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# UPR/PUPR/ATI Professional Development Program: A Multidisciplinary Approach to Public Transportation and Sustainable Development

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## Abstract

The UPR/PUPR/ATI Professional Development Program was established in August of 2004 as a cooperative project between the Mayagüez Campus (UPRM) and the Río Piedras Campus (UPR-RP) of the University of Puerto Rico, the Polytechnic University of Puerto Rico (PUPR), and the Integrated Transportation Alternative (ATI). The Puerto Rico Transportation Technology Transfer Center (PR-T<sup>2</sup>) at the UPRM Department of Civil Engineering and Surveying coordinates, plans, and executes the program activities as part of its mission of educating and training the current and future generations of transportation professionals.

The program is based on four focal principles: 1) real learning experience, 2) multi-disciplinary approach, 3) applied-research, and 4) leadership development. The main goal of the program is to foster applied research projects in topics related to the public transportation system and the associated urban development of the San Juan Metropolitan Area (SJMA). Among the program benefits are the development of local skilled professionals capable of planning, designing, building, and operating urban transportation systems as part of interdisciplinary teams who are conscious of and able to integrate multiple aspects and impacts of transportation solutions as well as to contribute to the sustainable development of our cities, to improvement in the quality of life of the population and to the optimization of the public resources.

## Introduction

Puerto Rico has an extensive road network of approximately 16,000 miles that serves a population of more than 2.06 million registered drivers and over 2.38 million registered vehicles. Metropolitan areas on the island experience intense traffic congestion throughout their urban networks due to the extensive use of the private vehicle as the primary mode of transportation. This situation leads to a significant reduction in the quality of life, economic losses due to time spent in traffic congestion and environmental pollution, among other undesirable outcomes. The high motorization rate of the island of 659 registered vehicles per 1,000 people (Lobato and Curi, 2005) is a direct effect of the increasing demand for transportation mobility, the lack or inefficiency of transit services and the wide availability of the private vehicle.

A key aspect to reduce the dependence upon private vehicles is the development of a comprehensive, reliable, and

sponsored public transportation system (PTS). The success of a PTS implies the adequate integration of the planning, design, and the establishment of routes and modes. This integration should consider the impact and interaction with urban planning and growth, and promote sustainable development in the planning, design and implementation of educational campaigns, promotions and incentives, and the optimization of operational and maintenance aspects of the infrastructure. These aspects involve professionals from the fields of engineering, planning, architecture, social sciences, environmental sciences and business administration, among others.

## THE UPR/PUPR/ATI PROFESSIONAL DEVELOPMENT PROGRAM

The UPR/PUPR/ATI Professional Development Program, in operation since the summer of 2004, integrates students and faculty from eight disciplines, three campuses, and two universities: the Mayagüez and Río Piedras Campuses of the University of Puerto Rico and the Polytechnic University of Puerto Rico (PUPR) through the Puerto Rico Highway and Transportation Authority (PRHTA) and ATI. The UPRM is continuing this successful venture as the lead university through the PR-T<sup>2</sup> Center. The program is directed by Dr. Benjamin Colucci-Rios, the principal investigator (PI) for the UPRM, in collaboration with Dr. Gabriel Moreno-Viqueira, the PI for the UPR-RP, and Dr. Gustavo Pacheco-Crosetti, the PI for the PUPR. The UPR/PUPR/ATI Professional Development Program follows in the steps of the first development program that had the collaboration of the Tren Urbano (TU) Office, the UPRM and UPR-RP campuses and the Massachusetts Institute of Technology (MIT).

The primary program objective is the development of local professionals and leaders able to plan, design, build, operate, and maintain a PTS. Other objectives are to: 1) strengthen the education and research in key transportation infrastructure-related disciplines, 2) establish an interdisciplinary cooperative model between engineering, architecture, urban planning, business administration, environmental sciences and social science professionals working alongside government and industry officials, and 3) develop a cooperative relationship between the UPR, the PUPR and the Puerto Rico transportation agencies.

