Automatic Vehicle Location (AVL) and Automatic Vehicle Identification (AVI) Systems

(Included in Daniel Rodriguez's paper)

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Automatic Vehicle Location (AVL) and Automatic Vehicle Identification (AVI) Systems

A .Definition

Automatic Vehicle Identification (AVI) is a term that refers to technologies that make it possible to electronically recognize and even communicate with vehicles in motion without physical contact between the vehicle and the roadside equipment. The basic components of all AVI technologies are an on board unit (OBU) with vehicle identification data, a roadside transmitting/receiving unit to signal the vehicle and receive information, and processing equipment to handle the information. The following is a description of the current technologies used in AVI.

Optical and Infrared Systems

Optical systems use roadside equipment which reads optical information such as the vehicle identification number (VIN) and processes this information according to the purpose of the system. Infrared systems work like optical systems but use infrared frequencies. The most reliable of the these systems use bar code reading technology. In this system a helium-neon laser beam is used to scan the bar code pattern on a plastic sticker located on the windshield of the vehicle. The speed of the data transmission is about 2.5 milliseconds (G). The bar code consist of a series of stripes of varying widths and colors which correspond to the VIN of the particular vehicle. The vehicle information is then used to conduct the transaction. The range of speed for dependable readings is from 30 to 55 mph at distances from 7 to 10 feet(G). Various levels of accuracy have been recorded, from 97% to 99.5 % where the optimal reading conditions at 30mph at a distance of 7.5 ft(G). This number can also decrease significantly due to several conditions such as rain, snow, fog, dirt accumulation and misalignment of the sticker. On the other hand the cost of this technology is very low at around $1 per tag(B).

Radio Frequency/Microwave Systems

The roadside equipment for radio frequency systems is transceiver with anywhere from one to three different antenna that identify the vehicle and send and receive information from a "tag" mounted on the windshield or dashboard of the vehicle. The tag is the

vehicle's transponder OBU. It consists of a signal receiver/transmitter, a power supply and a memory unit. The systems utilize frequencies in the 500 to 3000 MHz range of 30-1000 GHz (B). RF/Microwave systems tend to be very reliable under all weather conditions and in spite of visual barriers. Accurate readings have been obtained at maximum distances around 250ft , at speeds of up to 180mph(G) with most manufactures claiming accuracy rates between 99.95% and 99.99%(B). Although, in practice and depending on the system the rates of accuracy reported have been closer to 93% to 98%(B).

There currently are three types of RF/microwave tags. Type I is a read only tag that carries vehicle identification information which can be read by the roadside units. Type I transponder is the most electronically simple and therefore the cheapest. Type II tags are have read-write capabilities. They carry the same information as Type I tags but have a wired logic circuit in which the roadside equipment can add time, date stamps as well as other information relevant to the particular transaction.

With respect to energy supply, transponders can also be divided into three groups, active, semi-active and passive. An active tag has its own power supply and it is always on. It generates the signal that it transmitted to the roadside antenna. Because of the rate at which these tags receive and transmit information is quite high at it allows for redundancy in the exchange of information. This redundancy in transmissions is refereed to as a "handshake" and it reduces the risk of error. Semi active tags, in contrast, are only activated when passing toll gate, although they may also have their own source of power. They are not as rapid as active cards but they offer lower energy consumption. Passive tags usually have no power supply, they collect power from roadside reader when they receive the interrogating signals. They use what is called modulated backscatter technique. In this method the tag sends back information to the toll gate by changing or modulating the amount of RF energy sent by the toll gate antenna. The energy received by the tag is decoded to carry out the transaction. Because it relies on getting power from the roadside transceiver, this method uses very little energy.

Surface Acoustical Wave

Surface acoustical wave is a type of transponder systems where the vehicle's OBU contains a lithium crystal with etched metal caps that contain the car's VIN(G). The equipment at the toll station sends out acoustical waves that operate in a similar range to

Radio and Microwave signals. The crystal reflects the wave sending back out time-delayed signals. These signals are decoded by the roadside equipment and the transaction made much in the same way as the previous systems. This system is also relatively inexpensive because it contains few electronic parts and it can be tuned to accommodate varying conditions. But it cannot be programmed and its reliability at high speeds or big distances is not satisfactory.

