Universidad de Puerto Rico
Recinto Universitario de Mayagüez
SENADO ACADEMICO
Mayagüez, Puerto Rico

Certificación Núm. 69-16

Yo, Gloria A. Viscasillas, Secretaria del Senado Académico del Recinto Universitario de Mayagüez de la Universidad de Puerto Rico, CERTIFICO:

Que en reunión ordinaria celebrada por este organismo el martes 21 de octubre de 1969 se aprobó por unanimidad el establecimiento de un INSTITUTO DE TRANSPORTACION adscrito a la Escuela de Ingeniería.

Se incluyen y forman parte de este documento copia de la propuesta sometida por la Facultad de la Escuela de Ingeniería y copia del Informe del Comité de Asuntos Académicos.

Y para que así conste, expido y remito a las autoridades universitarias correspondientes la presente certificación hoy día veintidós de octubre de mil novecientos sesenta y nueve, en Mayagüez, Puerto Rico.

Gloria A. Viscasillas
Secretaria

Anejos

Universidad de Puerto Rico
Colegio de Agricultura y Artes Mecánicas
SENADO ACADEMICO
Mayoguez, Puerto Rico

INFORME

A : Miembros del Senado Académico

De : Comité de Asuntos Académicos

Asunto: Establecimiento de un Instituto de Transportación

El Senado Académico acordó remitir al Comité de Asuntos Académicos para su consideración y recomendaciones la Propuesta de la Facultad de Ingeniería para el Establecimiento de un Instituto de Transportación.

Después de estudiar la propuesta sometida, después de deliberar en detalle sobre la misma durante varias reuniones del Comité y después de discutir con el Decano de Ingeniería algunos detalles e implicaciones relacionados con el Instituto de referencia, el Comité de Asuntos Académicos concluye y recomienda lo siguiente:

Recomendamos que se acepte la petición de la Facultad de Ingeniería por las siguientes razones:

1. Sería una magnífica oportunidad para que el Colegio tome participación activa en los problemas de transportación y de carreteras de Puerto Rico. Existe una gran deficiencia en la preparación de técnicos en estas disciplinas. Las agencias que bregan con transportación tienen que recurrir constantemente a consultores para realizar los estudios pertinentes.

2. Se podrían desarrollar técnicas e investigaciones sobre las características especiales de Puerto Rico sin tener que adoptar normas de otros países que no son necesariamente aplicables a Puerto Rico.

3. Hay una magnífica oportunidad de obtener fondos federales. El gobierno federal, mediante legislación, ha aprobado la concesión de fondos a universidades para investigaciones y entrenamiento de personal en esta área.

4. Sería recomendable crear un organismo de esta naturaleza para enfocar los problemas de transportación desde el punto de vista social, económico, físico, etc., por lo cual mucho de nuestro profesorado que tiene preocupaciones sobre el particular podría participar activamente. Esto ayudaría grandemente a la integración de la labor académica y de investigación de los diferentes Departamentos.

5. Existen Institutos de Transportación en muchas universidades tales como el de Tejas, Northwestern, Cornell, California, Purdue y MIT, los cuales están realizando una labor sobresaliente. Las agencias usan estas Universidades para sus estudios, lo cual redunda en beneficio de todos al producir información y técnicas valiosas a la vez que se prepara más y mejor personal técnico.

6. El liderato e iniciativa en estas áreas debe ser nuestro.

Respetuosamente sometido,

COMITE DE ASUNTOS ACADEMICOS

Virgilio Biaggi
Presidente.

9 de octubre de 1969

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UNIVERSITY OF PUERTO RICO
SCHOOL OF ENGINEERING
MAYAGUEZ, P. R.

A PROPOSAL TO ESTABLISH A TRANSPORTATION INSTITUTE

INTRODUCTION

Puerto Rico occupies a unique position in the world today. The extraordinary transformation of an overpopulated tropical land 1/ with meager natural resources spells hope for other developing countries in Asia, Africa and Latin America whose population growth demands the maximum use of their resources. Thousands of foreign observers have visited the island to learn and to carry back home information on the methods and techniques that have made possible the progress achieved. Some of the indicators of socio-economic progress 2/ where outstanding change has occurred are in the per capita income, gross national product, life expectancy, literacy, motor vehicle registration, kilometers of roads, birth rate and death rate.

