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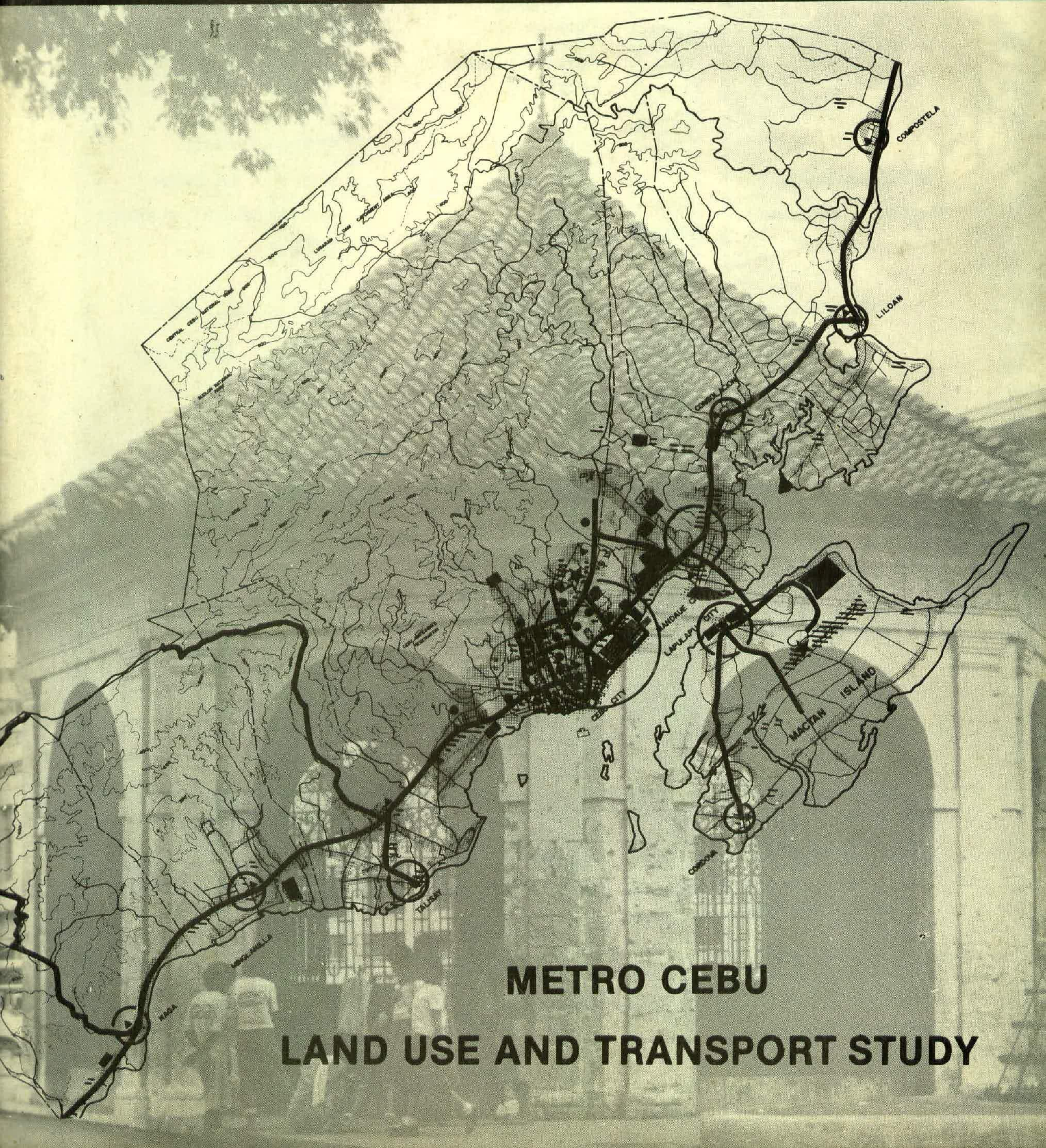

METRO CEBU

LAND USE AND TRANSPORT STUDY

PHILIPPINE PLANNING JOURNAL

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Editorial:

The world's less developed countries are currently experiencing massive urbanization as a result of rapid population growth and accelerated urban migration. This high concentration of population—coupled on the one hand with rising income and increasing vehicle ownership and on the other with increased fuel cost and limited resources—is producing severe transport problems in the primate and even the secondary cities. Planners are continually exploring various approaches in search of solutions to these problems.

This issue of the *Philippine Planning Journal* deals specifically with some approaches worked out by the Metro Cebu Land Use and Transportation Study, or MCLUTS, which is now on its implementation phase. The first phase, which was completed under the supervision of the Ministry of Transportation and Communication (MOTC) and with generous support from the Australian Government, defined the general guidelines for the development of the transportation sector and specifically identified the more urgently needed action programs. The recommended programs have already been adopted by the MOTC and also by the participating Provincial and City/Municipal Government Bodies for implementation.

The MOTC will continue to support MCLUTS in its new role of detailing and assisting in the implementation of the recommended projects. The World Bank has also commented favorably on the study and its recommendations, and has decided to fund certain projects through the newly created Central Visayas Urban and Rural Projects Office. These projects

metro cebu land use

include traffic signal planning and design as well as route feasibility studies, including preliminary and some detailed engineering studies of part of the road improvement program.

Three papers are presented in this issue. The first paper gives a general description of MCLUTS with emphasis on the strategic planning process consisting of data collection, forecasting, goal formulation, plan formulation, plan testing and evaluation, and plan selection.

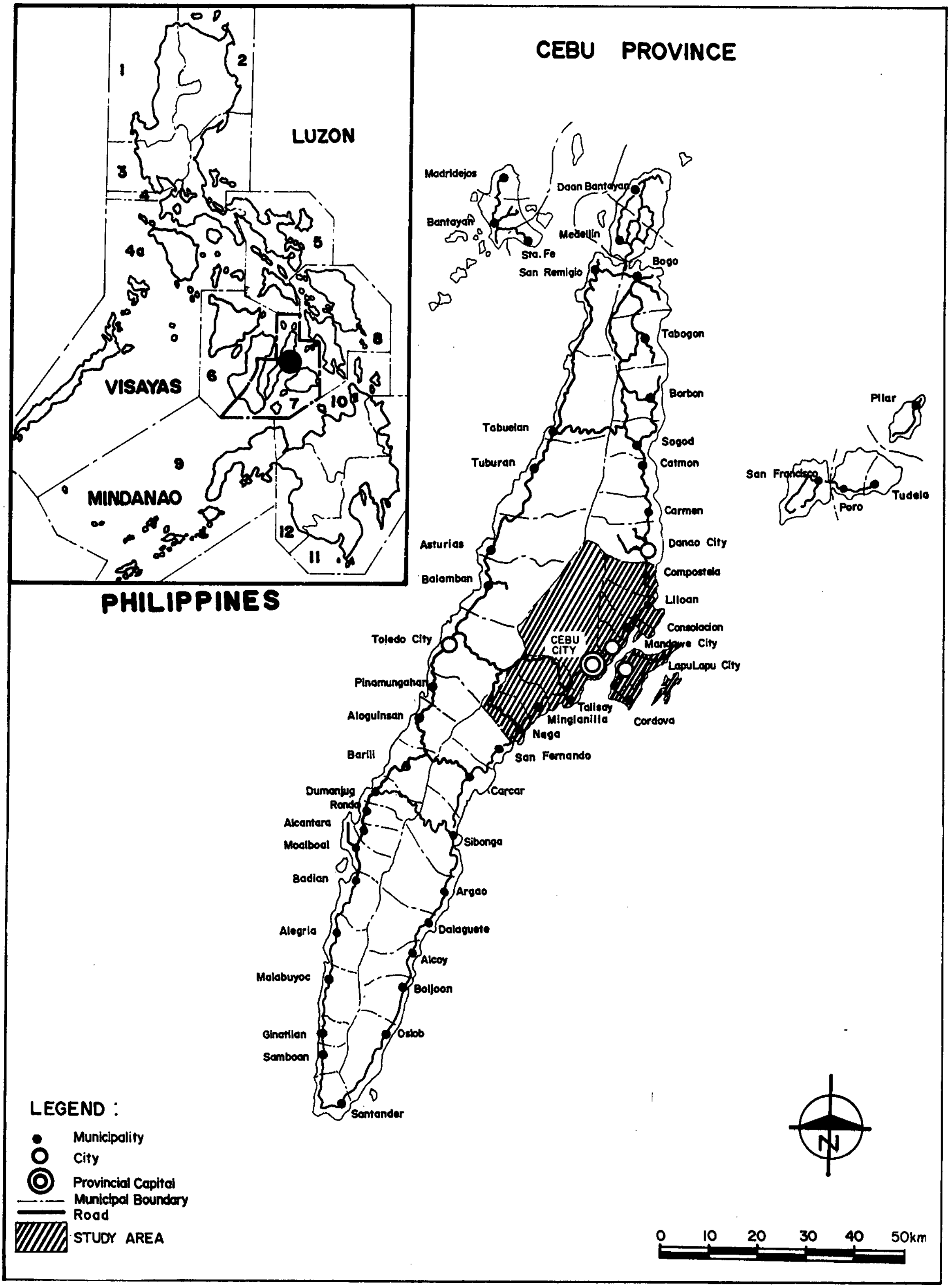
The second paper is more technical in nature and deals with the computer modeling process that was used to simulate the effects of the forecast growths in population and employment on each of the alternative land use and transportation plans.

The final paper contains a detailed description of the Action Programs identified and implemented under the MCLUTS. These action programs constituted a very important element in the work program and were designed to try to effect some immediate relief to the more severe traffic and transport problems in Metro Cebu.

The PPJ management acknowledges with much appreciation the permission granted by Minister Jose P. Dans, Jr. of the Ministry of Transportation and Communications to publish the papers on MCLUTS. This permission will indeed make it possible to disseminate widely information on something of vital interest to planners, especially of the developing world.

The Editors

and transport study



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THE METRO CEBU LAND USE AND TRANSPORT STUDY (MCLUTS)

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INTRODUCTION

Background

The Metro Cebu Land Use and Transport Study (MCLUTS) was established in October 1978 by the then Ministry of Public Works, Transportation and Communications (MPWTC), with the cooperation of the National Economic and Development Authority (NEDA), the then Ministry of Public Highways (MPH), the Ministry of Human Settlements (MHS), and other government agencies. With the split of MPWTC into two separate ministries in July 1979, the execution of MCLUTS became the responsibility of the new Ministry of Transportation and Communications (MOTC). The study consisted of two phases. Phase I is concerned with the formulation of a Strategic plan to guide the short, medium and long term development of Metro Cebu. Phase II involves the implementation of some recommendations of MCLUTS I and detailed study of others.

In May 1979, a Memorandum of Understanding was signed by the Governments of the Philippines and Australia defining the respective responsibilities and contributions of the two governments in relation to MCLUTS 1. MCLUTS 1, which lasted up to December 1980, was carried out jointly by U.P. PLANADES and REDECON-Australia on behalf of the Philippine Government and Australian Government, respectively.

The Ministry of Transportation and Communication (MOTC), along with the city/municipal governments in Metro Cebu and the Cebu provincial government decided to establish immediately (beginning January 1981) the second phase of MCLUTS to assist in the implementation of some of its recommendations and to develop others to a stage wherein direct implementation could be effected. The services of the U.P. PLANADES were again engaged to undertake this phase of the project. With the creation of the Central Visayas Urban and Rural Projects (CVURP) in May 1981, through Executive Order No. 694, MCLUTS became a part of CVURP, hence entitling it to financial support by World Bank.

Purpose of Paper

The main purpose of this paper is to describe briefly the work of MCLUTS under Phase I, which is comprehensively presented in five volumes.[3] A status report on the recommendations will also be given.

PROJECT OBJECTIVES

The main objectives of the project under Phase I were to:

- formulate a Land Use and Transportation Strategy Plan for Metropolitan Cebu;
- prepare, within the framework of the Strategy Plan, policies, guidelines, programs and proposals to meet the short, medium and long term travel requirements to year 2000; and
- undertake projects designed to effect immediate alleviation of existing critical transport and traffic problems.

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[2]With REDECON-Australia Under Phase 1 of MCLUTS.

[3]Metro Cebu Land Use and Transport Study, "Final Report", Volumes 1, 2, 3, 4 and 5, MOTC, December 1980.

STUDY AREA CHARACTERISTICS

The information presented in this section was derived from an extensive inventory of the land use and transportation systems, of Metro Cebu, and from a number of travel surveys which are described in the latter part of this paper.

Location

The study area, Metropolitan Cebu, is composed of the cities of Cebu, Mandaue and Lapulapu, and the municipalities of Compostela, Liloan, Consolacion, Cordova, Talisay, Minglanilla and Naga (see Figures 1 and 2 for Location and Existing Land Use and Urban Structures, respectively). The total area is approximately 80,100 hectares but only 7 percent of this can be considered urban or built up. The terrain in Metro Cebu is a major constraint to urban expansion. It is dominated by a backdrop of rugged mountain ranges which rise from a flat and narrow coastal plain to an average elevation of 200 m, with peaks of 800 m. Approximately 25 percent of the land area has slopes exceeding 30 percent.

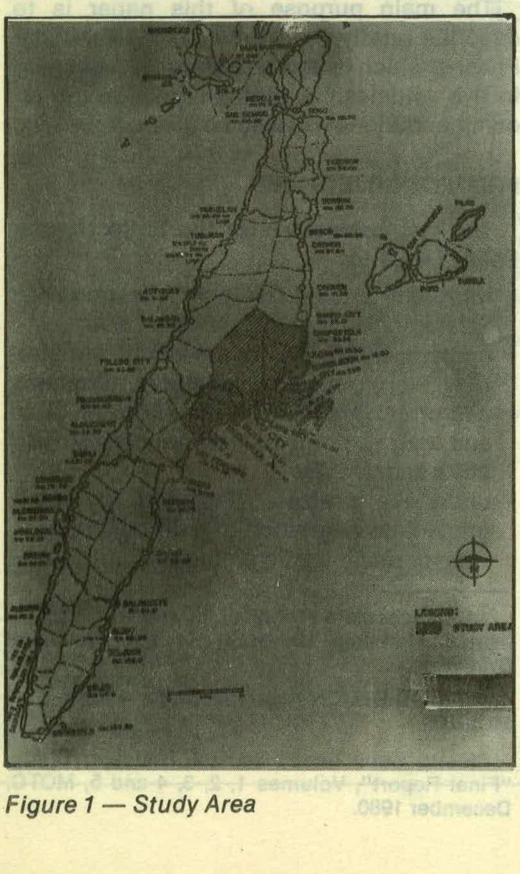


Figure 1 — Study Area

The harbor of Cebu is one of the safest in the country. It is in a protected strait sheltered by mountain ranges on the west and the island of Mactan on the east. The coast also offers fine beaches especially on the eastern side of Mactan.