GPS

In GPS systems the vehicle identification and data collection is done via pre existing satellite technology. Using satellite technology eliminates the need for roadside equipment and therefore GPS offers a reduction in capital, maintenance and operation costs greater than that of other AVI systems. The system works by having the vehicle's OBU make the toll fare calculations using geographical information provided by the satellite. In order to communicate with the satellite, GPS requires the vehicle to have an exterior antenna rather than the small ones used in RF/Microwave tags. The OBU itself is more complicated than the tag systems used in RF/microwave systems and it requires the following components.(D)

- a six channel, C/A-code receiver (and external antenna)
- a CPU and electronic memory
- electronic card reader
- digital display
- dedicated high-frequency, short range communication (DSRC) transceiver

This last element, the DSRC transceiver is used to provide method for violations such as insufficient balance to pay tolls. A "spot check" takes place between the vehicle and a mobile communication unit(D) on the ground.

B. Recent Progress and Outlook

Recently there has been greater development of a third type of tag or RF/microwave system, the type III or "Smart transponder" which integrates smart card technology to ETC. In such a system, the tag is a small smart card reader device about the size of a radar detector or a calculator that is mounted to the dashboard of the car. The reader mainly includes a signal receiver/transmitter, a power supply, and a programmable

microprocessor, as well as the smart card reading unit. It can also include an LCD display and connecting port for other electronic devices. Figure 6.1 shows the electronic components of a smart card reader

There are many advantages to using smart card technology for ETC. The sophisticated technology offers separate file systems that can be used to allow the same card to work for various systems such as different toll roads that require different information or different payment methods. By setting up the system to encrypt personal identification information or to require a single log-on procedure for the user to enable the OBU, it avoids the need for the driver to be identified at each transaction point. In addition, the card in the reader belongs to the driver, not the vehicle, which could help authorities in the enforcement of traffic violations. Another advantage is faster transaction speed. Not only is the equipment itself faster, but some of the transactions can occur in the vehicle's own OBU rather that the toll station processor. Finally, the capability to re-program the card reader reduces the risk of obsolesce for the equipment which helps make the equipment more cost efficient.

It is also important to mention new developments in the implementation of modulated baskscatter transceiver technology. The backscatter method can be used as the method of transmission to the roadside antenna regardless of the type of tag selected. It offer a couple of advantages over fixed frequency systems. One is the ease with which it can be set to respond to different frequencies. This feature provides the possibility of using the same tag for different systems set up at different frequencies which not only helps avoid inconvenience in the present, but also reduces the risk of obsolescence. Another advantage of using this method is a reduction in the possibility of signal noise interference. The roadside equipment that is used in this method is set up to verify the signal it receives from the vehicle and to compare to the signal it sent to the vehicle. The receiver dismisses any other signals therefor reducing the risk of interference.

C. Standards Development

As ETC systems become more prevalent the need for standardization of technologies has become obvious. The goal of standardization is to make all AVI systems compatible and help to better integrate all branches of ITS. Lack of industry standards hurts the development of technologies geared towards intermodal transportation. In particular, the possible use of a single smart card for toll collection, payment of parking fees, public

transportation and other services. This concept is even more powerful when non-transportation applications such as adding bank or phone card or even medical card come into the picture.

ITS AMERICA is working on developing standards for ITS use in the United States. For example, table 6.2. illustrates the technical specifications of various ETC systems, including the European standards from the Vehicle Information and Transactions Aid (VITA) program are outlined in comparison to ITS recommended standards. The first point of interest is the frequency chosen. American systems tend to stay close to the 900 to 930 MHz range allocated for industrial scientific and experimental use(B), while the Europeans have chosen a specific frequency of 5.8GHz. ITS standards allow the flexibility to choose between both of these options and adds a third option of 2.45Ghz. American systems also uniformly require higher data rates for transactions. ITS AMERICA recommends 550 Kpbs compared to European standards of 250 Kpbs. In terms of communication methods for uplinks (the signal from the vehicle to the toll station) most systems use passive, backscatter methods and only one system, March IV uses only active tags. Both the ITS AMERICA and VITA standards offer the flexibility of both active and passive methods.

High frequencies can be desirable because they work at longer range and great speeds at a faster data rate. But there is danger that more signal noise, reflection or absorption can corrupt the transmission.

D. Current Transportation Applications

1. Electronic Toll Collection

Electronic Toll Collection (ETC) is the ability to conduct toll transactions without physical contact between the driver and the toll station. All of the various AVI technologies explained above are currently available for ETC. The most prevalent and fastest growing are RF/ microwave technologies. Figure 6.3 shows a typical RF/microwave toll transaction.

a. Transaction Process Description and Specification.