The UPR/PUPR/ATI Professional Development Program exposes students to the SJMA complex transportation environment through an applied research experience that has the following stages:

### 1. Formative Stage:

- Introduction to the formal research process with emphasis on topic selection, literature review process, establishment of objectives and scope, and formal project writing and presentation.
- Introduction to public transportation and urban planning aspects with examples from Puerto Rico and other countries.
- Exposure to current data from government officials and private consultants associated with the SJMA public transportation system, the urban planning process and current developments.
- Experiencing the SJMA public transportation system: Students and faculty use the *Tren Urbano*, the AMA (*Autoridad Metropolitana de Autobuses*) and *Metrobús* bus systems, and *públicos* to travel around the SJMA. They have also the opportunity to evaluate the urban environment and the quality of the pedestrian facilities.
- Experiencing public transportation in other environments: a technical trip is made to a city with an established public transportation system to evaluate the key elements of its operation, find the lessons learned, and make comparisons with the SJMA system.

### 2. Research Topic Selection and Proposal Development Stage:

- Under the guidance of the faculty advisors, the students select a research topic that can contribute to the vision, mission and goals of ATI.
- A formal research proposal is written that includes literature review and study of antecedents, and the clear formulation of project objectives, scope, methodology, and schedule of activities.
- The research topic and proposal is presented orally, in order to receive the input and recommendations of all faculty members and the other students in the program. This task contributes a multidisciplinary point of view to each project, and also contributes to the formation of each student by exposing him or her to the other projects.

### 3. Research Project Development Stage:

- Students develop the proposed research topic under the guidance of faculty advisors.
- A formal research report is written, including the proposal, the application of the methodology, the outcomes and benefits, and recommendations for further studies.

- The progress of the project development is presented orally to the faculty and students at two stages of the program.
- A final project report is presented in the form of a written report, research poster, and an oral presentation. Personnel from ATI and other transportation-related government agencies are invited to this activity, together with personnel from the private sector, and the professional community in general. The research reports developed during the first three years of the project can be obtained at <http://uprati.uprm.edu>.
- The distribution of students that have participated in the program during the first four editions is as follows: 45 from UPRM, 22 from UPR-RP, and 18 from PUPR. Table 1 summarizes the number of students per discipline.

**Table 1: Number of Students per Discipline**

Discipline	Number of Students
Architecture	9
Business Administration	5
Engineering:	
• Civil	35
• Computer	4
• Electrical	1
• Industrial	5
• Mechanical	4
Environmental Sciences	3
History and Political Sciences	1
Planning	11
Psychology	1
Social Sciences	6

Research has been directed at developing strategies and studies for the promotion, planning and development of public transportation in the SJMA. Examples of research topics are: 1) transit-oriented developments (TOD); 2) analysis and design of non-motorized modes of transportation (pedestrian and bicycle); 3) modal integration; 4) strategies to increase ridership; 5) evaluation of new routes and route realignment; and 6) economic impact of public transportation versus car dependency.

Each university participating in the program contributes different aspects to the integrative and interdisciplinary understanding of transportation issues. Figure 1 presents this integration, and summarizes some of topics that have been supported by each campus. It is important to point out that the program gives emphasis to the idea that the development of a comprehensive PTS includes not only transportation engineering aspects, but also other engineering disciplines, architecture, planning, social sciences, environmental sciences and business administration.