Socio-Economic

As the principal center of business, trade and education in Region VII (Central Visayas), Metro Cebu has the second largest urban concentration in the Philippines with a population of nearly one million. Based on 1980 Census data, the highest concentrations of population are in Cebu City, Mandaue City and Lapulapu City accounting for 52 percent, 12 percent and 10.5 percent of Metro Cebu total, respectively. Over the last 20 years, the metropolitan population has grown at a reasonably constant rate, never falling below 3.3 percent per annum. Between 1975 and 1980, the highest growth rates occurred in Mandaue City, Consolacion and Lapulapu City with annual growth rates of 7.8 percent, 6.2 percent and 4.5 percent, respectively.

Employment in 1979 was estimated at 268,100 broken down into: 12 percent primary, 29 percent secondary and 59 percent tertiary. Employment grew at an estimated rate of three percent per annum between 1975 and 1980. The majority of employment are located in Cebu City, particularly in the Central Business District (CBD) where 40 percent of total secondary and tertiary employment, 25 percent of which is wholesale and retail trade, is concentrated.

The average household income in 1979 was estimated at ₱560 per month. Comparatively, income can be described as high in Cebu City and Mandaue City, and low to average in Lapulapu City and all the municipalities. Average ownership of cars and motorcycles was 17.3 per thousand population. As could be expected, ownership is highest in the cities of Cebu and Mandaue.

Road System

Metro Cebu has a total of 1,042 kilometers of roads, of which 14 percent is classified as national, 12 percent provincial, 14 percent city, 8 percent municipal and 52 percent barangay. In terms of pavement types, 8 percent is concrete, 29 percent asphalt, and 62 percent gravel.

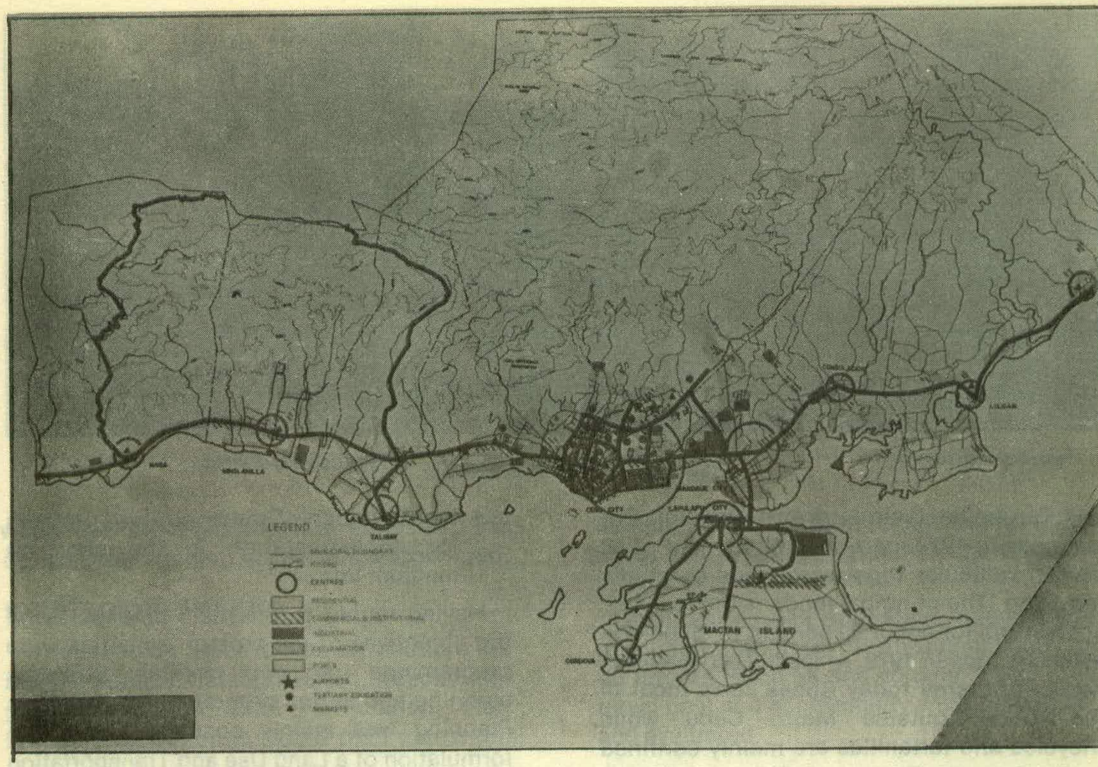


Figure 2 — Existing Land Use and Urban Structure

The existing road system (see Figure 2) is deficient both conceptually and physically. Conceptually, the roads have not been classified according to function. Many roads are "access-dominated" where roadside activities predominate, such as access to premises, loading and unloading, parking, and vehicle repair. Roads which are supposed to handle through traffic—"traffic-dominated" roads—lack continuity in standards. Some vital links are even missing while others are of poor standards.

In physical terms, many roads are two narrow and some do not have curbs or gutters and sidewalks, which could lead to the deterioration of the pavement and intrusion of roadside activities. In many areas, road pavements are failing due to inadequate sub-grade preparation, bad drainage and/or poor surfacing. Many intersections are in need of improvements, such as changes in lay-out, clear definition of priorities, and intersection control. Existing traffic signals are very old and are way past their economic life.

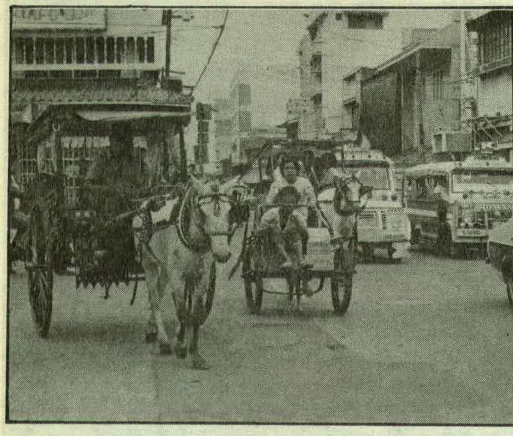
Travel Characteristics

An average of approximately 1,175,600 motorized person trips were generated per day in 1979. A very high proportion of these trips were made wholly within the study area. About 66 percent of all motorized person trips had at least one end of trip within the Central Business District (CBD). This is hardly surprising as the CBD accounts for a very high proportion of secondary and tertiary employment, secondary and tertiary school enrolment and wholesale and retail employment.

In terms of traffic volume, the 1979 roadside survey recorded 184,200 vehicles crossing the CBD boundary daily, 56,100 crossing the Cebu City boundary and 4,900 crossing the Metro Cebu boundary.

The overwhelming majority of the population are captive to public transport, consisting of jeepneys, buses, taxis, PU's,[4] tricycles

[4]PU's are similar to the taxis, but without meters. Fares are generally established through negotiations.



Typical Tartanilla

Typical PU Minica

and Tartanillas (animal drawn vehicle). For example, in 1979 more than 80 percent of all person vehicular trips were made by public transport. The principal mode is the jeepney, accounting for about 50 percent of all person vehicular trips in 1979. At least 3,000 jeepneys service the area today. Buses serve most of the routes outside Metro Cebu while tricycles and tartanillas are mainly confined to local areas. Taxis and PU's, numbering about 1,100 in 1979, service only a small proportion of total trip-making. Walking is a very important mode accounting for 40 percent of all person trips.

The total demand for travel contains a high proportion of trips to and from places of education, accounting for at least 36 percent of all trip-making. This reflects both the predominantly young population and the fact that Metro Cebu is the main educational center in the Visayas regions. The next most important trip purpose is the journey to and from work at 29.1 percent, followed by non home-based trips at 17.9 percent.

Truck travel represents approximately 17 percent of the total urban vehicle trips, with light trucks, pick-ups or vans dominating the commercial traffic flow. Truck movements are concentrated in the port area and the CBD, the main generating areas being the municipalities of Talisay, Tabunok, Talamban and Banilad.

GENERAL STUDY APPROACH

The project placed emphasis on the:

- Preparation and evaluation of action projects to alleviate existing transport and traffic problems; and
- Identification of transportation projects for implementation in the short to medium term.

Having regard to the main emphasis and the objectives of the project, activities were programmed into two streams: Strategic planning and action programming. Strategic Planning was mainly concerned with the formulation of a Land Use and Transportation Strategy Plan for Metro Cebu while Action Programming involved the immediate alleviation of existing critical transport and traffic problems.

The approach adopted for the Strategic Planning was a comprehensive one, entailing the use of a simulation model to test a number of alternative plans, consisting of different distributions of population and employment, and varying levels of highway investment. The process was divided into six stages: data collection, forecasting, goal formulation, plan formulation, plan testing and evaluation, and plan selection.

Action programming was designed to alleviate existing problems and as such did not rely much on data about future travel requirements. Analysis of the existing situation was the main basis for identifying problems and for the preparation of measures to deal with the problems.

To ensure that strategic planning and action programming activities though pursued separately, would not result in conflicting or incompatible policies, guidelines and programs, particularly with respect to short term and medium term issues (See Figure 3 for Work Program), close interactions bet-

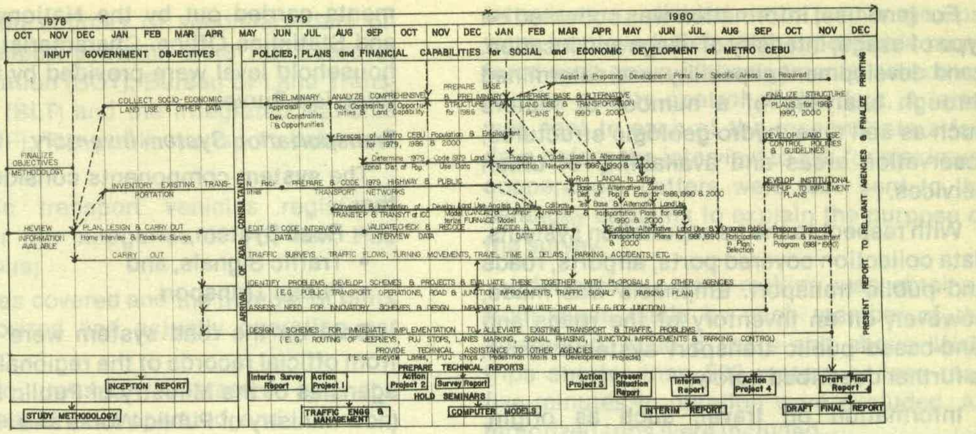


Figure 3 — Work Program

ween the strategic planning group and the action programming group was encouraged.

STRATEGIC PLANNING

The planning process was divided into six stages, namely, data collection, forecasting, goal formulation, plan formulation, plan testing and evaluation, and plan selection.

Data collection consisted of an inventory of the physical, social and economic conditions of the study area, and the undertaking of surveys to determine the magnitude and patterns of travel. The base year data was used in part to formulate and calibrate mathematical models, collectively called TRANSTEP,[5] so that the effects of alternative land use-transportation plans could be simulated. Much of the data would be used also in the action programming work.

The forecasting phase entailed the prediction of growths of the study Area in socio-economic factors such as population, employment and school enrolments, the level of funds likely to be available for transportation investment, and future values of TRANSTEP parameters.

Goal formulation included the translation of the development goals of the government into operational objectives and performance criteria. For example, a national goal of maximization of economic growth was interpreted to mean that a preferred plan should provide best value for money, i.e., benefit minus cost is maximum.

Plan formulation involved the preparation of alternative plans for 2000 which would be expected to satisfy future land use and travel demand, given the planning goals and objectives, and the study area development constraints and opportunities.

Plan testing and evaluation followed plan formulation whereby the effects of each plan on factors, such as link volume, travel time, travel cost and accessibility were determined and evaluated.

The last phase, plan selection, involved the assessment of the strengths and weaknesses of each plan in economic, operational and other planning terms, and the presentation of these to the decision-makers with the recommendations of the Team. The government authorities concerned made the selection.

Data Collection

This phase was undertaken to help the study team in:

- Obtaining a better understanding of the problems in Metro Cebu;
- Providing a factual basis for formulating measures to alleviate existing problems;
- Developing and calibrating the Land Use-Transport Interaction Computer Model (TRANSTEP); and
- Providing a bench mark for plan formulation and evaluation.

Three sets of data were collected pertaining to the base year (1979): land use, transportation system and travel.

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[5]See other paper by Cal, Graham and Nairn on page 33 of this issue.

For land use, information was collected on type of usage, intensity of usage and location. Land development capability was determined through analyses of a number of factors such as soil type, hydro-geologic structures, reservation areas and availability of urban services.

With respect to the transportation systems, data collection covered ports, airports, roads and public transport. Emphasis was made, however, on an inventory of the roads and land-based public transport systems which is further described below.

Information on travel, such as origin, destination, trip purpose, and mode of travel, was obtained from origin-destination surveys.

Trips were classified into:

- Internal trips—those made wholly within the study area;
- External trips—those with one end outside the study area; and
- Through trips—those with both ends outside the study area.

The first trip type was covered by carrying out a home interview survey; while the last two types by roadside surveys. In addition, travel time surveys were undertaken on selected road links.

Land Use Inventory and Capability Analysis

Data required for analysis included detailed subdivision of land usage, soil types, hydrogeologic features, land slopes, forestry zones and reservations, watershed catchments, agricultural land use and/or capability, urban services, population by barangay, employment by barangay, school enrolments, hospital beds, socio-economic characteristics of the population, and proposed population and employment generating projects.

All information necessary as inputs into land capability analysis was anticipated to be available from secondary sources. However, as it turned out, most of the data were neither available nor in a format suitable for direct analysis or input onto TRANSTEP. Much effort, therefore, had to be put into data preparation, processing and analysis.

The socio-economic profile obtained from each city and municipality of Metro Cebu served as an interim source of the socio-economic data. For employment, the main source was the 1978 Census of Establishments carried out by the National Census and Statistics Office. Characteristics at the household level were provided by the Home Interview Survey.

Transportation System Inventory

The system components considered were the:

- Road System,
- Traffic Signals, and
- Public Transport.

Data on the road system were extracted from official records of the regional and local agencies of the Ministry of Public Highways (now Ministry of Public Works and Highways). All public roads were covered regardless of classification by administration or by pavement type. Road systems within private subdivisions not yet turned over to the government for administration, operation and maintenance, were not included. Information derived from the records included lengths and widths, classified by administration and by pavement type.

A field survey had to be undertaken to obtain information on carriageway widths, median widths, intersection layouts, pedestrian crossings and lane markings of selected roads.

Data on the existing traffic signals were obtained from the Traffic Section of the Integrated National Police (INP), which currently oversees the operation and maintenance of all traffic signals. These were supplemented by field observation whenever necessary. The following were collected:

- Sketches showing junction layout, location of controller and signal heads, roadside development and other relevant physical characteristics;
- Type of operation, i.e., whether operating in isolation or interconnected with other signals;
- Type and brand of controller and signal heads;
- Number of signal heads and type of mounting;
- Spare parts required to get defective signals back into working order;
- Equipment needed to maintain and improve existing signals; and
- Signal phases and cycle time.

