire required the intervention of surveying, the stage of this as profession defined at local level begins there for the 1846. 1st of January of 1846 Don Rafael de Aristegui, "Conde de Marisol", Governor and Commander in chief of Puerto Rico approved the "Regulation for the Corps of Land Surveyors", regulating its practice, including the renewal as far as suitability and collection of fees. The beginning of the practice of surveying like profession regulated by the Government in Puerto Rico constitutes that event. With this, the Corps of Land Surveyors was created, with legal similarity to a professional school and an examining board. It was stated that to be able to take the certification exam on surveying, each candidate must have two years of training with a skillful land surveyor.

The profession followed its course until February of 1900, when an order of the new military government of the United States in Puerto Rico declared as free the exercise of all the professions, although the capability was not controlled to exert the same one. This disposition was in reduction of the quality of the services that were received.

In 1927, the Legislature of Puerto Rico promulgated the regulation of the profession of Surveying, Architecture and Engineering under Law 31. The subsequent legislation created the Professional Engineers Association of Puerto Rico in 1938. The Professional Engineers, Architecture and Land Surveyors Association of Puerto Rico summoned up legal life in 1954 by means of law number 27 and under protection of that law, by means of institutional regulation; the Institute of Surveyors was created in 1972. In 1980, by means of law number 12 the Professional Engineers and Land Surveyors Association of Puerto Rico was constituted, guaranteeing itself by means of legislative right, the Institute of Land Surveyors as an institutional organism.

Around 500 members of the CIAPR which are land surveyors; are also members of the Institute of Land Surveyors. A Student Chapter of the Institute of Land Surveyors exists at the University of Puerto Rico since 1990. The professors of the program have participated as officers of the Institute of Land Surveyors since its establishment. The actual president of the Institute of Land Surveyors is a member of the faculty of the Land Surveying and Topography Program at the University of Puerto Rico.

4. ACADEMIC AND PROFESSIONAL PARTNERSHIP

Since the year 2000 the "Instituto de Agrimensores del Colegio de Ingenieros y Agrimensores de Puerto Rico" started a partnership with the Land Surveying and Topography Program of the University of Puerto Rico with the purpose of increasing the enrollment of the program. The name of the program was Academic and Professional Internship, and consists of a selection of a maximum of 40 eleventh grade high school students. They would stay for three nights at the university, receiving instructions on surveying and developing a hand-on experience with the surveying instruments. Also as part of the activities there were field trips, cultural, and sport activities (Vélez, L. 2001). In a five year span the enrollment was

duplicated from 200 to nearly 400 students at the Land Surveying and Topography Program. For the summer of 2005, the Internship was re-focused on retention, so that a high percentage of the students will reach the goal of graduating from the bachelor program in Land Surveying. On September 23, 2005, counselors and teachers from different high schools received an orientation on the Land Surveying and Topography Program so that they could present it to the students before recruitment. A poster and a brochure were developed for distribution, where the definition and insight of the Land Surveying profession was published. Figure 6 shows the poster and demonstrates the growth of the program.

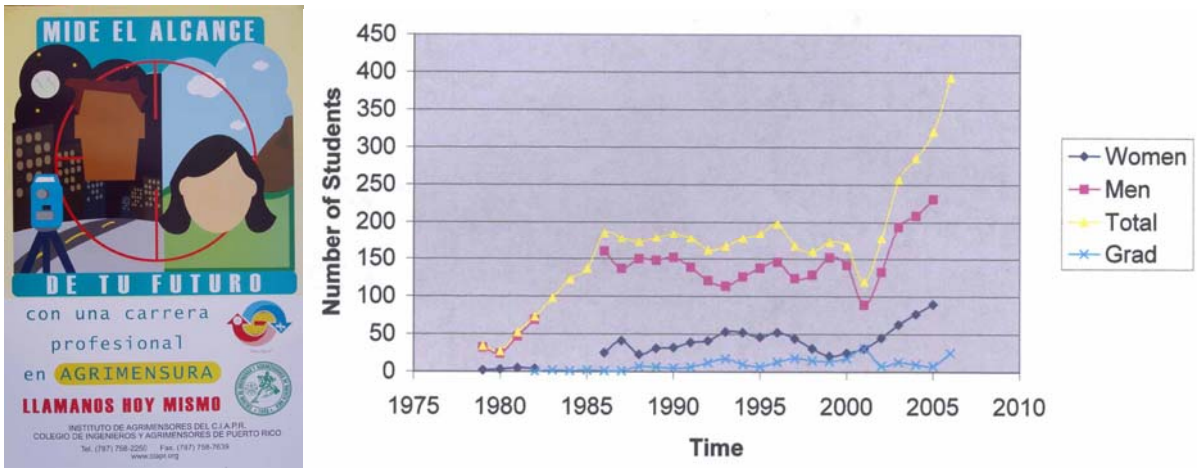

Figure 6 - Promotion Poster and the Land Surveying and Topography Program Statistics since the beginning (1979 to 2006).