1/ The density of population is about 800 persons per square mile equivalent to a 1968 population of 2,736, 000 in an area of 3435 square miles.

2/

ITEM	1940	1965	Estimated 1968
Per capita income (1965 prices)	$263	$884	$ 1100
Gross National product (1965 prices) (millions)	659.1	2720.5	3300
Life Expectancy (years)	46	69.9	70
Literacy	68.5%	87%	87%

There had also occurred a tremendous growth in the construction industry and in our urbanization rate. The physical growth of Puerto Rico, measured in terms of construction projects can be linked to the engineering field. Roads, expressways, ports, airports, housing developments, recreational areas, industrial buildings, condominiums etc., have their birth in the drafting and design tables. Our Engineering School has served well toward this end, but the time has come when a deeper and wider knowledge of the disciplines and new technologies involved have to be developed in order to arrive at solutions that are more integrated, sound and longer lasting. We mean by this that no longer can the solutions be based in an engineering approach only but that they have to be coordinated with the social sciences to cope with the needs, desires and aspirations of the people; with the economics field in order to achieve greater productivity with less cost; with the planning field in order to guide and shape the growth; with the cultural forces in order to produce solutions that are fitted to our ways of being

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2/ cont.

Item	1940	1965	Estimated 1968
Motor vehicle registration	26,847	318,809	473,000
Roads (kms)	2,394	5,294	6,200
Birth rate (per 100 pop)	39.0	31.1	30
Death rate (per 100 pop.)	18.0	6.4	6.4
Population (thousands)	1,869	2,664	2, 736

and customs et. all. 3/

Furthermore, the resulting methods and techniques could be fitted to areas in the United States to Latin America and other countries with characteristics similar to ours. Our contribution can be great if we take the necessary initiative by creating the corresponding teaching and research bodies that will devote themselves to the study and analysis the current and future problems that need to be solved in order to achieve the desired balanced between growth and services and facilities. Steps have been taken toward this end by the creation of the Water Resources Institute at the School of Engineering. The next steps which we analyze here, should be the creation of a construction institute and a transportation institute in the School of Engineering.

TRANSPORTATION INSTITUTE

Transportation Criteria

The mobility of people and goods is a prerequisite for a continuous growth and for greater economic productivity. Mobility is a binding force that gives coherence and meaning to the numerous social and economic forces that unite the urban and rural areas and the people that live in them.

The task of transportation is to move people and goods from place

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3/ Humanities, public health, education , business, public administration, law, natural sciences, architecture, etc.

to place. There should be a balance of the public services with the private rights of access and movement and the tastes and preferences of the people with respect to mode of travel, route, comfort and cost. There are three main factors to be considered in transportation that is the user, the channels of movement and the terminals and the modes of transportation.

The user moves for the purpose of work, business, shopping, recreation, school, etc. He must have different choices as to the mode of travel and the route. The user has some physical and emotional characteristics that must be understood.

The channels of transportation may be by air, water or highways. The terminals include the ports, airports, parking places, garages and similar facilities. The spatial organization and distribution of this channels of transportation must serve the different land uses and the same time must shape and guide the future development in order to promote an orderly and efficient use of the land. The channels must be able to handle traffic at a reasonable cost with relative convenience, safety and comfort.

The modes of transportation are the automobiles, buses, trucks, airplanes, ships, conveyors and similar mechanical devices. The pedestrian or moving by foot is another mode of transportation.

All the factors mentioned should be considered together because transportation is a comprehensive system of interrelated activities. There should be recognition of the importance of land uses, demographic and social characteristics and consumer choices in determining transportation requirements. Above all there should be a continuous evaluation of present modes and techniques and the evaluation of new ones to deal with the changing technology and the socio-economic change occuring.