The main sources of secondary data on public tranport systems were the Board of Transportation (BOT), Bureau of Land Transportation (BLT) and the Integrated National Police (INP). The public transport data consisted of:

- Public transport vehicles registered under the categories of PU, taxi, PUJ and bus;
- Routes covered and the number of units authorized and actually operating per route;
- Public transport operators and the number of units operated; and
- Route configuration or streets covered by each route.

Travel Data

As previously mentioned, trip-making in Metro Cebu was assessed by carrying out home interviews and roadside surveys. The home interview was designed to determine the characteristics of internal trips and the socio-economic characteristics of the Metro Cebu households such as income, household size, car ownership, age and sex, and employment status. The roadside survey was designed mainly to determine the characteristics of external and through trips as well as to provide data for comparison of TRANSTEP-predicted traffic volumes with observed volumes.

In addition, travel time surveys were undertaken to:

- Obtain speed and flow information for travel by private car and by public transport;
- Provide inputs to the preparation of the base year highway network; and
- Help in identifying traffic problem areas.

Home Interview Survey

A systematic random sample of households was drawn from the 1978 electoral roll of the local Commission on Elections Office. A sampling rate of five percent was considered adequate. From a total of 130,390 households in Metro Cebu, distributed among 256 barangays, one in every twenty households was chosen. A total of 6,531 households were drawn by this procedure.

The survey involved a team of interviewers calling on the sampled households to extract the required information. A total of 215 trained interviewers, divided into twelve groups, were employed. Selected supervisors monitored each group for assignments, schedules, and for quality control of the data. A letter was sent to each of the respondents a few days before the interview to ask for maximum cooperation. Letters were also sent to the barangay captains to explain the purpose of the survey.

Information on trip-making was obtained from those made by each member of the household, aged 6 years and above. Walk trips shorter than 500 meters or less than five minutes in duration were excluded. All motorized trips were included.

A total of 5,595 households were actually interviewed, representing 43 percent of the households in the study area and 86 percent of sampled households. Difficulties encountered during the survey included:

- Inaccessibility of certain households particularly those located in the mountain barangays;
- Many transient voters were listed in the election registers, and households identified with these transient voters could not be located;
- Multiple sharing of an address by several households particularly in squatter areas; and
- Non-specificity of addresses or unnumbered houses.

All data collected were manually edited for consistency and checked for obvious errors. Coding followed to translate the data obtained from the interviews into numerical codes for subsequent computer processing. A coding manual was prepared to guide the coding staff. A set of maps, indicating the barangay delineations and street system, and a master list of establishments and their locations was used to code trip origins, trip destinations, and trip purposes.

The coded interviews were then transferred to computer files for preliminary data analysis. A validation program was run to check the consistency and logic of the data input. Records found to be inconsistent and illogical were manually checked, recoded and again subjected to validation tests. A total of 4,938 records were accepted at the end of the validation runs.

To check the representativeness of the sample, a chi-square test was undertaken between the 1979 sample and the 1975 census data for age and sex distributions. The basis of this test is the assumption that the age/sex distribution of Metro Cebu has not changed significantly in the four-year period from 1975 to 1979.

The results of the tests indicated that the 1979 age/sex distribution, as determined from the household interview sample, is not dissimilar to that in 1975. At the municipality level, the significance level varied from 30 percent to 98 percent;[6] the significance level for Metro Cebu is 80 percent. There is therefore no basis to doubt the representativeness of the household interview sample.

Roadside Surveys

Roadside surveys were undertaken at 24 stations located along internal, Cebu City and external cordons and a screenline.

Internal cordon stations were located at points where streets crossed a defined cordon line enclosing the Cebu City central business district (CBD). The screenline stations were located on the bridges that cross the Guadalupe River, a major natural barrier that divides the study area into northern and southern parts. There were three stations which were both screenline and internal cordon stations. These were designated as SI stations.

The city cordon stations were located at the city boundary, while the external cordon stations were located at the points of entry to and exit from the Metro Cebu area. The locations of these 24 traffic survey stations are shown in Figure 4.

The roadside surveys consisted of:

- Roadside interview survey,
- Public transport questionnaire survey,
- Traffic counts, and
- Public transport passenger counts.

The roadside interview survey was undertaken to:

- Complement the information obtained from the home interview survey with regard to trips by persons not residing in the study area and in respect of trips by externally based commercial vehicles;
- Provide data for the forecasting of external trips; and
- Determine the traffic volume which could be by-passed from the Cebu City Central Business District.

The roadside interview survey involved stopping and interviewing of drivers of randomly selected private and commercial

[6] A significant level of no less than 10 percent is normally acceptable.

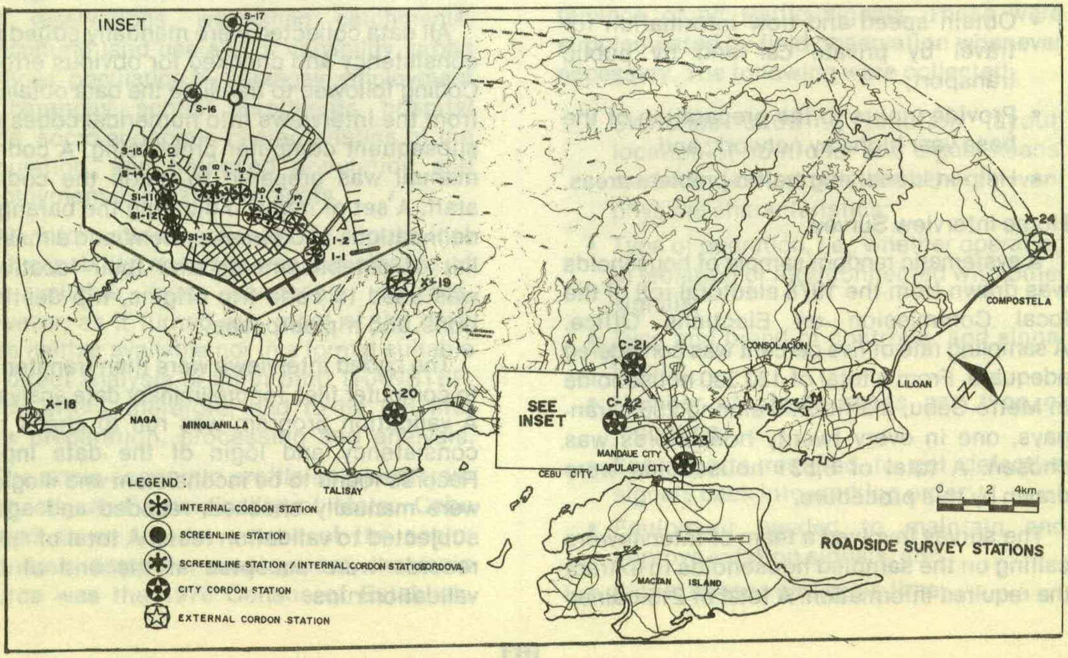

Figure 4 — Location of the 24 survey stations

A Roadside Survey Station

vehicles during a 16-hour period from 6:00 A.M. to 10:00 P.M. Information solicited included home address or place where the vehicle was usually garaged, origin and destination of trip, and land uses at the origin and destination. For private vehicles, the trip purposes at origin and at destination were also obtained and the number of occupants noted. For both private and commercial vehicles, the vehicle type was also noted. Categorized as private vehicles were motorcycles, passenger cars, private jeeps, taxis and PU's. Commercial vehicles were classified as light, medium, heavy and very heavy.

Roadside interview surveys were undertaken at all external and city cordon stations only. At city cordon stations, both inbound and outbound private and commercial vehicles were sampled. ("Inbound" is towards the central area of Cebu City and "Outbound" the opposite direction). At the external stations, samples were taken on the outbound vehicles only. This was thought appropriate in that the respondents could provide more accurate information about their trips upon leaving the study area than when interviewed inbound.

The survey was carried out on one weekday for each station during the period from 27 February to 8 March 1979. Interviews lasted sixteen (16) hours from 6:00 AM to 10:00 PM in all stations except at C-20 and C-21, where interviews were stopped at 9:00 PM due to darkness.

The general rule followed in the sample selection was to obtain a uniform sampling rate throughout the survey period at any given station. At the external stations where the traffic volume was low, exhaustive sampling was done to obtain sufficient samples. At the city cordon stations, the sampling rate varied from one in every three to one in every five depending upon the traffic volume and arrival rates. When the arrival rate was high, the sampling rate was lowered in order that, with six interviewers for each direction, no vehicle should wait unduly to be interviewed.

To calculate expansion factors, classified traffic counts were done simultaneously with, but independently from, the roadside interviews. In both surveys, records were kept at half-hour intervals.

The public transport questionnaire survey was undertaken to accomplish the following objectives:

- Help establish, together with the other surveys, the overall travel patterns; and
- Provide checks on the data obtained from the household interview survey on public transport trip making.

The survey involved the distribution of prepaid postal questionnaires to passengers of randomly selected public utility jeepneys and buses passing the three external and four city cordon stations. This survey was done during a 16-hour period, 6:00 AM to 10:00 PM, and simultaneously with the public transport passenger count.

Information requested in the questionnaire included the trip origin and destination, trip purpose, land uses at origin and destination, frequency of trip, address and car ownership of the respondent, time when the questionnaire was received, route and type of public transport being taken, and comments on the level of service provided.

At the external cordon stations, all outbound jeepneys and buses were stopped and questionnaires distributed to passengers. At the city cordon stations, where both inbound and outbound directions were considered, random sampling was resorted to. Sampling rates varied from one in every four to one in every three, depending on traffic volumes.

Traffic counts were undertaken to obtain the following information:

- Volumes and vehicle types crossing a cordon or screenline on an average day; and
- Variations of traffic flow with the time of day, days of the week, weeks of the month, and months of the year.

The above information was useful in developing expansion factors to convert interview data done on a single day to average annual daily traffic.

Traffic counts involved the counting of all vehicles passing each station and recording of volumes every half-hour and on the hour. For classified counts, vehicles were classified into:

- Motorcycles;
- Private cars and jeeps, taxi, PU;
- Jeepneys (AC, PUJ);
- Jeeps with trailer, light trucks, vans or pick-ups;
- Medium trucks;
- Very heavy trucks;
- Public buses (PUB, SB, RP);
- Animal drawn vehicles; and
- Tricycles.

For purposes of traffic counts, nine (9) out of the total twenty-four (24) roadside survey stations were classified as control stations. At these stations 24-hour classified directional counts were done for a total of 10 days spanning over a period of four weeks. Three classified directional counts were done on a Saturday, a Sunday and a weekday simultaneously with either or both the roadside interview and the public transport surveys. One classified directional count was done on a weekday, together with either the roadside interview or the public transport surveys, if these had not been done simultaneously earlier.

Six or seven unclassified directional counts were done on the remaining three or four days of the week not yet covered by the 24-hour classified directional counts, and one weekday each week (on the same weekday as the 24-hour classified directional count) for three consecutive weeks.

At each of the remaining 15 stations, only one 16-hour classified directional traffic count was made on a weekday, from 6:00 AM to 10:00 PM.

At station C-22 (Cebu City/Mandaue City), 12-hour classified directional traffic counts were conducted every last Monday of the month from October 1979 to September 1980. The data collected enabled the monthly variation of traffic flow at this station to be determined.

The public transport passenger counts were undertaken to:

- Determine the volume of public transport passengers crossing the cordon stations;
- Check and verify data obtained from the home interview survey; and
- Provide data for the development of the mathematical model.

These counts involved the counting of passengers of randomly selected jeepneys and buses passing each station. This survey was done for a 16-hour period from 6:00 AM to 10:00 PM, on a weekday at all stations and simultaneously with a 24-hour classified traffic count. Where possible, the selected jeepneys and buses were also classified as to origin or destination.

At the external stations, only outbound public transport vehicles were considered; at the rest of the stations both the inbound and outbound were covered. The sampling rate varied from exhaustive sampling at the external stations and some of the other stations where the headway of public transport vehicle arrivals was long, to one in every two or three at stations where the headway was short.

Data Processing and Analysis

All traffic count data processing was done manually. Data obtained at all control stations were analyzed to determine variation of traffic flow with the time of day, the days of the week, and the weeks of the month. Hourly variations were depicted as percentages of the total daily flow, and daily variations as percentages of the total weekly flow.

At each of the control stations, where observations were made for 10 days over a period of four weeks, the average daily traffic (ADT) was estimated. The ADT of each of the other stations was estimated based on expansion factors derived from the control station counts. This was possible by making the following assumptions:

- Volume of traffic passing a given station within a given time period of a given day bears the same relation to the total for that day, regardless of the day of the week;
- Volume of traffic passing a given station on a given day bears the same relation to the total volume for the week, regardless of the week of the month; and

- Volume of traffic passing a given station within a given week of the month bears the same relation to the total for the month, regardless of the month of the year.

The roadside interview survey resulted in a total of 6,004 interviews made on private and commercial vehicles. About 56 percent consisted private vehicles while 44 percent were commercial vehicles. About 15 percent of the interviews was conducted at the external stations and the remaining 85 percent at the city cordon stations. Data obtained from the roadside interviews were edited for consistency and coded in preparation for computer processing. A set of maps indicating the barangay delineations and road system was used to code trip origin and destination. About two percent of the total interviews were discarded due to some errors.

Data obtained in the public transport passenger count were manually processed to determine the average load of jeepneys and buses passing each survey station by direction, by time of day and by route. Also determined was the total number of public transport passengers passing each station during the survey. This information was used to determine the sampling rate for the public transport questionnaire survey.

In the public transport questionnaire survey, a total of 58,845 prepaid postal questionnaires were distributed to public transport passengers. These passengers represented about 40 percent of the total of 148,296 that were counted to have crossed all survey stations. Of these, only 2,080 replies were received representing about 3.5 percent of the total distributed.

After editing, only 1,720 reply cards were found acceptable, which represented only 1.16 percent of the total number of passengers counted. Of the acceptable cards, about 73 percent came from respondents who crossed the city cordon while about 27 percent came from those who crossed the external cordon.

Travel Time Survey

Travel time studies were undertaken for travel by private vehicles and by public transport. These studies were conducted along selected public transport routes and road links during the period from 23 August to 4 October 1979. These surveys were intended to:

- Obtain travel time/speed and flow information for travel by private car and by public transport;
- Provide inputs to the preparation of the base year highway network; and
- Help in identifying traffic problem areas.

The studies were undertaken during weekdays. For private transport, observations were made during the morning and afternoon peak periods for urban road links and during the off-peak periods for rural road links. The average car technique was used in the data collection.[7]

The survey team was composed of the driver, a timer, a recorder and two counters. The two counters were stationed at the roadside to conduct directional classified traffic counts throughout the duration of the survey. Volumes were recorded every 10 minutes. In the vehicle were the driver, timer, and recorder. At each passpoint along a link, the driver called out the odometer reading while the timer, with a stopwatch, called out the time. The recorder recorded both. Duration of any delay and the cause of the delay were also recorded. Six runs were made per direction per study period for each link. Link ends, intersections and count stations were designated as control points. Using synchronized watches, the time the test vehicle passed a control station was recorded by both the observers in the vehicle and the counters.