There are two kinds of toll systems, open and closed. In an open system all vehicles under the same classification pay the same toll rate regardless of their points of entry or departure from the road. A closed toll system is where the toll fare is dependent on the distance between the entry and exit gates. A type II is the kind of transponder needed for closed toll systems. Type II tags allow the toll gate equipment can write such data as time, date, and toll gate ID. The new account balance can also be written into the tag after the transaction is processed at the exit gate(A). Because type II tags have this ability, they are the tags used when the method of payment is via a debit card. Debit cards can be used in either open or closed systems.

Besides the fact that type I tags cannot be used in closed toll systems, there are two main advantages of Type II tags. First, greater speed in the payment transaction, because of higher data rates and because the balance information could be immediately accessible to the system. There is also the possibility greater privacy for the driver when a debit card payment method is used. The transaction may not require any personal information to be read from the card beyond just the account balances.

b. Cost Associated With Deployment

Deployment of ETC systems can offer significant reductions in capital, construction, maintenance and operating costs. However, as table 6.4 clearly shows, there are many factors that determine just how big these savings can be. Table 6.4 also shows that if the toll plaza is not designed carefully, the system could end up costing more. The equipment costs of both AVI dedicated and express AVI lanes is under one third of the costs for manual or automatic gates. However most plazas are set up with a combination of manual and automatic lanes and the cost of these combined lanes is closer to seven times the cost AVI only lanes. In contrast, the cost of lanes with combination AVI and manual or AVI and automatic are not much higher than just manual or just automatic. This indicates that although combining AVI with other payment methods does not increase capital costs significantly, it is desirable to include as few lanes for manual toll collecting as possible.

It is in terms of operating and maintenance costs that the advantage of AVI is most apparent. These costs for manual lanes are about 33 times greater than AVI dedicated and express lanes. The costs of any lanes that containing manual capabilities are all in the high range partially due to labor costs. Automatic lanes and combinations of

automatic and AVI lanes offer more manageable costs at around ten times the cost of AVI only.

In practice the need for some manual lanes should not be completely avoided. Although ideally the most cost effective set up would be AVI only lanes, not every driver can or wants to use AVI technology. Depending on the size of the toll plaza, the most best approach seems to be to reduce manual only or manual combination lanes to a minimum and make the rest of the lanes either automatic, AVI only, or a combination of the two. There needs to be some overlap of automatic and AVI in order to make the toll plaza more flexible in responding to traffic needs by switching dedication of the lanes.

c. Qualitative Benefits and Deployment Considerations

All the sources (A,B,E,G) agree that there are some important benefits of ETC technology. These include

Convenience to the driver. ETC offers the driver a reduction in travel time as well new payment options for toll charges.

- Congestion relief. ETC could offer relief of traffic congestion by reducing transaction time. If there are lanes dedicated exclusively to AVI, the vehicle would not even have to stop at the gate. This benefit is not only good for the driver, but it saves money by reducing travel time, fuel consumption, vehicle wear and tear, the cost of loss time to business, etc.

- Reduction in harmful emissions. Vehicles release excess emissions of pollutants when they accelerate, decelerate or when the vehicle is idle while waiting in line. (E) By reducing the need for the vehicle to stop or even slow down at the toll gate, the opportunities for harmful emissions are significantly reduced.

- Traffic management. The technology used by ETC is often the same technology used for other ITS applications. When the use of this technology is combined with AVL and other data, more reliable travel information can be provided for the commuter. This information also aides highway and transportation authorities in determining congested sections, detours, etc.

- Added security. This is specially important in urban areas where there are high crime rates or in particularly isolated areas. Because the car does not stop a the gate, both the driver and the toll attendant fell a greater sense of security. In many instances, the need for toll attendants would be significantly reduced.

- Lower costs. When implemented correctly, ETC systems significantly reduce both the capital and operating costs of toll plazas.

- Integrated transportation system. From the point of view of the consumer, ETC is an integral part of a complete transportation system. As new technologies are always being developed and old technologies improved ITS has become a more coherent program for the implementation of technology in all aspects of transportation. Consumers will be able to enjoy the convenience of ETC as part of a comprehensive, user friendly system for all their transportation needs.