The transportation system must be regional and multipurpose in scope so as to serve well the needs and desires of our ever growing population, the rapid increase in automobile registration and travel, the increasing urbanization rate with the related land uses, and the development of new industrial, commercial and recreation areas. The transportation system must reflect the structure, economy, functions and special characteristics of the areas they serve.

Transportation in Puerto Rico

Puerto Rico depends on air, water and surface transportation for the movement of persons and goods. Puerto Rico must seek overseas for the larger part of its consumer goods and raw materials, as well as for buyers for its industrial and agricultural products.

Cheap efficient land transportation is necessary to link different points in the Island and to provide and adequate flow of goods and services. Air and sea transportation must be brought to a maximum efficiency and economy to offset the disadvantages of the ocean barrier that separates Puerto Rico from the mainland.

Air transportation has grown very rapidly. The Puerto Rico International Airport, built in the year 1955 to serve for a period of 20 years, has surpassed the most conservative passenger projections 4/. The airport terminal building has been expanded and a new runway is under construction. There are also plans for a second international airport at the Southern part of the Island. The Mayaguez and Ponce Airports have also had a trmendous increase in air traffic which has surpassed all calculations. There has been a considerable increase in the number of private planes and several small airports have been constructed.

All this factors have to be evaluated and continous research is needed to determine the effects of this trend in the land uses, the economy and other modes of transportation

Water transportation has also envolved rapidly in the last years. The use of vans and containers has improved and accelerated the handling of cargo. The construction of new facilities include the Puerto

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4/ During the first half of the year 1968 more than 2,000,000 passengers moved throught the P. R. International Airport. This surpasses the estimates made for 1980.

Nuevo Terminal with new berths for 13 ships, development of 535 acres of land. buildings for wholesalers and exporters, feed mills and grain elevators and the corresponding parking and truck terminals.

The use of heavy trucks for the transportation of goods to other towns and cities bring problems of congestion and wear of the existing roads This has to be evaluated from the structural and geometric highway design point of view and as a regional planning problem. There has to be a cost allocation analysis to determine the share of the cost of highways by the different users.

The ports at Ponce and Mayaguez do not handle enough cargo to make them self sufficient. The number of employees working in these ports have been reducted to a minimum creating problems for the families that made a living from this source.

Water transportation should be also evaluated for tourism development. The coast line of Puerto Rico is a great asset that has to be explored for this purpose. There is also the possibility of using water transportation for passengers especially in the San Juan Metropolitan Area.

Surface transportation is one of our greatest problems. Research and analysis are urgently needed in these field.

By the year 1950 we had only 57,120 motor vehicles in our roads. This number increased to 473,000 according to the latest figures. The projections are for 1,000,000 vehicles in the year 1986. In constract with this rapid increase in vehicle registration, our road network is basically the same.

The increase has occured mainly in the municipal system that gives access to rural areas. There are only some 820 kilometers of primary highways and 1930 kilometers of secondary highways. These roads do not meet the design standards for speed and safety according to the traffic volumes handled. 5/ The new roads constructed - Aguadilla to San German, Humacao to Juncos, Río Piedras to Fajardo, do not have control of access, a feature that makes them local roads in a short period of time because of the accelerated marginal development.

There is also the problem of rising costs in construction. New methods and materials should be developed to lower this costs. Here is a wide field for research.

The Role of the Transportation Institute

The topics discussed reveal that there are many problems to be solved in the transportation field.

No longer can we tackle the transportation problem as a separate one. The other disciplines have to come into the picture so as to analyze the transportation problem in all its perspective.

In Puerto Rico, as well as in the United States 6/, there are not enough engineers and technicians trained in the transportation field. First, there is the need to establish a training program 7/ with the pertinent courses instruction according to the latest criteria and knowledge.

5/ Exeptions on a few kilometers of expressways constructed in the San Juan Metropolitan Area.

6/ There is a need of 3,000 traffic engineers in the United States.

7/ The proposal for the curriculum in highway and transportation will be presented separately.

Second; there is the need of constant research. We must find new ways and solutions applicable to Puerto Rico. As mentioned before, these findings could be eventually adapted to areas inhabited by Puerto Ricans in the United States and do similar areas in Latin America.