Streets covered by the private vehicle travel time, travel speed and delay studies were classified as either urban or rural. For urban streets, observations were made during the morning and afternoon peak periods. The morning peak period was taken between 8:00 A.M. and 9:00 A.M. while the afternoon peak between 4:30 P.M. and 5:30 P.M.

Only two rural links were observed during the off-peak period, between 10:00 A.M. and 11:00 A.M.; a Tabunok/Toledo link represent-

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[7]Institute of Transportation Engineers, "Manual of Traffic Engineering Studies", Arlington, Virginia, 1976.

ing a rural gravel road, and the south road link between the Balili Beach junction and the Naga/San Fernando boundary representing a rural paved road.

For the public transport travel time and speed studies, the traveling observer method was adopted. An observer traveled in a jeepney from origin to destination and kept record of the time to the nearest second, when the vehicle passed each control point along the route. Delays were not recorded.

Observers were divided into two groups; one at each route end. A dispatcher/coordinator was assigned to organize the dispatching of observers. Divison of routes into sections, including determination of control points, considered factors such as major road intersections, significant activity centers, major loading/unloading points and other traffic characteristics.

There were five routes covered in the public transport travel time and speed studies. Routes selected had one or more of the following characteristics:

- Heavy traffic,
- Traversing major trip generating/attracting land uses, and
- Plied by a significant number of public utility vehicles.

Forecasting

The preparation of alternative land use and transport plans had to take into account the growths of Metro Cebu in terms of factors such as population, employment and school enrolment. The impacts of these growth were determined with the aid of the computer model—TRANSTEP. In addition, the extent of highway improvement necessary to accommodate growths would be dictated by future funds likely to be available. Forecasting would be aimed, therefore, at predicting future values relating to:

- Socio-economic characteristics,
- Transportation Expenditure Assumption (TEA), and
- Land Use-Transport Interactive Model parameters such as travel time, vehicle operating costs and regional trip generations rates.

Socio-Economic Characteristics

Important determinants of the magnitudes and patterns of travel were identified to include population, secondary and tertiary sector employment, retail and wholesale trade employment, and secondary and tertiary education enrolments. Forecasts for these parameters are summarized in Table 1. They indicate that:

- Metro Cebu would likely have a population of 1.2 Million by 1986, 1.4 million by 1990 and at least 1.9 million by year 2000, representing population growth rates of about 3.7 percent per annum to 1990, and 3.3 percent per annum between 1990 and 2000;
- Employment would continue to grow at faster rates than population; 4.4 percent per annum to 1990 and 4.2 percent per annum between 1990 and 2000 jeepneys, giving employment of approximately 660,900 in 2000; and
- School enrolments would increase from 297,000 in 1980 to 624,300 in 2000 or an average rate of growth of 3.8 percent per annum.

Population forecasts were based on the National Census and Statistics Office (NCSO) projections to year 2000, which are available for each region, province and municipality in the country.[8] Medium projections, adjusted to take into account trends since 1970, are generally used for planning purposes and infrastructure development and investment programs. A set of alternative projections, which took into account past growth trends for Region VII, Cebu Province and Metro Cebu, and preliminary 1980 census results, was prepared to test the NCSO forecasts. It was concluded that the medium projection for Metro Cebu was too low and that an appropriate rate would be marginally higher than the NCSO high projection of 3.46 percent per annum.

Forecasts of total employment were based on the application of a simple set of assumed participation rates applied to the projected population. The MCLUTS Home Interview Survey provided the base figures for projecting the potential labor force, labor

[8]Results of a research program undertaken with funding assistance from the United Nations Fund for Population Activities, published in *Population Dimension of Planning*, NEDA-POPCOM-NCSO, Manila, 1975.

TABLE 1. *Population Employment and School Enrollment Projections, Metro Cebu, 1979-2000 (Thousands)*

						Growth Rates (Rounded)			
	1979	*1980*	*1986*	*1990*	*2000*	*79/86*	*86/90*	*90/2000*	*80/2000*
Population	906.8	944.5	1177.7	1360.8	1889.2	3.8	3.7	3.3	3.5
Potential Labour Force	504.9	527.0	666.6	775.7	1105.2	4.1	3.9	3.6	3.8
Labour Force	376.2	392.6	486.6	558.6	773.6	3.7	3.5	3.3	3.5
Employment (Jobs)	(270.5) 268.1	279.9	366.9	436.3	660.9	4.4	4.4	4.2	4.4
Primary	32.2	33.1	38.1	41.8	52.9	2.4	2.4	2.4	2.4
Secondary	76.8	82.7	128.4	161.4	264.4	7.6	5.9	5.1	6.0
Tertiary	159.0	164.1	200.4	233.1	343.6	3.6	3.9	4.0	3.8
(Wholesale/Retail)	(44.5)		(56.1)	(65.3)	(96.2)				
School Enrolments	285.1	297.6	376.4	439.4	624.3	4.1	3.9	3.6	3.8
Elementary	148.2	153.9	195.4	288.6	309.8	4.2	4.0	3.1	3.6
Secondary	54.7	58.0	78.5	96.0	152.6	5.3	5.2	4.7	5.7
Tertiary	82.2			93.8	108.8				

Potential Labour Force: Percent of population 15-64 years was 55.7% in 1979; Source: Home Interview Survey, MCLUTS, 1979: Assumptions 55.8% 1990; 56.6% 1986; 57.0% 1990; 58.5% by year 2000.

Labour Force: In 1979 the Labour Force Participation Rate (LFPR) was 74.5%, that is, all persons employed either "full or part time", or "unemployed but excluding housewives, students and retired persons; Source: Home Interview Survey. MCLUTS, 1979: Assumptions 73%, 1986; 72% 1990; 70% by year 2000.

Employment (Job) Rate: In 1979, the employment rate was 71.9% of the labour force, that is persons employed either "full or part time"; Source: Home Interview Survey, MCLUTS. It has been assumed the employment (Job) rate will increase to 85% by year 2000.

force and employment rate. The primary sector was assumed to decrease its proportion of total employment from an estimated 12 percent in 1980 to 9.5 percent in 1990 and 8 percent in year 2000. The secondary sector was assumed to increase its share of total employment from 29.5 percent in 1980 to 37 percent in 1990 and to 4O percent by year 2000. The tertiary sector was assumed to decrease its share of total employment from 59 percent in 1980 to 54 percent in 1990 and 52 percent by year 2000. For planning purposes it was assumed that retail and wholesale employment would remain at a constant 28 percent of tertiary sector employment.

Forecasts of elementary school enrolments were based on the assumption that the proportion of elementary-age children to total population would decrease from an estimated 17.3 percent in 1979 to 16.8 percent by 1990 and 16.4 percent by 2000. It was further assumed that participation rate would increase from 94 percent in 1979 to 100 percent in 2000. Secondary and tertiary enrolments were based on a similar analysis taking into consideration the proportion of student age population likely to be in the labor force.

Transport Expenditures Assumption (TEA)

The TEA was prepared to ensure that proposals to upgrade existing roads and to build new ones would be related to the level of funds likely to be available. This discouraged the preparation of schemes which would be beyond the resources of the government to finance.

Actual funds for implementation could be derived from a combination of domestic loans and taxes, and foreign borrowing and aid which would be channeled through national and local levels of government.

Estimates of national government funds for investment in highway infrastructure in Metro Cebu were based on assumptions of the gross national product (GNP), allocation of GNP to infrastructure investment, allocation of the national infrastructure investment to Region VII and, in turn, to Metro Cebu, and finally, share of highways to infrastructure investment in Metro Cebu. Estimates between 1981 and 2000 ranged from ₱0.60 billion to ₱3.2 billion, the actual amount depending upon the values of factors used. A realistic range for the amount of funds likely to be available would be from ₱0.60 billion to ₱1.5 billion.

Funds likely to be available from local governments in Metro Cebu for investment in highway infrastructure between 1981 to 2000 were estimated to lie anywhere between ₱44 to ₱88 million. As will be noted, these amounts are very small in comparison with funds coming from the national government.

TRANSTEP Parameters

Values of the following variables were required for each of the planning years as input to the activity patterns and assign trips modules of TRANSTEP;

- Values of Travel Time,
- Vehicle Operating Costs, and
- Regional Trip Generation Rate.

Travel time was valued as a function of the average income of travelers and the purpose of travel. The study adopted the Ministry of Public Highways valuation of travel time as equal to average income for business trips, 50 percent of income for travel to and from work and none for other trip purposes. Information on income in Metro Cebu was based on the results of the Home Interviews.

Vehicle operating costs were calculated for a range of vehicle types for 1979, 1985, 1990 and 2000. The method used by the Ministry of Public Highways[9] to calculate vehicle operating costs was adopted.

Within the TRANSTEP modeling package, trip generation is derived as a function of accessibility. It is expressed in terms of the ratio of zonal trip generation rate to the regional trip generation rate. Therefore, the value of the regional trip generation rate would be required to calculate zonal trip ends. The following assumptions were made for forecasting the regional vehicle trip generation rate:

- Private vehicle trip rates increase at 0.5 percent per annum, in line with the anticipated increase in private car ownership levels;
- Public transport trip rates remain constant;
- Commercial vehicle trip rates increase at 5.0 percent per annum; this is in accord with the anticipated growth in commercial vehicle registration relative to population growth;
- Vehicle occupancy levels remain constant at 2.3 for private car, 11.0 for public transport and 2.0 for commercial vehicles; and
- The trip purposes split for each mode remains constant.

Planning Goals and Objectives

As in other similar planning and development initiatives in the Philippines. MCLUTS was guided by the following fundamental goals of the government:

- Promotion of maximum feasible economic growth;
- Promotion of social development;
- Provision of a more equitable distribution of income and wealth;
- Maximum labor force utilization;
- Preservation of environmental stability; and
- National integration.

To provide more specific guidelines these goals were translated into objectives applicable to Metro Cebu:

- Provide good value for money, i.e. anticipated benefits exceed costs of implementation;
- Increase accessibility to important locations such as employment, health facilities, shops, schools and recreational facilities; identify key areas for government intervention in the development process,

[9]Project Planning and Development Office, Basic Road Traffic Costs, *Highway Planning Manual*, Ministry of Public Highways, Vol. 4, 1979

particularly relating to medium term investments to accommodate low income workers and their families close to places of employment, including as appropriate the existing and proposed reclamation projects;

- Ensure that improved mobility is not only available to a privileged few, but to all sectors, preferably lower income groups;
- Create employment opportunities; make maximum use of existing government initiatives in terms of committed and proposed employment generating projects, urban services systems, and other infrastructure projects and proposals;
- Protect environmentally sensitive areas from the intrusion of traffic and urban development; preserve land, water and coral areas suitable for recreation development, fishponds, mangroves, prime agricultural land, forestry zones, reservation and water catchments, through the proper allocation and intensity of urban development; and
- Create a well integrated multi-modal transport system to encourage maximum linkages within and outside Metro Cebu; make the smaller municipalities and centers more integral to Metro Cebu, at the same time, increasing their opportunities for economic growth, intensive agricultural and garden production and providing a greater balance in terms of the distribution of community services, education facilities and jobs.

Plan Formulation

The objective of this phase was to prepare alternative land use and transportation plans that could accommodate the forecast urban expansion while satisfying the planning objectives formulated. Two separate but interrelated activities were undertaken to formulate the alternative plans. These were:

- Preparation of alternative zonal distributions of population, secondary and tertiary jobs, wholesale and retail jobs, and education enrolments, taking into account the amount and location of land suitable for urban development; and
- Formulation of alternative transport network improvements within the level of funds likely to be available for transport investment in the future (TEA).

The different land use plans and transportation networks were analysed and amended, where necessary, to produce compatible pairs of plans. These would be tested using TRANSTEP and evaluated on the basis of their performance over the base plan, i.e. a plan derived through the pursuance of a "do nothing" policy. Performance would be measured in terms of economic, operational and other planning criteria.

The preparation of alternative plans was also made following an analysis of development constraints and opportunities, and consideration of committed and proposed housing and employment projects.

Constraints to urban development considered included: physical attributes such as soil types, slope, hydro-geologic factors, erosion potential and flooding hazards; existing settlements; and committed projects.

Land was classified according to relative suitability for urban development to ensure that planned or projected land uses were broadly responsive to natural constraints and the maintenance and protection of environmentally sensitive areas such as recreation and preservation areas, forestry zones and reservations and water catchments.

The constraints and opportunities are summarized in Figure 5 and they include the following elements:

- Existing built up areas in terms of residential and employment uses;
- Existing forestry zones, reservations and water catchment areas, including the proposed Mactan Island reservation and tourist-resort area;
- Urban services envelope which defines the boundaries of existing and proposed distribution systems for water supply, power and telephone;
- Proposed limit of urban expansion; within this boundary, further attention would need to be given to the protection of prime agricultural land, water courses, areas requiring reforestation and protection from the encroachment of urban development;
- Land which is highly suitable for urban development; i.e. classified as good or fair; within the proposed urban boundary, this type of land totals approximately 20,000 ha., half of which is located within the urban services envelope; and
- Proposed reclamation projects.

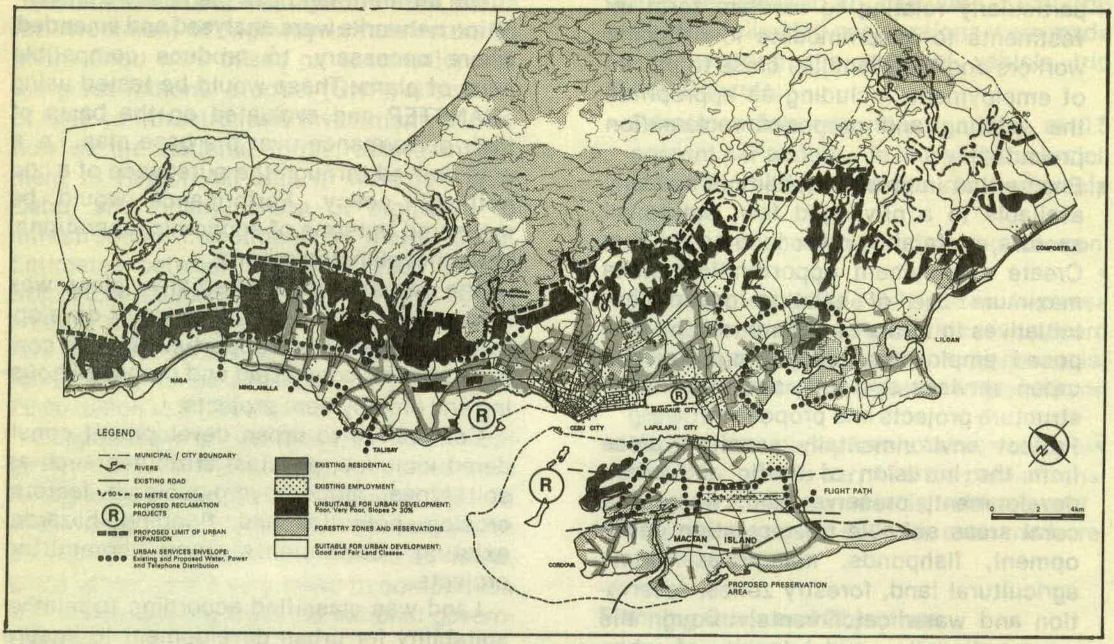

Figure 5 — Development Constraints and Opportunities

It was concluded that, excluding the base plan, four basic options were feasible (See Figure 6). Each plan was based on issues such as:

- Reclamation or no reclamation;
- Reclamation on the mainland or reclamation on Mactan Island;
- Stimulation of development on the mainland or Mactan Island or both;
- Concentration of development within the cities of Cebu and Mandaue, or dispersal of growth to new communities in Consolacion, Talisay and outer smaller municipalities;
- Concentration of central area activities or dispersal to district centers; and
- Continuation of current trends or high level of government intervention.