Legal issues

The tow most cited legal issues in the literature are user privacy and the enforcement of fines for toll violations. The issue of privacy is related to the possible uses and misuses of the information obtained from the cars OBU. It has as much to do with the legal implications of actual misuse, as with finding ways to alleviate the public's perception of what risk they are taking by using this technology. There are various areas of concern. For the purpose of the economic transaction, most vehicle's OBUs contain personal information about the driver. Also, can or should this information be used to track vehicle location? Most people agree that the possibility of using tags to gage traffic congestion is a benefit to the public, but driver anonymity has to be maintained. The question is, how this information can be purged from the toll collection processors once the transaction has been accepted. There are a few different ways to protect the driver that need to be considered when choosing an ETC system. Systems using a prepaid balance can eliminate the need to transmit unnecessary personal information. Also, the more advanced smart transponders have the capacity to encrypt information.

The other major legal concern is the management of toll violations. Most ETC systems respond to toll violations by taking a video image of the delinquent vehicle and using the vehicle's license plate to identify the responsible party. However, this only identifies the car's owner not may not be the driver. Unfortunately, in many states, traffic violation

tickets can only be issued to the driver of a vehicle and not to the owner. Therefore new approaches to solving this problem have to be found. Another minor point related to toll violation is the ability of some systems to identify speed limit violations. This can be done because the system records the time and location of the vehicles. Although at this point this is not a major legal issue, there is concern that it could discourage potential users.

Implementation issues

There are many issues to take into account when choosing between the available technologies. The issues of accuracy and reliability go hand in hand. The reliability of the whole toll station system is mainly dependent on the accuracy of the communication between the vehicle and the roadside equipment. There is little worry about the data processing aspect of the toll transaction. This is the main reason why, in spite of the attractiveness of their low costs, optical systems are not a good alternative. The accuracy of the reading suffers greatly under poor weather conditions and even under simpler problems such as dirt accumulation and tag misalignment.

RF/ Microwave systems have proven to be accurate under severe weather conditions, great distances and high speeds. There certainly are problems with such things as interference noise from other electronic devices but these concerns can be addressed by the particular choice between the different types of tags and data transfer methods. It is because of the high level of accuracy and reliability that RF/ Microwave systems are the most common systems and the basis for standardization efforts.

Another set of concerns deals with how "user friendly" the chosen technology is. Many of these questions, such as compatibility, have already been mentioned on some other capacity. These are some of the questions from the point of view of the consumer.

- Is it complicated to use?
- Does it require different tags for different highways?
- Can the same tag be used for other activities (e.g. parking)?
- What is the cost of the equipment for the consumer?
- Will it really help save time?
- How convenient are the methods of payment?
- Will driver privacy be compromised because of electronic identification?

The economic considerations include the cost of billing systems and procedures including collection of delinquent accounts and toll violation enforcement methods, as well as the deployment cost discussed in the previous section. There is also the choice of billing methods. The two main approaches are, pre-payment and post-payment. Pre-payment seems to be the most desirable option overall. It can take several forms. The user can set up an account with the agency in charge of toll collection just for this purpose. The user keeps a positive balance on the account by cash or check payment. This method can be used regardless of the type of tag used, since all tags have the ability to carry an account number. At the time of the transaction, the toll computer would use that account number to access the balance and make the appropriate deduction. With the use of Type II tags, pre-payment can also be as simple as using a fixed balance debit card similar to the prepaid telephone cards. In these tags, the account balance is read from the card and the new balance is written into the card after the transaction takes place. However, a potential problem with pre-payment is that the user would need keep separate balances, either in accounts or cards, for each road system he or she uses. With post-payment, the user would only pay for the actual use of toll roads rather that having to keep many positive balances. The possibility of delinquency for post-payment is much greater because the driver could run up a high balance and the default on the payment. It creates a situation much like credit card like account because the agency would probably want the users to qualify for a certain amount of toll credit. The need to qualify for credit would inherently discriminate against some members of the population. Another option which is somewhat in between the other two, is to automatically link the user's account to a credit card or bank account. This option has the advantage that it could reduce the burden of bill collection while providing for the use of the same card for many systems.

Finally, there are other issues that are specifically relevant to the implementation of a particular site. The most important is the problem of lane dedication. In order to help ETC to fulfill its potential of reducing congestion, it is imperative that the physical structure of toll plazas be designed to take full advantage its features. There should be lanes exclusively dedicated to ETC transactions. Otherwise the vehicles would have to stop and wait for other cars that do not use the technology. By doing so, ETC would not reap the benefits of either saving for the driver or the reducing environmental pollution. Another design consideration is the number of lanes before and after the toll gates. Toll plazas tend to have several lanes, usually more than the rest of the road. A situation where the number of lanes is significantly reduced after passing the collection gate

creates a bottleneck effect. This problem also defeats the purpose of ETC because any time saved in the toll transaction is again lost in the traffic jam. Adequate sineage is also essential in making sure that drivers take full advantage of ETC. It is closely related to the issue of user friendliness. Signs are important specially if the system includes a mixture of ETC dedicated and combined lanes which may vary according to the time of day. Sineage is also crucial if there are price variations such as special rates for ETC users or if congestion pricing is implemented.