Aside from some courses on highways and some work done by the Soils and Highway Laboratory nothing is being done in Puerto Rico towards an integrated research analysis for finding new solutions to our transportation problems. The need for expanded research has been recognized in the United States and there are proposals for the creation of similar Research Institutes.

The Transportation Institute can make a great contribution in various fields. We will analyze the types of problem areas and how the transportation Institute fits into them.

Planning Areas

Planning may be defined as the preparation for action, the gathering of the pertinent information and fact and the evaluation of them establishing goals for the future. It consists of four basic steps; survey and analysis, goal formulation, plan preparation and plan effectuation.

In relation to the transportation planning, the Transportation Institute can work in the development of new statistical and computer methods for determining and predicting the generation of traffic by the different land uses and the distribution of this traffic in the different roads and streets. As it is known, some types of land uses such as commercial areas and industrial sites, generate considerable amounts of traffic. The urban areas are choked with traffic because of the same intense use of land. The so called master plans for development have been used to guide the growth but a more detailed analyses is needed of the before and after effects of traffic. We see the urban sprawl and feel the traffic problems but we are not analyzing past experience to avoid the same mistakes. In other words, we have our eyes opened but we are not seeing.

There has to be a real insight of the problems, what causes them, what can be done to channelize the growth in a more effective way and to avoid the "learn as you go" process.

It is also evident that the analysis of transportation abroad variety of impacts of the transportation systems which have been termed "social consequences" has not received adequate treatment in the planning and evaluation processes. The tendency has been to examine the many types of social consequences as response to complaints and criticism . The results of this incomplete analyses is that transportation planners frequently find themselves trying to ameliorate undesirable

consequences while they continue to find difficulty is presenting more favorable economic and social effects.

The Transportation Institute can work together with the social scientists and economists, in evaluating existing methodologies for alternative transportation plans. Techniques must be developed for continuously rating the performance of the transportation systems. It can get deep into the current criteria and use of data, for determining its flaws. This can be done with the agencies concerned on a mutual agreement bases as will be explained later.

A second frame for investigation and research can be the evaluation of plans in terms of the relative values of the returns resulting from the resource investments or the input output relationships. Of particular interest can be the evaluation of the construction of municipal roads when the population is moving to the urban areas and when agricultural production is not significant. Many of the new rural roads being constructed might not be needed shortly. By the same token, road life studies are needed to find out the best methods of construction that will cost less in the long run. The reconstruction programs are taking more than their share in the highway programs, at the present time.

The research has to be focused upon the process of transportation plan evaluation and upon strategies for improving it. The evaluation values, goals, objectives as well as the characteristics of the environment and the available transportation alternatives may result different from the criteria now being used and may even be different for each region of Puerto Rico. The above mentioned research approaches apply to air, water and surface transportation, each one on its own perspective but integrated to the others.

The scope of this type of research, in the transportation planning field, falls within the abilities and the initiative of the available research personnel for the institute but we feel that social scientists and economists will be more than willing to undertake this type of research.

Economics and Finance

Puerto Rico has to use its resources in the most efficient and wisest way. Each year a large portion of our budget is used for transportation systems,. They will be require about 2.5 billion dollars up to the year 1968.

10/ 13.1% of budget devoted to transportation and communication.

The present programs of the Puerto Rico Highway Authority contemplate an average cost of $70 millions per year. The source of these funds are the gasoline tax, federal contributions, general fund apportionments and bonds. According to the studies conducted these funds will not allow the construction programs needed.

There should be an evaluation, which can be conducted by the Transportation Institute, of new methods for the collection of funds for highways such as a revision of the taxes to highway users. The Institute can also evaluate the distribution of funds to the various systems based on the criteria mentioned under transportation planning.

Benefit - cost analysis and related methodologies are common method for applying a criteria of efficiency. This too has to be examined in the light of consequences of intangibles that cannot be measured quantitatively. For example; in the analysis, the asthetic impacts; the effects on human activities when residential, institutional and recreational areas is taken for highways; and the creation of physical barrier in urban areas are not fully evaluated. Many projects are also being "descentralized" so as to give the island an equal share of the progress, but the economic and financial results of these activities or policies, good or bad, is not realized or determined until the programs succeed or fail. There seems to be a day by day approach toward this evaluation and we consider that this is a natural or expected reason because of the same accelerated development.