Base Plan

It is conventional in evaluation to compare the implications of a "do something" against a "do nothing" situation. A base plan is one derived from the "do nothing" approach which assumes that no new policies or infrastructure measures are incorporated other than those that are irreversibly committed.

The base plan highway network assumed that generally, existing road standards would remain as they are. The elements of the base plan land use were the same as for Plan 1.

Plan 1, CONCENTRATED, Without Reclamation

The objective was to prepare a plan based on expected trends. It was assumed that government intervention in terms of land use would be minimal. All committed public and private sector population and employment generation projects, including the Northern Reclamation and Aboitiz Reclamation, were incorporated into the plan.

The basic arterial road network for all development alternatives include:

- North-South, via M.J. Cuenco, P. del Rosario, Southern Expressway and Cebu South Road;
- North-West, via Archbishop Reyes, N. Escario, M. Velez and V. Rama Avenue; and
- East-West, via M.L. Quezon Avenue, A. Cortes Avenue, and Mactan Bridge.

The basic distributor roads for all development alternatives include:

- Bonifacio Street,
- New Circumferential Road,
- San Jose de la Montaña,

- Gorordo Avenue,
- General Maxilom Avenue,
- Osmeña Boulevard/Jones Avenue,
- F. Cabahug—H. Cortes Street,
- Katipunan Street, and
- Tupas Street.

The Network is defined around a principal north-south arterial passing through Mandaue City, Cebu City and Talisay. This route can be developed by upgrading M.J. Cuenco through Mandaue City and Cebu City, constructing a new link from M. J. Cuenco to P. del Rosario, and upgrading P. del Rosario, Southern Expressway and Cebu South Roads. This will result in a four-lane divided highway which will bypass the CBD and connect Mandaue City and Talisay.

Transport accessibility and land availability indicate that the Banilad area has high development potential. Access to this area can be improved by the provision of a second arterial to the northwest. This route can be developed by upgrading Archbishop Reyes Avenue from Gorordo Avenue to M.J. Cuenco Avenue, N. Escario, M. Velez and V. Rama Avenue.

Construction of a circumferential road from Banilad, around the Capitol to Banawa, has been discussed for many years. This route is included in the basic network. The proposed alignment traverses very steep terrain; hence, construction cost will be high. The route is located as close as possible to existing and proposed development; and it could function as either a by-pass, distributor road or a collector road.

Plan 2, CONCENTRATED, With Mainland Reclamation

Plan 2 is a modification of Plan 1 and includes:

- Private sector initiatives relating to the development of the Mandaue and Southern Reclamation Projects;
- Government initiatives relating to the proposals contained in the Regional Development Investment Program (RDIP) and Regional Cities Development Project (RCDP) relating to sites and services housing programs; and
- A coastal road from Mandaue City to Talisay via the CBD required as the main distributor road for the Mandaue and Southern Reclamation areas.

As a result of an examination of Plan 1, additional structural elements which would require government intervention were incorporated in Plan 2. They include:

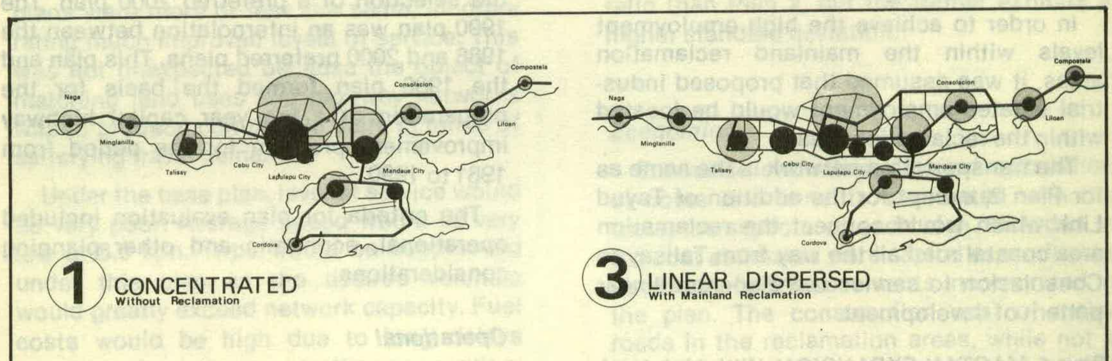

Figure 6 — 2000 Development Alternatives

- The creation of an additional institutional focus in the Banilad area which might include hospitals, a new university, a concentration of secondary education facilities, the proposed Regional Government Administrative Center, and a design population of 60-100,000; and
- An additional 60,000 population on Mactan Island to reduce the unbalanced relationship between jobs and population caused by the rapid development of the Mactan Export Processing Zone (MEPZ).

Plan 3, LINEAR DISPERSED, With Mandaue Reclamation

Plan 3 assumes the highest level of government intervention to:

- Maintain the CBD as the dominant center for commercial and retailing activities;
- Disperse and decentralize development by the creation of new planned communities in Liloan, Consolacion and Talisay, each with a design population of approximately 100,000 in addition to trend levels of development; and
- Encourage higher levels of employment within the Mainland reclamation projects than other plans intend to have, to achieve and reinforce the linear pattern of concentrated employment.

In order to achieve the high employment levels within the mainland reclamation areas, it was assumed that proposed industrial estates employment would be located within the reclamation areas.

The transportation network is the same as for Plan 2, except for the addition of Tayud Link which would connect the reclamation area coastal road all the way from Talisay to Consolacion to service the dispersed linear pattern of development.

Plan 4, MACTAN EXPANSION, With Mainland and Mactan Reclamation

The overall distribution of population and employment is similar to Plans 1 and 2, with the exception of that of Mactan Island. Under this plan, Mactan would accommodate 33 percent of population growth and 22 percent of employment growth of Metro Cebu between 1986 and 2000. Total Mactan population would be expected to reach 360,000 and employment 115,000 by year 2000 or 19 percent of Metro Cebu population and employment.

This level of development in Mactan could not be catered for by the existing bridge, hence, a second bridge crossing has been added to the network of Plan 2.

Plan Testing and Evaluation

The land use-transport interactive model (TRANSTEP) was used to test each plan.[10] The sequence of plan testing and evaluation is shown in Figure 7.

Plan testing started with the 1986 plans. The objective was to check whether the proposed highway link improvements were justified from an operational point of view. In the light of the operational evaluation results, a plan might be modified and again subjected to tests until the network improvements become consistent with the travel requirements for that year.

Tests of year 2000 plans followed. In these, the base and the four alternative plans were tested. These plans were subjected to full evaluation to enable a preferred plan to be selected. The 1986 plan[11] was used to provide data on economic benefits for 1986. Benefits in the other intervening years and beyond 2000 were calculated by interpolation and by extrapolation, respectively.

Year 1990 tests were carried out following the selection of a preferred 2000 plan. The 1990 plan was an interpolation between the 1986 and 2000 preferred plans. This plan and the 1986 plan formed the basis for the preparation of a ten year capital highway improvement program for the period from 1981 to 1990.

The criteria for plan evaluation included operational, economic and other planning considerations.

Operational

The operational evaluation of the various plans was based upon total vehicle-kilometers, average trip length, average travel speed, volume/capacity ratios, and the like.

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[10] See following paper by Cal, Graham and Nairn regarding the application of TRANSTEP.

[11] Fixed for all plans since actions taken between now and 1986 are not likely to affect significantly the 1986 situation.

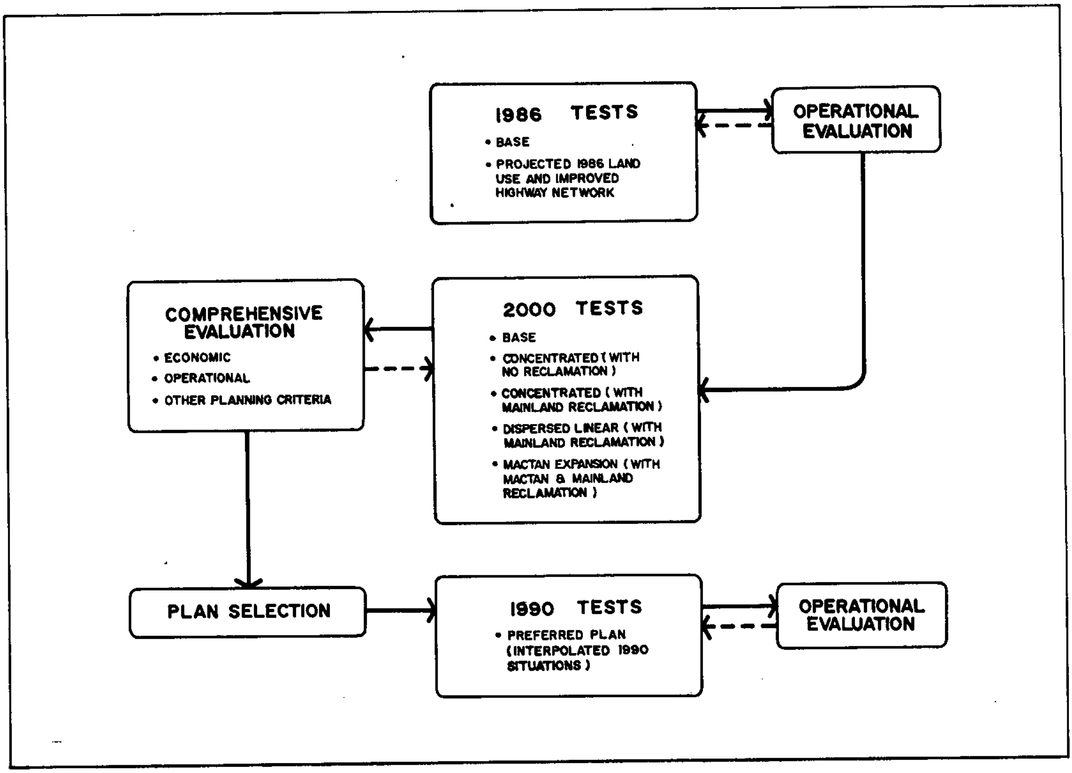

Figure 7 - Sequence of plan testing and evaluation

With the exception of the base plan, all the plans were more or less the same, incorporating much improved levels of service. This was not unexpected because the object of matching land uses and highway networks was to produce compatible pairs in terms of satisfying travel demand.

Under the base plan, level of service would be very poor. Average speed would be very low at 8.5 kph. Trips would be suppressed under this plan as the desired volumes would greatly exceed network capacity. Fuel costs would be high due to long delays resulting from severe traffic congestion. Plans 2 and 3 would have the highest average travel speed at 20.9 kph and Plan 4 the lowest at 16.2 kph.

Important operational evaluation criteria are the average volume/capacity ratio and standard deviation of link volume/capacity ratios. The average volume/capacity ratios provide a measure of the distribution of capacity utilization. A superior plan should have a relatively low average volume/capacity ratio and standard deviation. Of the five plans, Plan 2 utilizes the network best. Plan 4 has a slightly lower average volume/capacity ratio than Plan 2, but the former exhibits a higher standard deviation.

Economic

Economic evaluation entailed calculation of costs and benefits associated with the transport aspects of each plan. Included in the cost estimates were capital expenditures necessary for improvements incorporated in the plan. The construction cost of major roads in the reclamation areas, while not a financial cost to the government, was included as it was a resource cost as far as economic evaluation was concerned.

Benefits, consisting of savings in vehicle operating costs and users' travel time, were estimated using the "consumer surplus" technique.

All costs and benefits were calculated in economic values, that is, exclusive of transfer payments such as taxes and including adjustments where market values do not reflect the resource costs of items.

The annual costs and benefits were discounted to 1979 using a rate of 15 percent. From these, Net Present Value (NPV) and Net Present Value/Cost ratio (NPV/C) were calculated.

All the plans had high economic returns. This should not be surprising as it merely reflected the inability of the base plan limited road system to meet the travel needs of a metropolitan area with a population of nearly two million people. In order to function satisfactorily the area required more than two-lane roads as the basis of its arterial and distributor road network.

In more specific terms, the results of the economic assessment indicate that:

- Plans 1 and 2 offer the highest economic returns with NPV/C ratios of 2.8 and 2.9, respectively;
- The longer trip length occurring in Plan 3 reduces its economic value, aggravated by the need to construct the Tayud link which is estimated to cost ₱168 million; and
- Plan 4 is not as economically attractive as Plans 1 and 2; the substantial additional investment required for another bridge to Mactan is the major negative factor.

Other Planning Considerations

It may be postulated that a plan will have a better chance of being realized if it does not entail substantial intervention from government authorities.

The four basic plans require varying levels of government intervention. Plan 1 requires the least amount of intervention as it was based on this very assumption. The planning parameters under this plan were distributed in accordance with existing approved zoning ordinances of cities and municipalities within Metro Cebu and with trend projections. The resulting urban form is a concentrated one with substantial growth occurring in Cebu City and Mandaue City.

Plan 2 also requires little intervention except that the government will have to expand its housing program to accommodate an additional 60,000 people allocated to Mactan. This plan would involve the approval of the mainland reclamation proposals, and was formulated with a high proportion of the population located within serviced areas.

Plans 3 and 4 require substantial government intervention to stimulate development away from Cebu City and Mandaue City. Severe development controls will probably have to be applied in Cebu City and Mandaue City, whereas outlying areas will have to pursue policies and programs to attract people and industries. Under Plan 3, substantial development is planned to take place in Consolacion, Liloan, Compostela, Talisay and Minglanilla. Plan 4 entails a big expansion on Mactan Island.

Relative to 1979, all four plans will increase areas of high accessibility at varying levels, although areas of greatest accessibility will still be in or around the CBD.

Plan Selection

The evaluation results are given in Table 2. It was concluded that either Plan 1 or Plan 2 would be preferable.