Sources

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several points of view: the project officials, the central government, and the municipal governments.]

Finally, some general planning concepts and case studies are mentioned in the Pumarada article, and I would like to understand these ideas more thoroughly. First of all, there are six "tools" mentioned in the article as being recommended to the municipalities for use in their planning endeavors:

1.) reserving plots for "endowed" uses
2.) requirement to develop endowed uses
3.) linkage
4.) contribution for capital improvements
5.) development rights transfer
6.) reparcelization

They are briefly explained in the article, but I think it would be useful to research these urban planning concepts and how they have been applied elsewhere. I am curious about whether or not they have been successful, what has been important in that success or failure, and what the prospects are for their success in Puerto Rico. Finally, the article mentions that the legislators looked at urban planning in other countries and states around the world to try to develop some goals and strategies for the revisions that they made:

Countries:	France	States:	Hawaii
	England		Florida
	Spain		New Jersey
	Holland		Oregon
	Germany		
	Canada		

I would like to look at these studies and other related materials for further insight into the intention of the legislation and the goals of the new law.

Most of these questions need the insight of those close to Tren Urbano and familiar with the situation in Puerto Rico. Speaking directly with contacts at the University of Puerto Rico, the Tren Urbano office and the offices of different consultants on the project will be my first area of exploration next fall so that I will have a reasonable framework in which to examine the Tren Urbano situation.

3.) Effects on Tren Urbano

These questions relate to the possibilities for development of Tren Urbano and any future transit / public works projects of the same magnitude. Based on the answers to these questions and discussions with project officials, I hope to be able to determine the key issues for project developers and some options that they will have in trying to solve any problems they face. These questions pertain to the success of Phase One of Tren Urbano and the possibilities for expansion.

- What are the implications of the new law for:
    1. station area development
    2. transit improvements/changes (AMA? públicos?)
    3. other public works changes which affect Tren Urbano
- Are municipalities at the ends of the Phase One alignment interested in expansion of Tren Urbano? Are they makings plans which include/exclude extensions?
- Are the municipalities at the edge of the area served by Phase One growing too fast and in such a way as to threaten viable train service to these areas?
- Can municipalities change or block future phases of Tren Urbano?
- Are large scale projects that cross municipal boundaries being handled well? Who (which municipality and/or central body) is in charge? What is the role of the SJMPA and the planning board in large scale projects?
- What is critical to make Tren Urbano a success? to make expansion easier? Is the ability to expand critical to the ultimate success of the project? [I hope to answer these questions from

planning powers , which would suggest a cooperative relationship exists. Unfortunately, there is little or no incentive for the municipalities to pursue the goals of the law as outlined in the paper. These issues may have significant impact on future development and need to be addressed before considering specific projects such as Tren Urbano.

- What are the forecasts for population and job growth? for public works needs?
- Where is there expected to be significant urban development in the next five to ten years?

  These issues in particular can be addressed by examining the census data and the predictions made current planning process in place for Puerto Rico. I would like to examine these figures in detail next semester.

- What is the status of those municipalities in predicted high-growth areas?
- Are the goals of the new law realistic in this development climate?

    1. *Coherence of adjacent plans.* Can/will the municipalities try to "do their own thing"?
    2. *Infrastructure development.* Can projects cross municipal bounds easily? Who is ultimately in charge of such projects? Are municipalities interested in providing infrastructure (since it brings them little, if any, tax revenue)?
    3. *Citizen participation.* What form is it taking? Are citizens interested in being a part of the process?
    4. *Economic and social development.* Are these developments viewed as important by the municipalities (indicating that they will receive attention in the future)?
    5. *URBAN: Consolidated development.* Given the forecasts, is concentrated development possible? In areas without the "numbers" to make concentrated development natural, what is being done to encourage focused development?
    6. *DEVELOPABLE: Organized Transformation.* Essentially, what is the structure of the organization? Would further urbanization be desirable?
    7. *RURAL: Protected Management.* Are there conservation plans in place? What flexibility exists in these plans?