Here is where the University, and its Transportation Institute could provide a breathing space for the government by providing the necessary evaluation, calm and sound.

Also, the Institute could go into examining the costs of transportation and exploring new ways of handling and transporting cargo that can benefit the private enterprise. Containerization, the use of pipelines and bulk handling could be explored further.

Surveying, mapping and exploration

We have been using the traditional methods of tape and transit for the location and improvement of our roads, ports and airports. The technological advances that have been made in photogrammetry and computers must be used now to keep pace with modern methods. Here we need to train engineers and technicians in this field to get the most of our human resources. (This will be proposed separately in the proposed curriculum).

Photogrammetry is also being widely used in the United States for determining sources field materials. This is of great importance to accelerate our construction programs.

The proposed Institute can begin in these fields by gathering the necessary equipment and researches to train the students and even engineers and technicians that are already working on surveying, mapping and exploration.

Seminars and special training programs can be prepared for these purposes. The governmental agencies have shown great interest in these training programs.

Highway Design

It is necessary to have a greater knowledge of the driver, the vehicle and the road characteristics, in order to design the roads properly to increase their safety, comfort and convenience.

Puerto Rico has a greater death rate per vehicle mile 11/ than the United States. Last year there were 450 deaths in our roads and the rate continues increasing. Research is needed to determine and know the real causes behind these accidents.

The new types of vehicles, especially large trucks, have a determining affects on the elements of geometric design of highways and structures. The same occurs with the new vessels being designed for cargo transportation and new types of airplanes that are in the drafting table. We must be aware of these changes, thru the Institute, to advise and warn the agencies of the changes that can be foreseen.

11/ Death rate per 100 million vehicle miles in 19 4 in U.S. 5.6 and in P.R. 11.8

Structures and Materials

As previously mentioned, the cost of construction is rising every year in Puerto Rico. We must find new and better materials for the construction of transportation facilities. This will have to be carefully studied because we are limited to our own resources. Recent investigations have found that our beaches are being damaged by the continuous extraction of sand. Recently, new light weight aggregates have been developed but at a higher cost. Research must be continued to develop new materials at a lower cost.

New constructing methods for roads, bridges, etc., that will insure safety and beauty as well as speed in construction must be also developed. Engineers and architects must work together toward this end. These disciplines don't seen to have a common end now.

The ideas mentioned before are only a first hand approach indicating the fields where the Institute can work. The number of projects that can be developed, applicable to Puerto Rico, is large. After the Institute is organized; according to their priority, could be undertaken.

Some definite projects are already under the Highway Planning and Research Programs of the Puerto Rico Highway Authority and will be explained later .

In summary, the Institute must do the following:

1. Analysis and design of methods and techniques in the field of Transportation.
2. Evaluate them in the light of present trends and special socio-economic characteristics of Puerto Rico.
3. Determine the special fields of research that have priority.
4. Organize the research to be undertaken according to the particular interests of the research personnel and funds available.
5. Establish public relations and coordination.
6. Expand facilities, personnel and projects.

AGENCIES THAT CAN BENEFIT FROM THE TRANSPORTATION INSTITUTE AND SPECIAL AREAS OF RESEARCH

Puerto Rico Planning Board

The Puerto Rico Planning Board was created in 1942 for the purpose of guiding a coordinated adjusted and economic development of Puerto Rico which, in accordance with present and future needs and human, physical and financial resources will best promote the health, safety, morals, order, convenience, prosperity, defense, culture, economic soundness and general welfare of the present and future inhabitants and such efficiency and economy in the process of the development and in the distribution of population, of the uses of land and of public improvement as will tend to create conditions

favorable thereto". This Planning Board prepares also a master plan "with recommendations for the development of Puerto Rico and may include the general location, character, and extent of the land uses, minerals, water, vegetation and animal life and their present and possible future utilization for mining, power, irrigation, flood control, navigation, institutional, governmental and public-utility facilities and operations".