Although Plan 2 is operationally and economically better than Plan 1, the differences are not significant. The choice would depend upon the status of the mainland reclamation project—Plan 2 would likely be preferred if the mainland reclamation project pushes through, and Plan 1 if it does not.

The alternative plans, evaluation results and recommendations were presented to the Metro Cebu Council at a special meeting in November 1980. The council adopted and approved Plan 2, the CONCENTRATED WITH MAINLAND RECLAMATION PLAN and the corresponding 20-year strategic highway capital improvement program.

ACTION PROGRAMMING

This project stream was undertaken in pursuance of the third objective of the study, i.e., the undertaking of projects designed to effect immediate alleviation of existing critical transport and traffic problems. In general, the action programming approach consisted of problem identification, formulation of solutions, evaluation of solutions and development of the preferred solution.

Problems were identified as a result of analyses of survey data or information

TABLE 2
SUMMARY OF PLAN EVALUATION

Plan	Brief Description	Evaluation Criteria: Operational	Economic	Other	Recommendation
Base	•Trend land use with existing highway network plus committed schemes	•Severe traffic congestion with very long delays •Very poor accessibility	•Congestion effects would produce substantial disbenefits relative to current situation •High fuel consumption	•Put severe constraints to development	•Highly undesirable
1	•Land Use same as Base Plan •Substantial network improvement	•Low overall speed in Cebu, Mandaue area because of concentration of activities •High desired volume on Mactan, requiring restraint on car travel and improved ferry services •Early up-grading of Cebu, Mandaue network necessary	•Lowest transport investment cost of ₱770M •Economic return second highest with NPV/C of 2.8	•Minimum amount of intervention necessary •High proportion of population located in serviced areas*	•Preferred plan, if reclamation projects do not go ahead within planning period
2	•Concentrated, with mainland reclamation •Network same as 1 plus reclamation roads •Sixty thousand more population in Mactan island than in Plan 1 to improve self containment level	•Improved accessibility to lower income groups •Higher overall speed and better utilization of network •Restraint of car travel on Mactan Bridge and improved ferry services necessary	•Highest economic return with NPV/C of 2.9 •Investment cost = ₱795M	•Minimum amount of government intervention except for housing provision in Mactan •High proportion of population located in serviced areas	•Preferred plan if mainland reclamation projects go ahead
3	•Linear dispersed development •Network same as 2 plus Tayud Link	•Movements to and from the CBD lowest (47% higher than 1979 level) •Highest veh -km because of dispersed activities •Volume on Mactan Bridge within capacity •Poor utilization of highway network	•High cost, ₱980M due to construction of Tayud Link •Lowest economic return with NPV/C of 2.1 •High fuel consumption	•Substantial government intervention necessary to stimulate development in Consolacion, Liloan, Compostela, Talisay and Minglanilla •Lowest proportion of population located in serviced areas	•Not recommended
4	•Mactan expansion •Network same as 3 plus second bridge to Mactan and improved network in Mactan	•Higher overall speed and fair utilization of network •Second bridge to Mactan necessary	•Substantial additional investment required for another bridge to Mactan, total investment cost = ₱1200M •Fair economic return with NPV/C of 2.5	•High government intervention to stimulate development in Mactan	•Not recommended

Note: *Areas covered by existing and proposed water supply, power supply and telecommunication system.

provided by government agencies requesting technical advice and assistance. Problems varied, ranging from general policy issues to specific cases.

Ideas or solutions considered were drawn from available literature and/or from previous experiences both in the Philippines and abroad. In some instances, certain traffic engineering measures were first experimented on to test their applicability under Metro Cebu conditions.

The action program that was formulated has been reported by Graham and Emphasis.[12] Basically, it covers the following:

- Central Business District Transport and Traffic Action Plan, covering road network improvements, parking, environmental precinct, jeepney re-routing, etc.;
- Traffic Enforcement or Arterial Road System plan (Operation TEARS), designed to improve the flow of traffic on arterial roads;
- M.J. Cuenco-Cebu North Road Traffic Study, aimed at the alleviation of traffic congestion along a section of M.J. Cuenco-Cebu North Road;
- Traffic Signal Study, concerned with a review of existing traffic signal installations and identification of future requirements; and
- Public transport improvements relating to vehicle registration and franchising, fares, routings, etc.

RECOMMENDATIONS

The results of the strategic planning and action programming activities were consolidated to produce a comprehensive set of recommendations grouped under the headings Structure Plan, Highway Improvement Program, Public Tranport, CBD Transport and Traffic Action Plan, General Areas and Institutions.

Structure Plan

Plan 2, the approved plan, was developed further to provide a framework for:

- Assessment and guidance of short and medium term investment decisions and programs relating to housing, infrastructure and education planning; and
- The preparation of outline plans for specific and municipalities.

A visual representation of Plan 2, indicating the distribution of population, employment and school enrolments, and the strategic highway network, is shown in Figure 8. The main recommendations include:

- Encouragement of the development of high density residential precincts within the CBD.
- Development of approximately 15-20 hectares of government owned land within the Northern Reclamation area to accommodate a population of around 10,000 with associated community facilities.
- Design of the Banilad, Cabangkalan, Casunkingan area as an Urban Land Reform area and preparation of an outline plan. The designated area will include:
  + a minimum design population of approximately 60,000 (desirably 30,000 by 1990);
  + the proposed Regional Government Center;
  + secondary school facilities to accommodate approximately 8,000 students (desirably 4,000 by 1990);
  + establishment of a new integrated university campus and residential requirements to accommodate the expanding needs of existing institutions (preliminary indications are that an additional 10,000 students could be accommodated by year 2000); and
  + establishment of a new hospital as required.
- Designation of the Mobolo-Kasambagan area in Cebu City as an Urban Land Reform area. The area provides excellent opportunities for:
  + comprehensive development to accommodate a broad range of income groups from very low to very high;
  + experimenting and undertaking land consolidation and land pooling initiatives and cross-subsidy techniques

[12] See article of Graham and Emphasis on Traffic Engineering Action Programs appearing in this issue of the PPJ.

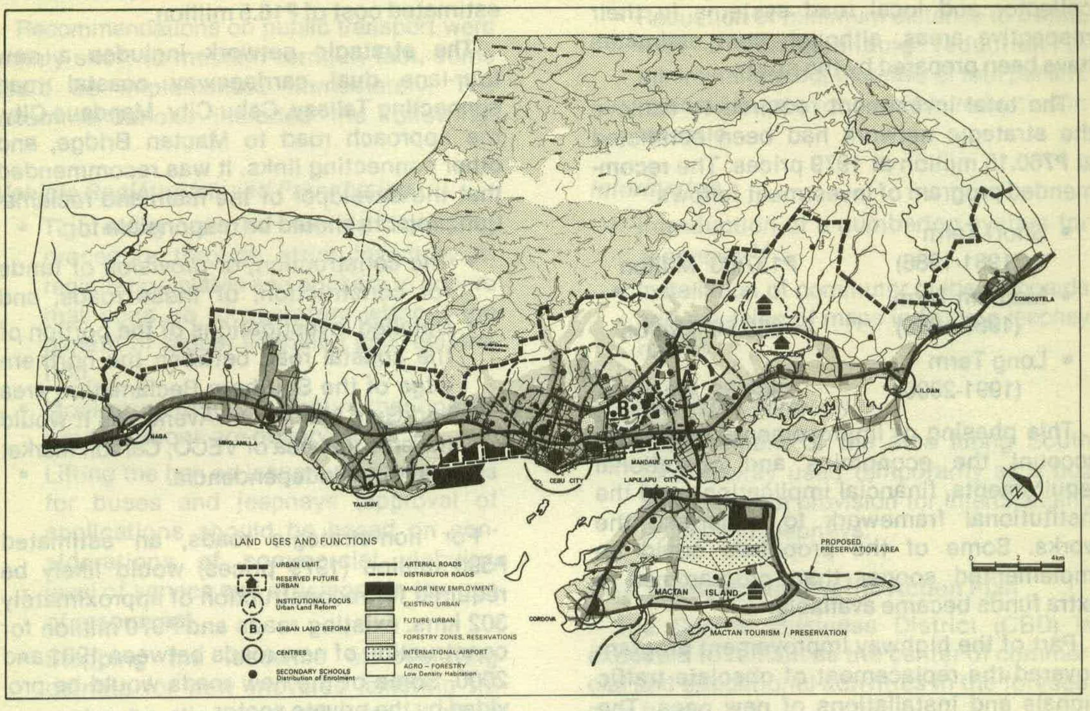

Figure 8 — Metropolitan Cebu Structure Plan 2000

for the provision of low cost land or land and housing; and

+ strong initiatives by the Cebu City Government in conjunction with the national government, line agencies and the private sector, to initiate the programmed housing development of Metro Cebu.

- The undertaking of a detailed study of the manufacturing sector in Metro Cebu to provide guidance to the government in pursuing the mainland reclamation proposals for which it has opted, and a detailed and substantive economic and financial appraisal justifying the need for and desirability of an industrial estates program.
- Development of a new community in Lapu-lapu city with a total design population of 100,000 to bring the job-to-population ratio to a reasonable level.
- Undertaking feasibility studies of Sites and Services projects recommended by the Regional Cities Development Project.
- Undertaking detailed Urban Agro-forestry studies within the proposed Urban Development Limit.
- The use of the government share of land within the proposed mainland reclamation projects for housing and all associated community facilities for a design population of at least 60,000 (the developer should be encouraged to participate in the provision of land or land and housing within the reclamation areas).

Highway Improvement Program

The program concerns mainly the strategic highway network shown in Figure 9. The adopted network is of the radial-circumferential form with six radial and three circumferential roads. This is consistent with the preferred concentrated pattern of development. The principles of classifying roads into a hierarchy have been applied in the development of the network. Only the arterial and distributor road systems have been included as it is assumed that local authorities would identify and prepare plans for collector and local road systems in their respective areas, although cost estimates have been prepared by the study.

The total investment required to achieve the strategic network had been estimated at ₱760.15 million at 1979 prices. The recommended program of investment follows:

- Short Term (1981-1986) ₱137.83 Million
- Medium Term (1987-1990) 255.80 Million
- Long Term (1991-2000) 366.52 Million

This phasing of improvements takes into account the economics and operational requirements, financial implications and the institutional framework to undertake the works. Some of the proposals could be implemented sooner than programmed if extra funds became available.

Part of the highway improvement program covered the replacement of obsolete traffic signals and installations of new ones. The Short Term program provides for this, at an estimated cost of ₱16.5 million.

The strategic network includes a new four-lane dual carriageway coastal road connecting Talisay, Cebu City, Mandaue City, the approach road to Mactan Bridge, and other connecting links. It was recommended that the developer of the mainland reclamation projects should be responsible for:

- The construction, or provision of funds for construction, of these roads; and
- Detailed investigations of the portion of the coastal road between the northern edge of the Southern Reclamation area and Gen. MacArthur Avenue as it would traverse the area of VECO, Carbon Market and Plaza Independencia.

For non-strategic roads, an estimated ₱590 million (1979 prices) would likely be required for reconstruction of approximately 302 kms. existing roads and ₱970 million for construction of new roads between 1981 and 2000. Some of the new roads would be provided by the private sector.

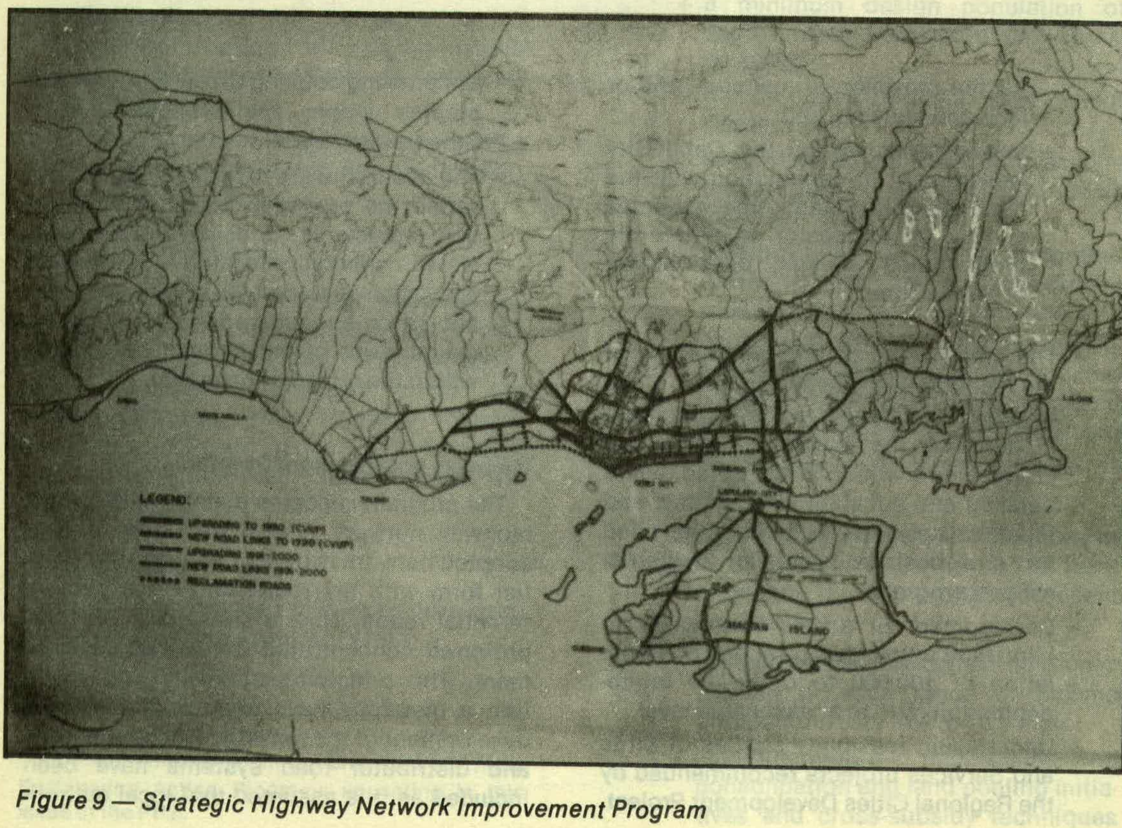

Figure 9 — Strategic Highway Network Improvement Program

Public Transport

Recommendations on public transport were mainly short to medium term; in fact, some could be implemented immediately. The recommendations included the following:

Vehicle Registration and Franchising

- Tightening up the vehicle licensing procedure through strict inventory of registration plates and stickers to ensure that none go to operators without the benefit of proper licensing and registration.
- Monitoring routes to ensure that operating conditions are observed.
- Lifting the ban on issuance of franchises for buses and jeepneys (approval of applications should be based on considerations of commercial viability, level of service and efficiency in the use of resources).
- Stopping the issuance of operating permits for new tricycles (existing tricycles be allowed to transfer to areas where supply is lacking; this policy should be reviewed in 2 years).