- What are the criteria for evaluating whether or not the goals of the law have been met?
- Is there a timetable for completion of this transformation?
- Is there a projected time of completion based on experience thus far?
- Are there any areas of concern with the implementation that could become problematic?

getting started, my work this term has resulted in more questions than answers, but overall it has sparked many ideas for future work. What follows is a basic outline of the questions and research issues that I have compiled so far in preparation for next term.

1.) Current Urban Planning in Puerto Rico

These questions all center around the implementation of the new law allowing municipal planning. Several municipalities have applied for permission to carry out planning and permitting under the new laws, however as yet, none have been granted such authority. The progress and the process of the implementation will be an important starting point for the rest of the research.

- How many municipalities have applied for permission and with what results?
- Why have the municipalities been turned down?
- Are those municipalities trying to reapply and what is the process for them now?
- Are other municipalities preparing applications? Has there been any "backlash" due to the denied applications (i.e. other cities & towns are reluctant to apply because they feel it might be useless)?
- Has the transition for approved municipalities been particularly easy or difficult?
- Is there any evaluation of the implementation process that might yield further information?
- What is the feeling (publicly or privately) about the new planning legislation among developers, citizens, and the government leaders?

2.) Development Trends and the Future of Urban Planning

These questions mostly deal with the next steps for urban planning in Puerto Rico. There are many possibilities for the future depending on how the cities and towns engage in the planning process. For example, one scenario would be municipalities working independently, and "competing" for different kinds of development, working at odds with each other instead of cooperatively. By contrast, some neighboring municipalities have been applying jointly for the new

TREN URBANO: End of Term Summary
Diana M. Dorinson -- 5/29/95
Advisors: Nicola Shaw & Prof. N.M.H. Wilson

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My work this term has been primarily an introduction to Tren Urbano that has focused on two different parts:

1. A basic familiarization with the project and the major transportation issues in Puerto Rico.

   This introduction to Tren Urbano was very straightforward, consisting mostly of reviewing summaries and public relations documentation, the Draft EIS for Phase One and also studies of the existing transit facilities in the San Juan Metropolitan Area. At this point I feel I certainly have a basic knowledge of the project and further research should be directed towards specific issues as opposed to general knowledge.

2. An introduction to current urban planning issues in Puerto Rico.

   This review led me to focus particularly on recent legislative changes in Puerto Rican urban planning. A new law was passed a few years ago that enables individual municipalities, once they have permission from the central administration, to engage in their own planning and permitting activities. An article written by Rafael Pumarada published in Plerus in 1995 introduced me to some of the key planning issues facing Puerto Rico, and led me to think about how they might impact Tren Urbano. At this point I must finish up for the summer, and with little time left for research, I have decided instead to organize my thoughts so far and compile a list of items to study in more detail next term. My current interests can be classified in three areas:

   1.) Current Urban Planning in Puerto Rico
   2.) Development Trends and the Future of Urban Planning
   3.) Effects on Tren Urbano

   In addition, there are some general urban planning concepts that should be explored and case studies that may be helpful in evaluating the situation in Puerto Rico. Because I am just

My purpose in investigating this document was to try to gain insight into planning legislation in Puerto Rico, and as I was reading my thoughts frequently focused on the viability of this system. It is important both for the municipalities and for the central government that an effective planning structure be developed to conserve resources, more efficiently use the available space, and guide future development. But, if this law backfires and ends up creating more problems, it could have some very serious results. By giving the municipalities an initiative to do their own planning, it is possible that development does not follow a coherent pattern, and this could be a detriment to development. In the context of Tren Urbano, this could be a very serious situation. Although the Phase One development is in its final planning stages, its success and any future development are both dependent on the urban planning environment in the nearby municipalities. The future of Tren Urbano can be seriously affected by the ramifications of the new law, and I hope to be able to study this issue further to determine what the implications are for Tren Urbano and public infrastructure in Puerto Rico's future.

The Permitting Office (Officina de Permisos) will process permit applications in an expedient manner and initiate legal action when necessary regarding violations of permits.

Nuevas competencias para viabilizar el desarrollo urbano
New "tools" for promoting urban development

The legislature has approved six new "tools" for use by the municipalities in their planning and development efforts. The use of the tools is optional, but they have specific uses within the planning and development process:

1.) *reserving plots for "endowed" uses:* up to 10% of the developable land may be reserved for "public" uses including recreation, health, schools, culture, sports, etc.. the regional plan may dictate the location, particular use, and size of such reserved plots.