The Puerto Rico Planning Board has a wide field of responsibilities as can be seen from the above functions and responsibilities. It is the coordinating agency for the other government agencies and instrumentalities. It furthermore covers the whole island, although some regional offices have been established for specific functions.

In spite of the lack of enough trained engineers and technicians, the Planning Board has done a remarkable job. But it can use some help. They have the facts, the data but lack new techniques and methods for evaluating them.

The Transportation Institute can be of great help. As mentioned before the Institute can explore the social consequences of the projects related with transportation. It can also develop techniques and criteria for the evaluation of transportation projects from the location and geometric design point of view. Furthermore it can go into the analysis of the road network, called the Master Plan for Highways which has not been fully revised since its adoption. New routes are being included in the Master Plan for Highways which has not been fully revised since its adoption. New routes are being included in the Master Plan without a definite method of analysis that will locate the projects according to the service they are going to provide.

This can be complemented with the training of personnel in enough quantity and quality to evaluate all the transportation aspects.

It is well to mention that the Planning Board participated in a Transportation Study for San Juan, Ponce and Mayaguez at a cost of more than one million dollars. There is the danger, like with many other studies conducted by consultants, that they are not kept up to date because of the same lack of trained personnel. The School of Engineering and the Institute can certainly fill this gap.

The Puerto Rico Ports Authority

This government instrumentality deals with ports and airports in Puerto Rico.

The Aviation Division promotes and operates the civil airports at San Juan, Ponce, Mayaguez, Arecibo, Fajardo, Vieques and several

other minor airports.

Puerto Rico has experienced a very rapid rise in the movement of of air passengers and cargo. The figures keep mounting up and the facilities are being expanded as needed. This does not seem to be a wise policy because the efforts may be in the wrong direction. There is a proposal even for a new international airport at the sourthern part of the island. This has to be evaluated continuously to determine the effects of this action on the whole island. Even the economic feasibility of the airport itself has to be fully evaluated on the basis of origin and destination of passengers and cargo and the frequency of said trips.

The Ports Authority also needs engineers trained in the design and planning of airports. This a field where there is practically no specialist in Puerto Rico.

Furthermore, new methods to construct and maintain facilities that will continue to be atractive to tourists should be explored. We have must keep ahead.

The Marine Division of the Ports Authority develops and operates shipping terminal facilities and is responsable for the control and maintenance of ports. Puerto Rico depends on marine traffic for the movement of most of the consumer goods and raw materials to and from the United States. Substantial investments have been made in terminals of San Juan, Ponce and Mayaguez.

Facilities have been established for bulk handling of cargo, terminals for trailerships, feed mills and warehouses.

The effects of this technological changes were first evaluated on the basis of the effects on employment on the waterfront. Compensation was given to displaced longshoremen. After this, little research has been done about the later consequences of these changes.

New petrochemical industries have been established at new ones are proposed at Peñuelas, Guayanilla and Yabucoa.

We are sure that the Transportation Institute can do research in the maritime transportation field. New and cheaper methods of handling cargo, by bulk or by pipelines should be investigated. The effects of trailers on the roads must be studied. The economic and social effects of the operation of the different ports must be further investigated.

The Metropolitan Bus Authority

The Metropolitan Bus Authority was formerly a Division of the Ports Authority. In the year 1957 it was organized as a separate Authority. The main responsibility of this government instrumentality is mass transportation in the San Juan Metropolitan Area. It uses buses exclusively for transportation of passengers.

The Bus Authority uses consultants mainly for the determination of routes of service fares and operation costs. With the rapid expansion of the San Juan Metropolitan Area this needs continuous revaluation.

Here, the Engineering School, with the corresponding training of students on mass transportation, can prepare the urgently needed engineers and technicians in this field.

This becomes more important when the Transportation Study conducted in San Juan recommends a rapid transit transportation system at a estimated cost of 282 millions dollars. There is also under study a rail transit system from San Juan to Arecibo. A large number of engineers for planning design, construction and maintenance will be needed.