The re-focus to retention, has the idea of developing a sense of belonging, so they can identify themselves with a professional group and get tied to it, from the beginning of their students years (Vélez, L. 2005). For this reason the land surveyors worked close with the student chapter that sponsoring activities to fulfill that goal. During the academic year of 2005-2006, this Internship sponsored the orientation to the freshman students, preparing each one of them "A Personalize Survival Kit", that consist of a tote with their name, an umbrella, a water bottle, a notebook with an aerial photography of the town where they live, and literature about land surveying and the curriculum program. Also on September 7, 2005 a film was presented "The Aviator" at the University Auditorium. At the end of the first semester of 2005-2006 a Christmas dinner was also sponsored for the students. During the second semester a team of five students competed in the National Society of Professional Surveyors (NSPS) contest, obtaining a third place prize, this was the first time that the University of Puerto Rico participated in this activity. That was part of the Annual Convention of the American Congress on Surveying and Mapping (ACSM) held in Orlando, Florida during April 22 to 26, 2006 (Vélez, L. 2006). The Institute of Land Surveyors was their main sponsor. On May 2, 2006 a conference entitled "Your personal and professional success" by Dr. Miguel Rivera-Cuadrado was held to all the students in the land surveying program, as part of the internship retention program.

For the High School program, the Institute of Land Surveyors, in conjunction with the National Society of Professional Surveyors co-sponsored a trigonometry competition known as "TRIG-STAR", for high school students. On March 10, 2006 over 100 students took the test for the selection of the TRIG-STAR award for Puerto Rico. The winner will compete at a National Level. This TRIG-STAR program is used for recruiting high school students for university levels.

5. CONCLUSION

The University of Puerto Rico and the Colegio de Ingenieros y Agrimensores de Puerto Rico has a great challenge, because history has allowed us to occupy a very excellent seat of honor in the development and infrastructure of Puerto Rico and we have the responsibility of guarding to continue making the pertinent contributions to the foundation of our physical, social, and economic development.

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BIOGRAPHICAL NOTES

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Ms. Linda L. Vélez-Rodríguez has a BS in Civil engineering from the University of Puerto Rico at Mayagüez and a MS degree in geodetic science from The Ohio State University at Columbus, Ohio, USA. Ms. Vélez-Rodríguez is a full professor at the Land Surveying Program of the Civil Engineering and Surveying Department of the University of Puerto Rico at Mayagüez. She also is a Licensed Professional Engineer and Professional Land Surveyor in Puerto Rico. Ms. Vélez-Rodríguez was elected President of the Professional Land Surveyor Institute of the "Colegio de Ingenieros y Agrimensores de Puerto Rico" for the 2005-2006, and re-elected for the 2006-2007. She participates in conferences, seminars, and workshops, as well as contributing numerous articles to technical journals published by the Puerto Rico's Engineers and Land Surveyors Association and others. In addition to teaching, she does consulting as expert witness in Land Surveying cases. She is a member of the Editorial Advisory Board of the Journal Surveying and Land Information Systems, published by the American Congress on Surveying and Mapping, a "Geodetic Liaison" for the National Geodetic Survey since 1999, as part of the Memorandum of Understanding between National Ocean and Atmospheric Administration and University of Puerto Rico at Mayagüez. Her research topics interests are on Remote Sensing, Geographic Information Systems (GIS) and Global Positioning Systems (GPS) with several federal and local agencies. She is a member of the following professional organizations: Society of Women Engineers (SWE); American Society of Civil Engineers (ASCE); American Congress on Surveying and Mapping (ACSM); Sociedad de Ingenieros de Puerto Rico; Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR) to which all Registered Engineers and Land Surveyors must belong by Law; National Geographic Society, and Sororidad Honoraria de Educadoras ADK-Capítulo Delta.

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