2.) *requirement to develop endowed uses:* the municipality is allowed to require that developers construct one of these endowed uses as part of their project. the examples of telephone facilities or recreation areas are given.

3.) *linkage:* for large scale projects, developers can be required to use up to 5% of their project costs on the development of, improvement, of, or investment in another public/social project, generally involving disadvantaged groups.

4.) *contribution for capital improvements:* the central government may require future projects to contribute to a fund to he held for the planning and construction of major capital projects of government services such as water works and roadways.

5.) *development rights transfer:* a property owner may transfer his/her right to develop a plot to any other plot of similar type (urban, developable, or rural) or sell those rights to another developer to be used on one of the buyers plots. such sales and transfers must be registered with the permit office.

6.) *reparcelization:* the planning board has the right to reparcel an area according to an organized, large scale plan. the object is to facilitate infrastructure, permitting, and financing for development.

OBSERVACIONES
Observations

This section discusses the issues outlined here in summary and suggests that the law will need the full participation of the citizens in order to be successful.

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Comments:

Overall, I find this article a bit grandiose -- a lot of big words and talk about the past plans and the implications for the future, but mostly a lot of speculation and opinion. As I mentioned before, I want to know how confident the legislature is about the potential of this plan and where that confidence comes from. I am curious how the plan has been received and/or implemented by the municipalities so far. Are there intermediate evaluations or progress reports on these issues? I used the word precarious before when talking about the assumptions being made, and I still feel that is an appropriate word to describe the situation. It teeters between wanting to have large scale planning goals and wanting to give authority to the smaller scale government. The power distribution is one of the key issues that needs clarity and resolution for this to be successful. The power relationship will also be important for dealing with big developers and others in the private sector who must adjust to the new structure. Finally, the issue of large developments, particularly public works, will be a test of the strength of these laws.

3.) *reglamentación* - articulates the policy regarding construction, changes and individual actions according to the municipality's own plan.

Transferencias de facultades para considerar permisos de uso y construcción
Transfer of powers for use and construction permits

The transfer of the powers of permitting from the central government to each of the municipalities is accomplished when the municipality applies to the governor and explains the human, technical and economic resources available within the community. These resources will be parameters in the agreement between the government and the municipality. If the municipality does not apply for the transfer, the new administration will continue to manage the permitting process. [implying that no proactive planning action will take place without initiative from the municipality. Is this a realistic expectation for Puerto Rico? How strong is government on the municipal level?. The assumptions about how the cities and towns will be able to deal with the new regulations must come from somewhere -- what assurances do the legislators have? The evaluation of each municipality before powers are transferred seems to be the way that the irresponsible municipalities will be weeded out. What are the criteria going to be for selection? Are they based on the experience of the central planning administration or on overall planning goals?]

An evaluation will attempt to determine how effective this new planning and permitting system is. If a municipality has not applied for the transfer of permitting, evaluations will be sent to the central administrative body. Municipalities who have the transfer will perform their own evaluations and report the results to the administration. In addition, any project that is determined to have regional impact will need overall approval from the administration before continuing and one municipality will be assigned jurisdiction over the project. [This evaluation seems like a good idea. Hopefully, the results be returned to the municipalities with feedback or possibly even distributed to others for comment. More realistically, the administration could compile and distribute the results to all municipalities so that they will have a way of measuring their performance against both the standards set forth in the legislation and against the performance of the other municipalities faced with making this change.]

Officinas de Ordenación Territorial y de Permisos
Territorial and Permitting Offices

Each municipality desiring to carry out its own planning and permitting must open and maintain a public offices for the respective function - one office for each activity. The article implies that a municipality does not have to provide these offices unless they want to do their own planning and permitting. They may open only one office or both, and neither office is required in order to be able to have the other. Two municipalities may join together in this venture, creating a "consortium." [This means that they may establish joint offices, although it is not clear if the word consortium is meant to imply that one office will handle functions for both communities, or that the offices would merely be operating in explicit cooperation.]

The Planning Office (Officina de Ordenación Territorial) will prepare and review planning documents and carry out the functions necessary to execute a planning process based on those documents. They will also attempt to mobilize citizen participation, supervise development and project completion, and compile and maintain all of the records and pertaining to the planning process.