The Transportation Institute can foster the training of said personnel thru the corresponding research projects, that can also be conducted by graduate students.

The fields of research can be the economic feasibility of similar systems for Ponce and Mayaguez; the effects of other types of public transport like the "publicos", the taxi operation; and their share in the national economy.

The Department of Public Works

In the year 1965, most of the functions of the Department of Public Works were transfered to the Puerto Rico Highway Authority. The Department remained with the functions of maintenance of roads, traffic operations, accident records, the motor vehicle division, and the acquisition of right-of-way for highways.

The Department is badly in need of traffic engineers and technicians trained in highways. The duties of traffic operations, maintenance, accident analysis, etc.require the most advanced techniques to deal with the ever changing traffic conditions.

The Department has done a remarkable job in the gathering of data and facts but it has fallen short in the analysis because of the same lack of technicians and the turnover of personnel. Many of the persons that became qualified to undertake comprehensive studies according to the functions were transferred to higher administrative positions.

The Institute can gather copies of all the data and information in the Department files and evaluate the present situation on the basis of those facts. Acceptable methods used in the past for gathering information and new techniques for its evaluation could be developed.

Another field of research is the effects of land acquisition for highways on land values. We feel that the government should not be paying prices for land that it helps itself to create by providing the necessary accesibility. The legal aspects of land acquisition and dedication, the different methods of appraisal could be evaluated. At the present time, value is determined solely on the market value approach by similar sales, and by negotiation' This, we feel, is leaving out other considerations in determining values that might have serious effects on the future due to the scarcity of land area for construction and development.

The Puerto Rico Highway Authority

This public corporation and government instrumentality was created in the year 1965 for the purpose of buildings highways, bridges, terminals, channels and related facilities. It draws its funds from the gasoline tax, federal funds, apportionments from the General Fund and bond emisions.

This entity, we feel, is the one that will benefit the most from the creation of a Transportation Institute. The research indicated previously in the fields of planning; geometric design; materials and structures; surveying, mapping and photogrammetry; and economics and finance can be fully used by the Highway Authority.

The Highway Néèds Study recently conducted by this Authority, at a cost of $325,000, has to be kept up to date. This needs to be evaluated carefully in viewof the cost of the study. Basically the study is a highway defficiency study including some recommendation as to financing. The social aspect is missing and needs further study.

The Author ity also makes studies of truck weight, capacity, volume, speed, road inventories, road life and others. The analysis of this information is very defficient because of the lack of trained personnel.

The Authority sends one or two engineers every other year to study Traffic Engineering in the United States. This is a very slow process. The School of Engineering could provide the courses to train enough engineers in this field if the proper promotion is made.

The Transportation Institute can undertake the various fields of research mentioned. It can make a special contribution by evaluating the present methods used for planning and construction. The field of roadside zoning and development is a promising one for study and research.

The Authority has also contacted the School of Engineering for the undertaking of the research projects under the Federal Highway Planning and Research Program. One of the projects," Behavior of Asphaltic Concretes" has funds available in the amount of $9000. Another study is the Aggregate Survey for Puerto Rico. The Transportation Institute will be more than willing to undertake this studies as the first projects.

The Bureau of Public Roads

This is a Federal Agency, pertaining to Region No. 1 of the Federal Bureau of Public Roads, that is in charge of administering and supervising the use of federal funds apportioned to Puerto Rico. The average amount is about 6.4 million dollars per year. These funds are used for land acquisition, and construction of primary, secondary and urban

They also participate in the Highway Planning and Research Program, the Screening of Junkyards, Roadside Adversement Control, and Landscaping. Among their functions is the approval of plans, supervision of construction and planning.

The Bureau is hiring engineers from Puerto Rico and sending them for further training in highways in the United States. They are also interested in conducting research studies under the Highway Planning and Research Program. This is a prerequisite for the apportionment of Federal Funds.

The Institute will aid this agency in the same degree as the Highway Authority because of the similarity in functions.

Private Firms

There are many private firms in Puerto Rico that do consulting work in the fields of transportation and mostly in the design of highways. This firms get their personnel from other agencies and from abroad. They are in need of more qualified personnel to do their consultant work and in need of specialists that will perform specific studies and research pertaining to the many facts of planning, design and construction.