Public Transport Vehicles

- Development of criteria to govern the choice of public transport vehicles to operate a route, along the line pursued by MCLUTS.[13]
- Implementation of the suggested plan for the re-routing of jeepneys.[14]
- Investigation of the feasibility on introducing buses to operate wholly within Metro Cebu.
- Phasing out of the operation of PU's and allowing existing roadworthy PU's to be converted into taxis with meters.
- Prohibiting the entry of tartanillas into the CBD during peak periods.

Fares

- Reduction of minimum distance to 3 kms. with a corresponding reduction in minimum fare but increase of rate per km. to compensate for possible reduction in revenue.

Information

- Introduction of a numbering system for jeepneys.[14]
- Installation of commuter guide billboards and provision of maps indicating jeepney routes.

Southern Bus Terminal

- Improvement of the area along South Expressway used temporarily as a bus terminal, with provision for interchanging buses and jeepneys.

CBD Transport and Traffic Action Plan

The Central Business District (CBD) is expected to remain as the center of commercial and educational activities in the foreseeable future.

Recommendations for implementation in the short term (1980-1986) include:

General

- Reversal of the one-way flow along Pelaez Street/Legaspi Street, between Manalili Street and R.R. Landon Street; and opening of Junquera Street, between Colon Street and R.R. Landon Street, to two-way traffic.
- Installation of box intersections.
- Improvements on traffic signing and pavement marking.
- Designation of jeepney stops.
- implementation of Jeepney Re-routing Plan.
- Restriction of the entry of tartanillas into the CBD.
- Provision of pedestrian facilities.

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[13] See MCLUTS, Main Volume, *Final Report*, Ministry of Transportation and Communications, Vol. 2, pp. 214-216, 1980.

[14] See MCLUTS, Transport and Traffic Engineering Studies, *Final Report*, Ministry of Transportation and Communications, Vol. 3, pp. 18-44, 1980.

- Development of Colon street, between Pelaez St. and Jakosalem St., as a "PUJ Only" Street on experimental basis.
- Development of the Magellan's Cross Area as an environmental precinct.
- Improved enforcement of traffic rules and regulations.

Parking

- Increasing off-street parking provision by paving and making available the lot bounded by Junquera and Sanciangko, and by enforcement of parking provisions embodied in the Zoning Ordinance.
- Progressive and firm enforcement of parking regulations concentrating on violations which have the effect of obstructing moving traffic.
- Lifting of parking prohibitions in the following locations:
  + southern side of Pelaez/Legaspi Street from Manalili to Sanciangko Streets,
  + both sides of Plaridel Street,
  + one side of Gonzales Street,
  + both sides of Juan Luna Street from P. Burgos to M.J. Cuenco Avenue, and
  + eastern side of Colon Street from Jakosalem to Mabini Streets.
- Introduction of experimental pay parking schemes.
- Identification and implementation of "no loading and unloading" zones.

General Areas

The following recommendations were also made.

- Take immediate steps to improve road maintenance, intersection layouts, traffic signing, pavement marking, etc.; corollarily, improve drainage and flood control systems.
- Improve traffic flow along arterial roads by installation of jeepney stops, intersection control, strict enforcement of parking restrictions, etc.
- Deploy traffic aides to control and direct traffic at critical intersections.
- Provide pedestrian facilities like sidewalks and crossings where demand is high.
- Control movements of heavy commercial vehicles.
- Require the provision of off-street parking by new large developments in accordance with the Cebu City Zoning Ordinance or the National Building Code, in the case of other cities and muncipalities.
- Implement programs to educate road users in traffic rules and regulations, and basic road courtesy.
- Maintain continuity in traffic direction and in the enforcement of existing regulations.
- Exercise development controls to ensure conformance with structure plans and to provide adequate reservation for required road right-of-way.

Institutions

The MCLUTS recommended investment program for Metro Cebu should form part of the Regional Development Investment Program (RDIP) for Region VII. The RDIP lists and programs all existing, on-going, pipeline and proposed projects of local governments, line agencies and, to a lesser extent, the private sector, whether locally or foreign funded. Such a regional package of programs and projects is designed to assist in the achievement of the goals of the regional plan regarding employment, productivity, income and provision of basic services.

The capability of existing institutions to implement plans and programs in Metro Cebu and in the whole of Region VII was reviewed in collaboration with the NEDA. It was concluded that serious gaps existed in planning, project preparation, programming, budgeting, monitoring, co-ordination, funding and implementation. For example, key programs for agro-reforestation and urban/industrial infrastructure development that were revenue generating were not handled at all by existing government agencies. Moreover, the region did not have any institution that could be the recipient of external assistance. This was a serious deficiency particularly in the light of the historically low levels of public investments in the region.

To correct these deficiencies, the following reforms were recommended, among others:

- Decentralization of government decisionmaking, particularly in the industrial sector.

- Strengthening of the Regional Development Council (RDC) by giving it additional powers, funds and manpower to act as a planning, coordinating and implementing organization.
- Creation of a Programming and Budgeting Committee under the RDC to formulate a program of investments and the corresponding budget for the region.
- Establishment of a Regional Development Authority and a Metro Cebu Development Authority under the RDC to ensure successful implementation of the region's policies and programs; in the interim, creation of a Regional Planning and Development Office to handle the RDIP Project Preparation exercise.

CONCLUSIONS

The success of a planning project may be judged by how quickly it is followed by succeeding project phases. In the case of the MCLUTS project, there has been no break from Phase I to Phase II; the concerned government authorities, namely the MOTC, NEDA, city/municipal governments in Metro Cebu and the Cebu Provincial government, decided to proceed immediately to the next phase. Today, roughly eight months after the completion of the planning phase, MCLUTS is well underway into the implementation of some of its recommendations and the detailed study of others.

The successful completion of Phase I of MCLUTS has served as a catalyst in the speedy creation of the Regional Planning and Development Office (now called Central Visayas Urban and Rural Projects or CVURP), with World Bank funding. The urban component of CVURP—Central Visayas Urban Project (CVUP)—covers Transport, Urban Services, Shelter and Livelihood, Industry, and Local Government Finance and Management in the three urban centers of Central Visayas—Metro Cebu, Dumaguete City and Tagbilaran City. The Transport Sector has been split into two packages: Traffic Engineering and Management, and Public Transport Improvement Package; and Roads, and Road Maintenance Package. MCLUTS, now integrated with CVUP, handles the first package with its brief expanded to cover the cities of Dumaguete and Tagbilaran The latter package has been grouped with Urban Services and will be handled by a consulting firm under contract with CVUP. Included in this contract will be the undertaking of route feasibility study, and some preliminary and detailed engineering work of the 1981-1990 Highway Improvement Program of MCLUTS. The recommended Traffic Signal Planning and Detailed Design will also be undertaken by a consulting firm under a separate contract package.

At present, the team is deeply involved in the implementation of the MCLUTS Rationalization of Jeepney Operation Plan which consists of:

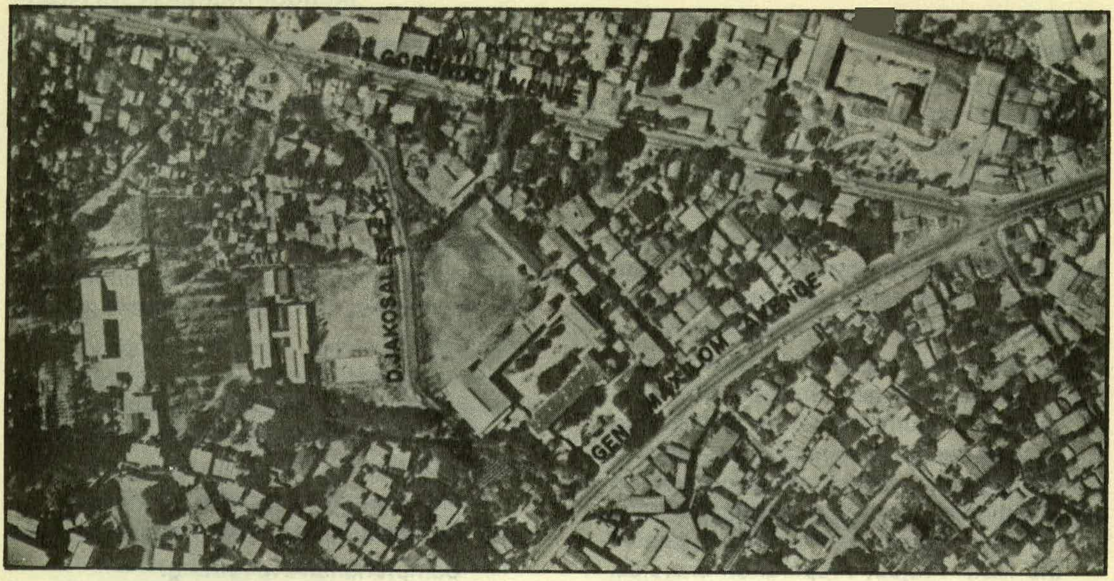
- Route numbering and stickering,
- Legalization of colorum jeepneys,[15] and
- Comprehensive re-routing.

The first two components are currently being implemented; the third and last will not be started until these components are completed. MCLUTS acts as the central processing unit for application papers as well as the monitoring and continuing planning body. The latter role is a very important one, considering that the implementing procedures have to be revised several times to meet changing conditions and circumstances. Three other agencies closely involved in the scheme are the BOT, BLT and CHPG; the BOT is the approving authority for new routes and franchise applications from operators of colorum jeepneys, the BLT is responsible for the registration of legalized units and the CHPG in-charge of the enforcement aspects of the MCLUTS Plan.

Other MCLUTS recommendations that have already been implemented included:

- Traffic Enforcement on Arterial Road System (Operation TEARS) designed to improve traffic flow along major arterials in Cebu City;
- Widening and road surface improvement of M.J. Cuenco Avenue;
- Introduction of a new lay-out at Gorordo Avenue-Salinas Drive Intersection; and
- Construction of D. Jakosalem Extension.

[15] Jeepneys without valid operating authority



Aerial view of newly completed D. Jakosalem Street Extension.

The implementation of MCLUTS recommendations has not been without problems. The re-building of the Gorordo Avenue-Salinas Drive intersection to install a new lay-out as recommended by MCLUTS is far from satisfactory. It seems that the sketch plan submitted by MCLUTS was not followed by detailed engineering prior to actual construction. Moreover, the recommended standards had been apparently sacrificed in an effort to reduce construction cost. This case underlines the importance of close coordination between planning and implementing bodies. Had MCLUTS continued to be involved right through the implementation period, the problems could perhaps have been avoided.

Included in MCLUTS' terms of reference under Phase II is the continuing provision of technical advice and assistance to other government agencies. MCLUTS has already prepared a number of proposals in response to requests and helped to resolve policy issues, including:

- Preferred alignment for the proposed Arlington Pond Street Extension;
- P. del Rosario St.—Jones Avenue intersection improvements;
- Evaluation of Southern PUJ Terminal; and
- Traffic Impact Study of the proposed Magellan Cross Environmental Area.

A number of lessons learned during the course of the MCLUTS project that might be of interest to other practitioners include:

- The formulation of land use-transportations plans must take into account future funds that are likely to be available for transportation expenditures; this prevents the preparation of grandiose plans that are beyond the resources of the government to implement.
- The terms of reference for a planning project should include the preparation of action projects designed to alleviate existing transport and traffic problems; politicians want immediate results, therefore they are likely to support a project that is oriented to the preparation of solutions for immediate implementation.
- Direct importation of solutions must be avoided; measures must be evaluated to ensure that they are applicable under local conditions.
- Survey techniques which have been tried in other countries may not necessarily be applicable in the Philippines. For example, despite incentives such as gifts that could be won, a very small percentage of sampled respondents returned the self-completed public transport questionnaires; the mathematical modeling approach was subsequently modified so that it would not rely on the doubtful accuracy of these data. □

LAND USE—TRANSPORTATION INTERACTIVE ANALYSIS

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Introduction

The Metro Cebu Land Use and Transport Study (MCLUTS) adopted a strategic planning process that involved the testing and evaluation of alternative land use and transportation plans. This type of approach was evolved from transportation studies first carried out in the United States in the 1960's. In past studies, plans had been formulated with a fixed land use, i.e., only the transportation networks varied.[3] The land use would be determined separately by a relatively simple procedure. In some cases, a single land use would be directly formulated. A disadvantage of this approach is that the transportation network chosen may be optimum only in so far as the land use formulated was considered; it is possible that a different network could have resulted had other viable land uses been tested. Moreover, this approach fails to recognize the inter-relationships between land use and transportation; that is, transportation may affect land use in the same way that the latter affects the former. The fixing of land use is opted to reduce the task of plan testing and evaluation, which is usually time consuming and demanding in the use of computer resources.

In MCLUTS, the testing and evaluation of plans is not limited to a single land use. A number of viable options has been formulated and, for each option, one or more compatible pairs of land uses and transportation networks have been developed and evaluated. The only simplifying assumption used was that the Metro Cebu total for each of the planning parameters such as population, employment and school enrolment remained fixed for all plans; only the zonal distributions varied between options.

The simultaneous treatment of land use and transportation in plan testing, evaluation and selection is referred to as land use-transportation interactive analysis. This analysis, which is the subject of this paper, has been carried out by MCLUTS using a computer model called TRANSTEP.[4]

The Computer Model

The Land Use-Transportation Interactive Model (TRANSTEP),[5] as used in MCLUTS, consists of twelve modules; five modules perform simulative modelling while the other seven perform utility functions only. The modules which perform modelling functions are:

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[1] Also Associate Professor, Institute of Environmental Planning, University of the Philippines System

[2] With REDECON-Australia under Phase I of MCLUTS.

[3] For example, see METROPLAN, Final Report, 1978

[4] The original model was acquired from R.J. Nairn and Partners as part of the Australian Government assistance to MCLUTS

[5] See MCLUTS, TRANSTEP Users Manual, Final Report, Vol. 4, November 1980, for detailed descriptions.

- Activity Patterns Model (APM),
- Modal Split (MS),
- Assign Trips (AT),
- Land Use Analysis and Projection (LANDAL), and
- Load Public Transport (LPT)

The Activity Patterns Model is the core model of TRANSTEP. It has two-fold functions: namely, to produce a valid interzonal trip matrix, given a set of land use data and interzonal travel costs; and to produce zonal accessibility data in a form suitable for plotting. The function of the Modal Split module is to divide a trip matrix, as produced by the Activity Patterns Model, into car driver trip matrix and public transport trip matrix using a logit type equation. The primary function of the Assign Trips module is to carry out the assignment of an interzonal vehicular trip matrix onto the highway network. Its secondary functions involve the production of a congestion-constrained interzonal generalized cost matrix, summary evaluation results and congestion-constrained public transport link speeds. The LANDAL module has been developed during the MCLUTS study mainly for distributing regional forecasts of urban activities among the traffic zones within the study area. The main function of the Load Public Transport module is to carry out the loading of an interzonal public transport trip matrix onto the public transport network and to provide line information suitable for detailed planning and economic evaluation.