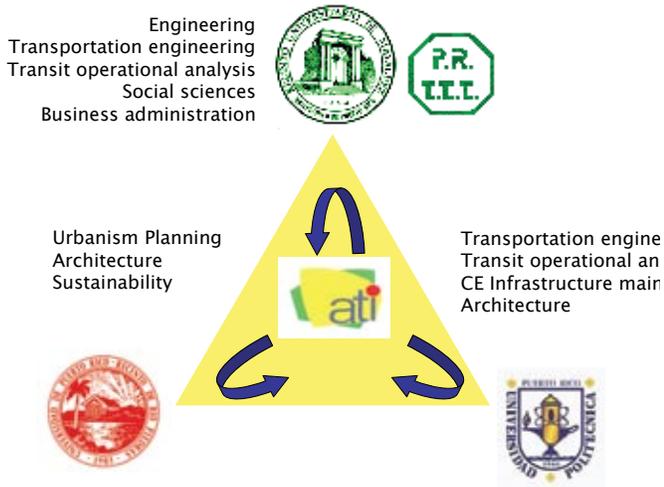


Figure 1: UPR/PUPR/ATI multidisciplinary-multicampus-multi-institution nature

For instance, the UPR-RP component contributes to the two engineering-based campuses by bringing concepts of urbanism and sustainable development as key elements in the study of transportation. Urbanism is the study of the organization, planning, design, economics and environmental dimensions of urban development. Urbanism has had a great influence in the professional development of students from all disciplines. Integrating transportation and urbanism concepts is crucial in developing a livable urban environment. The scope of the research projects and training in the program includes envisioning the integration of transportation and urbanism to provide a better quality of life in the SJMA, not defined merely as having less traffic congestion, but rather having a city with public life in the streets and public spaces, security, environmental quality, leisure, accessibility to jobs and a vital economy. The research projects have focused on the creation of a city that promotes a healthier balance among cars, public transportation, pedestrians, public space and in some cases, bicycles. The pedestrian has been emphasized not only because it is part of ATI, but because the user of public transportation is ultimately a pedestrian. Transit services cannot be viable without quality pedestrian-oriented urban space. The concept of sustainability is also key as a guiding principle in professional work in an era in which climate change and global warming are central issues for the planet.

### EXAMPLE OF PROJECTS DEVELOPED

A brief description of two research projects developed in the program is presented below. The description includes the project title, the students and mentors, and a summary of the project.

- Title:** Intermodal Integration at Bayamón Station.
- Students:** Gilberto Vigo (Architecture) and Frances Tatis (Civil Engineering)
- Mentors:** Gustavo Pacheco-Crosetti and Amado Vélez-Gallego

**Project Summary:** The final project report consisted of a 211-page document that proposed a categorization of modes around the TU Bayamón Station where the heavy rail acts as the main system; the AMA as a local feeder, and “públicos” as regional feeders. New routes and corridors are proposed for AMA taking into consideration the principal trip generators within the Bayamón area. A diversification of the bus types is proposed according to the area to be served. The final project also proposes the location and design of new bus stops, by taking into consideration the circulation of users, the required vision of the users, the appropriate location of signs and urban furniture, the supply of adequate information to the users, and the architectural identity of the system (see Figure 2). The location and basic design of a transfer station is also developed.

- Title:** The Pedestrian Accessibility of Las Lomas Station of the Tren Urbano.
- Student:** Angela Matos (Group III, UPRM Civil Engineering)
- Mentors:** Felipe Luyanda Villafañe and Alberto M. Figueroa Medina

**Project Summary:** The Las Lomas Station, as of 2006, had the lowest ridership participation of the Tren Urbano rail system. The research objective was to identify strategies to increase the number of riders using the station. The project tasks included surveys and interviews to nearby residents and workers to assess their opinions regarding the services near the station, the quality of the pedestrian facilities and the accessibility of the public transportation services. A qualitative and quantitative analysis was performed to evaluate the level of service and quality of the pedestrian infrastructure near the station (Figure 2). Recommendations to improve the pedestrian infrastructure were given to improve the user accessibility of Las Lomas Station.



Figure 2: Proposed new AMA station (Tatis and Vigo, 2005)

### Conclusions

The UPR/PUPR/ATI Professional Development Program is a dynamic and productive multidisciplinary, cooperative, applied-research program with emphasis on public transportation and sustainable development. The evidence of the success of this program as well as the initial UPR/MIT/Tren Urbano program is its students. Around 70% of all the participants have been involved with government agencies or private industries or consultants that are related to public



Figure 3: Pedestrian facilities at the Las Lomas Station neighborhood (Matos, 2006)

transportation in the SJMA.

Each research project provides a well-documented report that can contribute to ATI (and other agencies related to transportation and urban development) in several aspects associated with the planning, decision-making, design, and operation stages of the public transportation and urban development projects. The program also helps involve students and faculty in thinking beyond of the typical boundaries of their respective disciplines to find integrated solutions to critical aspects of the urban development of the AMSJ transportation system.

### Acknowledgments

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