For example, the estimates of the capacity of the highways, after being designed have to be checked. They depend on the engineers of the Highway Authority to check the figures. This is a very slow process

because of the large amount of work that must be done by a couple of qualified engineers. The Institute could help in this type of work by undertaking the necessary revisions with the consent of the agency concerned. This can accelerate the approval of plans. At the same time, the personnel working on this studies get more training for the general benefit of all.

The private firms have to be aware of the information that is already available. Large amounts of money can be saved by avoiding duplication of effort. The Institute can gather in its files all the available information as well as a copy of each of the area of interest and make it available to the private firms. This needs a great effort and full cooperation from the agencies in order to have a complete file of reports, studies and statistics. By the same fact, the Institute can diseminate the information and reports of interest that have been conducted abroad.

The Mayaguez Campus

The proposed Institute, as has been mentioned, can bring together various disciplines to work comprehensively toward a common end. It will require the participation of social scientists, economists, statisticians, planners and others in the different projects. This will undoubtedly help the existing courses in the Engineering Departments and other Departments because it will foster interest and will bring reality into

the picture. A course devoted to the book only is not as good as if actual experience from this approach.

The Institute will also be aware at every moment of the financial aid that the University can get for the purpose of Transportation Research. At the present time we know of federal funds available to Universities for purposes of research that have or can not be used because there is no Transportation Institute formally operating.

The Institute, through the School of Engineering, can certainly become a leading entity in the transportation field. The undertaking of seminars and special courses, and bringing the top best lecturers in this field to P. R. will undoubtedly create the right climate for asuming a leading role in transportation.

ORGANIZATION AND FUNCTION OF THE PROPOSED TRANSPORTATION INSTITUTE

Purpose: To carry on education and research related to the design, construction, operation and maintenance of highways, airports, ports, and related facilities for public transportation, and to the interrelated problems of design,control, safety, economics, finance and social aspects involved.

Functions: The functions of the Institute will be to (1) support the educational programs in Highways, Transportation and Planning offered in the Engineering School, particularly at the graduate level (2) to offer professional educational opportunities for these practicing in the transportation field and (3) to provide services appropiate to the role of the Institute to agencies and private firms.

Funding: The Institute will have an operating budget from the University funds, supplemented by contributions form the agencies, the general fund and other Federal apportionments that can be made available to universities for Research. Funds can also be collected from work to for private consultants in the transportation field.

Organization: The Institute must have a Director who will be under the Dean of Engineering. The Director will be responsible for the administrative details, organizing the research personnel and promoting the further development of the Institute.

. An Advisory Board should be appointed by the Chancellor to give the Institute the benefit of a range of vewpoints by those concerned with different aspects of Transportation. The Board should consist of individuals representing the various sectors that are more linked to the transportation field and the transportation industry and will be selected after a further analysis.

The Staff of the Institute will consist of the professors and graduate students interested in the Transportation field.

Activities: The Institute will be able to support graduate instruction by the development of research laboratories, by making facilities (such as a research library collection) available for student use, by extending the exposure of students to ongoing research programs; and if possible, by giving them financial support.

Graduate enrollments on transportation engineering should be built around a group of transportation engineering courses which include emphasis in the economic, social and intermodal aspects of transportation including courses in various other departments.

Other graduate students can undertake programs in soil mechanics, bituminous materials, photogrammetry and construction. Research Projects to be undertaken can be classified under the following headings:

1. transportation theory
2. transportation engineering economics and administration
3. highway planning, design and operation

4. traffic engineering

5. human factors

6. airport and port planning, design and operation

7. vehicle, equipment, illumination and sound

8. materials and structures

9. regional development

Other activities: The offering of short courses, special courses, seminars and conferences should be encouraged and stimulated by the Institute.

Publications: Research and special reports, information, circulars and bulletins, and other material originating at the Institute should be available and disseminated.

Facilities: The space to be occupied by offices, equipment, classroom, etc., should be carefully planned. An extensive transportation research library should be organized.