Comparición de esquemas de ordenación territorial
Comparison of the different organization schemes

In order to understand what kinds of changes in the legislation would be desirable, the development plans of many other cities and countries were analyzed including France, England, Spain, Holland, Germany, Canada, Hawaii, Florida, New Jersey, and Oregon. In general, countries besides Canada and the U.S. have recently expanded the local influence on the planning process. The North American experience has been one in which planning has become more centralized in an attempt to avert the conflicts between cities and towns that were becoming commonplace. The U.S. states mentioned above have found a medium between the two ideas by establishing state-wide organizations that dictate policy and coordinate the actions on the local level according to that policy. The state policy includes general development guidelines and procedures for following them in planning. An important aspect of this third planning model is that the local planning bodies are involved in the formation of the general policy.

[Nicola pointed out that although the comparison presented here gives a good summary of the options that are available to the planners, not all of them are realistic for implementation in Puerto Rico. In addition, cultural differences may include different attitudes toward development and planning that will complicate the adaptation of other planning schemes. Localized planning will need the participation of the citizens, and so public support of the idea will be crucial to its success.]

LA ORDENACIÓN TERRITORIAL EN LA LEY DE MUNICIPIOS AUTÓNOMOS
The territory's organization under the new autonomous municipality law

Objectivos del Planeamiento
Planning Objectives

The municipalities cam create their own municipal plans, as long as they are consistent with the seven overall objectives of the new law. Municipal plans must:
1.) be compatible with central plans *and* with other [neighboring] municipalities
2.) promote the development of infrastructure
3.) be developed with ample citizen participation
4.) favor social and economic development
5.) *(for urbanized areas)* - try to produce a consolidated & coherent urban area with good [efficient] land use and a fitting and aesthetic public environment
6.) *(for developable areas)* - establish an organized transformation process [from undeveloped to urban] where new development fits a useful and aesthetic form
7.) *(for rural areas)* - try to protect it and prevent it from becoming divided into lots and urbanized; promote its use and management for the benefit of future generations

Planes de Ordenación
Organizational Plans

There are three types of organizational plans that can be created: Plan Territorial, Plan de Ensanche [expansion], and Plan de Área. The first is a plan for the whole of the municipality's area of jurisdiction. The other two plans pertain to a specific area within the municipality. Any of these plans will usually consist of three parts:
1.) *memorial* - establishes an appreciation for the future development [sets a tone]
2.) *programa* - outlines the investments (from central and local governments as well as from the private sector) necessary in order to make policy implementation viable

TREN URBANO: Research
Diana M. Dorinson - 5/29/95
Document: La Ordenación Territorial En La Ley De Municipios Autónomos

This article is written in Spanish and is a summary of a magazine article published in 1995 in the magazine "Plerus." The original article discussed the new planning organization resulting from the 1991 law allowing the municipalities to create their own planning boards and local zoning. What I have written here goes over the major points of the document and suggests some conclusions that might follow from it. Commentary is enclosed in brackets.

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INTRODUCCIÓN
Introduction

This section outlines the history of planning and zoning in Puerto Rico. It is a straightforward description of the dates and major points of the various planning laws that have been passed over the last 55 years.

LA ORDENACIÓN TERRITORIAL PREVIA A LA LEY DE MUNICIPIOS AUTÓNOMOS
The territory's organization before the autonomous municipality law

Problemas con el uso del suelo y el planeamiento
Problems with land use and planning

This section describes some of the motives for trying to create a more effective planning model. Essentially, the island itself is facing the difficulties of overpopulation and scarce resources. This results in congestion and threatens to bring an energy crisis. In addition, the lack of developable space is creating problems since important infrastructure and public goods cannot be constructed. For this reason, new planning legislation is looked to as a good thing, in the hopes that plans will be developed that better manage what is currently available and encourage people to be innovative in new development.

[This is a precarious argument since the new law distributes the authority to each of the local municipalities reducing the likelihood of coordination between them and precluding an overall conservation strategy. But, perhaps the government feels that the situation it at a point of stagnation and believes that giving the local governments some new power will spark a new interest in planning and resource management. This seems like a plausible explanation, but there is the distinct possibility that resources will be further abused and problems with the system will be harder to locate.]

Aspectos legales y herramientas para dirigir el uso del suelo en Puerto Rico
Legal aspects and tools for management of land use in Puerto Rico

This section describes the various documents that were examined in the preparation of the new legislation. These include development plans, existing zoning regulations, and references on existing development. Another important factor is the fact that because there were 49 municipalities that did not have their own plans, the developers ended up becoming the *de facto* planners. [Perhaps this is a better reason to try to create organized planning than those in the previous section.]