What makes TRANSTEP particularly adaptive to modelling land use-transportation interactions is its Activity Patterns Model. This model treats trip generation and trip distribution simultaneously and is a function of both land use and transportation systems. This means that changes in land use, transportation network, or both, could give rise to changes in zonal trip generation rates as well as in interzonal movements. (Traditional transportation planning models normally treat trip generation and trip distribution sequentially and do not include accessibility as a factor affecting trip generation.) The trip distribution process, while sensitive to land use changes, utilizes a preference function which is independent of land use and, therefore, is more likely to be stable geographically. In fact, according to Nairn, et. al. the preference function "appears to be invariant across cities and time".[6] This is an essential feature in the study of grossly different alternative land use plans. A description of the mathematical formulation of this model, including calibration and validation, is presented in the sections following.

The Activity Patterns Model

The key to the modelling process is the derivation of a trip length probability distribution for each traffic zone. This distribution gives the probability of an individual traveller making a trip to any other point in the study area. The multiplication of each ordinate of this distribution by the total trip productions in the zone produces the trip length frequency distribution for that zone. This distribution gives the total number of trips made to all points in the study area located at a certain distance (expressed in generalized cost) from the zone.

Its derivation for a particular zone and trip purpose, as viewed from the production end, uses a two-step procedure, as follows:

1) The first step is to build a trip opportunity frequency distribution as a function of interzonal separation, usually expressed in generalized cost. The distribution may be developed using one of the land use variables, e.g., employment for home-based work, or the zonal trip attractions directly. The normalization of this distribution produces a trip opportunity probability distribution (See Figure 1).
2) The trip length probability distribution is obtained by multiplying the ordinate of the trip opportunity probability distribution by the ordinate of the preference function (See Figure 2 and later section for derivation) for each generalized cost increment and then normalizing the resulting curve. Figure 3 shows a typical trip length probability distribution.

The trip length probability distribution allows the zonal average trip duration to be

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[6]See NAIRN, R.J., et. al., "Land Use/Transport Interaction Modelling with TRANSTEP", 3rd Australian Transportation Research Forum, 24-25 May 1977 for exposition of the theory.

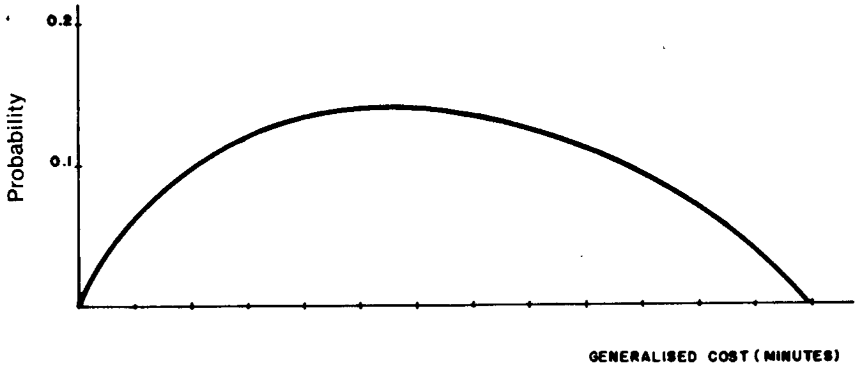

Figure 1 — Opportunities Probability Function

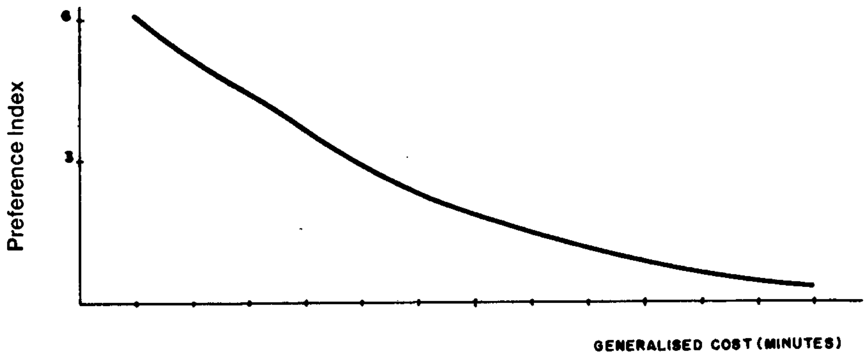

Figure 2 — Preference Function

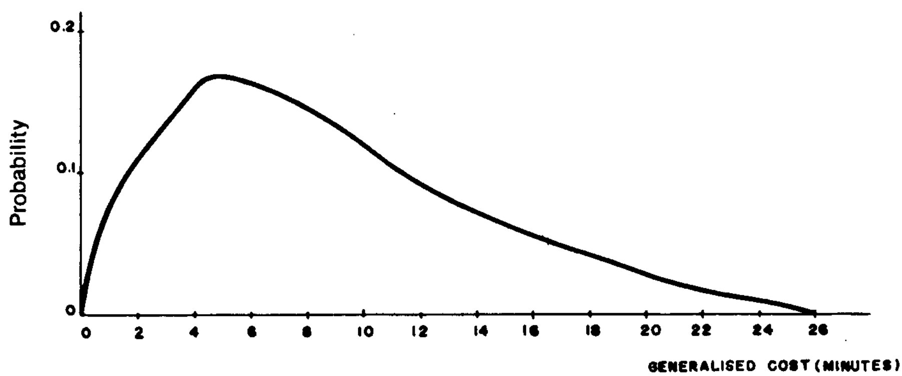

Figure 3 — Trip Length Probability Distribution

derived and in turn, is the basis for calculating the zonal trip generation rate (See Figure 4). This trip generation rate multiplied by the population in the zone gives P_i, the number of trips produced in zone i.

The ordinate of the trip length probability distribution multiplied by P_i gives the trip length frequency distribution, represented as $T_i(C_{ij})$ where C_{ij} is the generalized cost from Zone i to Zone j.

The above procedure is repeated for each of the remaining traffic zones. Trip distribution is then derived using the following formula:

$$T_{ij} = A_j \frac{T_i(C_{ij})}{\sum_{i=1}^{N} T_i(C_{ij})}$$

where A_j = No. of trips attracted in zone j
N = Total No. of traffic zones

The above trip distribution process ensures that $A_j = \sum_{i=1}^{N} T_{ij}$, however, productions may not be similarly constrained. Constraining of both productions and attractions is done by an iterative procedure involving repeated reversals of the role of productions and attractions in applying the foregoing procedure.

Model Calibration

Values of certain parameters are required to run the Activity Patterns Model. The model had in-built values derived from other studies, but as the model had not been used previously in the Philippines, it was considered desirable to establish these for Metro Cebu. The object of calibration was therefore to derive appropriate values of these model parameters, particularly:

- Trip Generation Rate Adjustment Curve, and
- Preference Function

Trip Generation Rate Adjustment Curve

One good feature of the Activity Patterns Model is its ability to consider the effect of a transportation system on trip generation. This is achieved by the use of a trip generation rate adjustment curve, which is a plot of the ratios between the zonal trip generation rate and the regional trip generation rate, against the zonal average trip duration. The function is based on the theory that trip generation rates are directly proportional to the level of accessibility of a zone, that is, zones with high accessibility levels generally generate high trip rates while zones with low accessibility levels produce low trip rates. In this study, the zonal average trip duration has been used as a measure of accessibility.

The MCLUTS home interview survey formed the basic data source for the calculation of the regional and zonal trip generation rates. The trip generation rate per traffic zone was obtained by taking the quotient of the total number of person trips recorded for a specific purpose and the total number of persons actually sampled. The average trip duration for a zone, expressed in minutes, was calculated by averaging the zone's trip durations to all other zones in the system, weighted by the zone to zone trips. The interzonal trip duration were derived by running the Assign Trips Module on the 1979 transportation network.

The resulting trip generation rate adjustment curves for several trip purposes are shown in Figure 4. These curves were then used for trip generation prediction purposes within the Activity Patterns Model.

Preference Function

A key factor in the use of the Activity Patterns Model was the existence of a preference function which would enable a trip length probability distribution to be generated for each zone and for each trip purpose. This distribution enabled the average trip duration to be derived for each zone, which was needed in applying the trip generation rate adjustment curves as part of the trip generation process. It was also the basis for the distribution of trips to various destination zones.

The preference function was derived by dividing the ordinates of the study area observed trip length probability distribution by the ordinates of the observed trip opportunity probability distribution. Both distributions are a function of interzonal costs. The base year interzonal cost matrix was obtained by running the Assign Trips Module on the base year highway network.

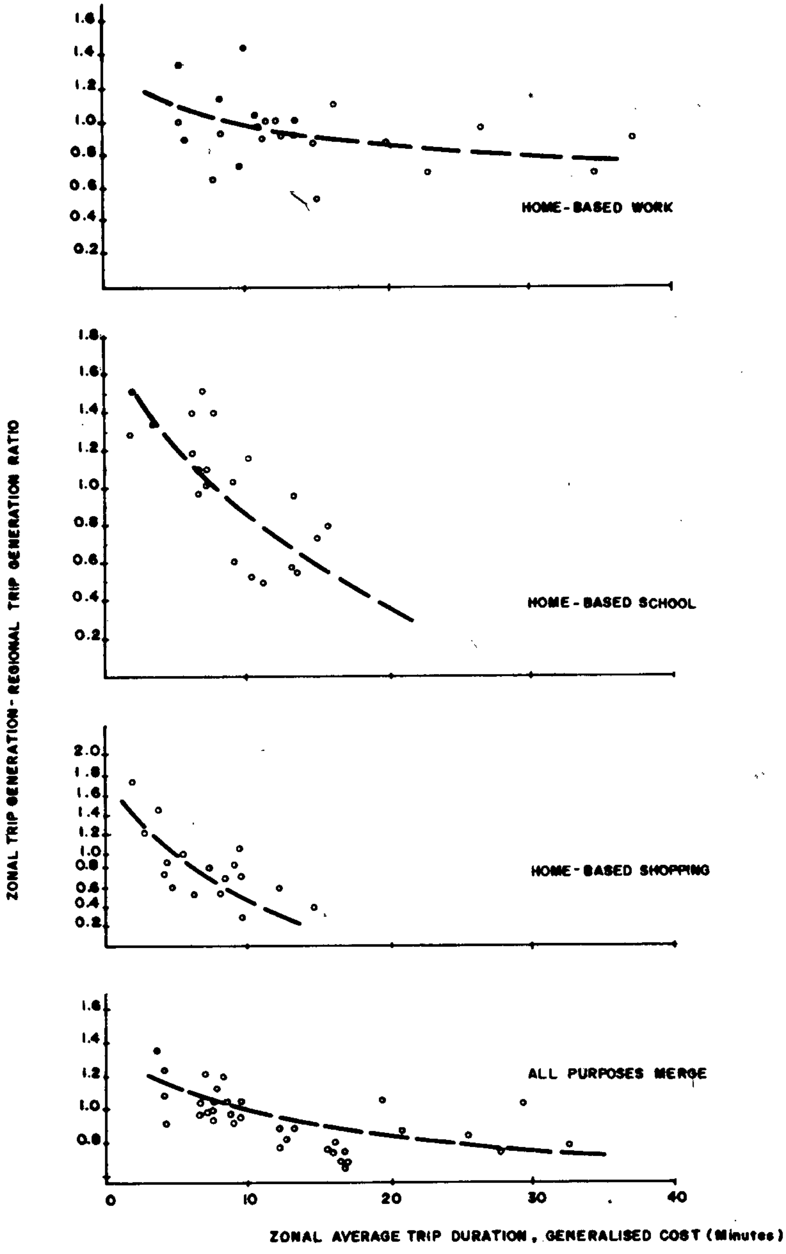

Figure 4 — Trip Generation Rate Adjustment Curves

The zonal trip length probability distribution was derived from the 1979 survey trip tables and the interzonal skim matrix.

Similarly, the 1979 population, employment, school enrolments and shopping activities were used to develop the trip opportunity probability distributions for the home-based trip purposes. Separate preference functions have been developed for home-based work, school, shopping and all purposes merged.

Figure 5 shows the derived preference functions for four different trip purposes. The home-based work and shopping curves are generally similar. This pattern conforms with the make-up of Metro Cebu in which work and shopping opportunities are located primarily within the central area of Cebu City. The home-based school curve shows much higher preference for the short distance trips. However, from 20 minutes onwards, preference indices are more or less the same for all trip purposes.

Model Validation

TRANSTEP was run using the derived parameters to reproduce the 1979 travel patterns. The results of this run were compared with the observed patterns as a check on the accuracy of the derived values of TRANSTEP parameters. Comparison was made on:

- Zonal trip length frequency distributions and
- Traffic volumes at selected stations and corridors

Trip length frequency distributions, synthesized and observed, for three selected zones are shown in Figure 6. The results indicate that the model does replicate existing trip length frequency distribution reasonably well.

Results of trip assignments are shown in Tables 1 and 2 together with values obtained from actual traffic counts. Traffic assignment was done directly from an all-day all-vehicle interzonal table. Estimates of public transport trips were obtained by assigning a separately synthesized public transport trip matrix using an all-or-nothing minimum distance assignment technique.

The difference between the assigned and traffic count volumes was considered to be within acceptable limits, except for the volume of public tranport trip across the Mactan Bridge which was very much overestimated. In addition, the model has been developed on the basis of the average walk/public transport split for the whole of Metro Cebu and therefore it cannot predict trips accurately in areas where the split varies largely from the average. A separate factor should be applied to the Mactan link in future public transport person trip assignments to overcome the tendency of the Model to overestimate trips on this link.

TABLE 1
COMPARISON OF OBSERVED AND SYNTHESIZED TOTAL VEHICULAR VOLUMES ON METRO CEBU SCREENLINES, 1979

Screenline	*Observed*	*Synthesized*	*Observed/ Synthesized*
Central Business District	184,200	156,100	1.18
Guadalupe River	97,800	90,550	1.08
Lahug River	98,300	91,870	1.07
Cebu City Boundary	55,900	57,110	0.98
Mactan Bridge	7,000	7,610	0.92

TABLE 2
COMPARISON OF OBSERVED AND SYNTHESIZED PUBLIC TRANSPORT PASSENGER VOLUMES ON METRO CEBU SCREENLINE, 1979

Cordon	Observed	Synthesized	Observed/ Synthesized
Central Business District	724,400	570,400	1.27
Guadalupe River	328,200	307,200	1.07
Cebu City Boundary	321,700	228,000	0.97
Mactan Bridge [a]	19,300	32,000	0.61

[a] One explanation for the large difference on Mactan bridge is that a large number of public transport passengers walk across the bridge and catch a PUJ in Mandaue; counts did not include pedestrians.

APPLICATION OF TRANSTEP IN MCLUTS

The strategic planning process adopted by the study involved the preparation of alternative land use and transportation plans that could accommodate the forecast urban

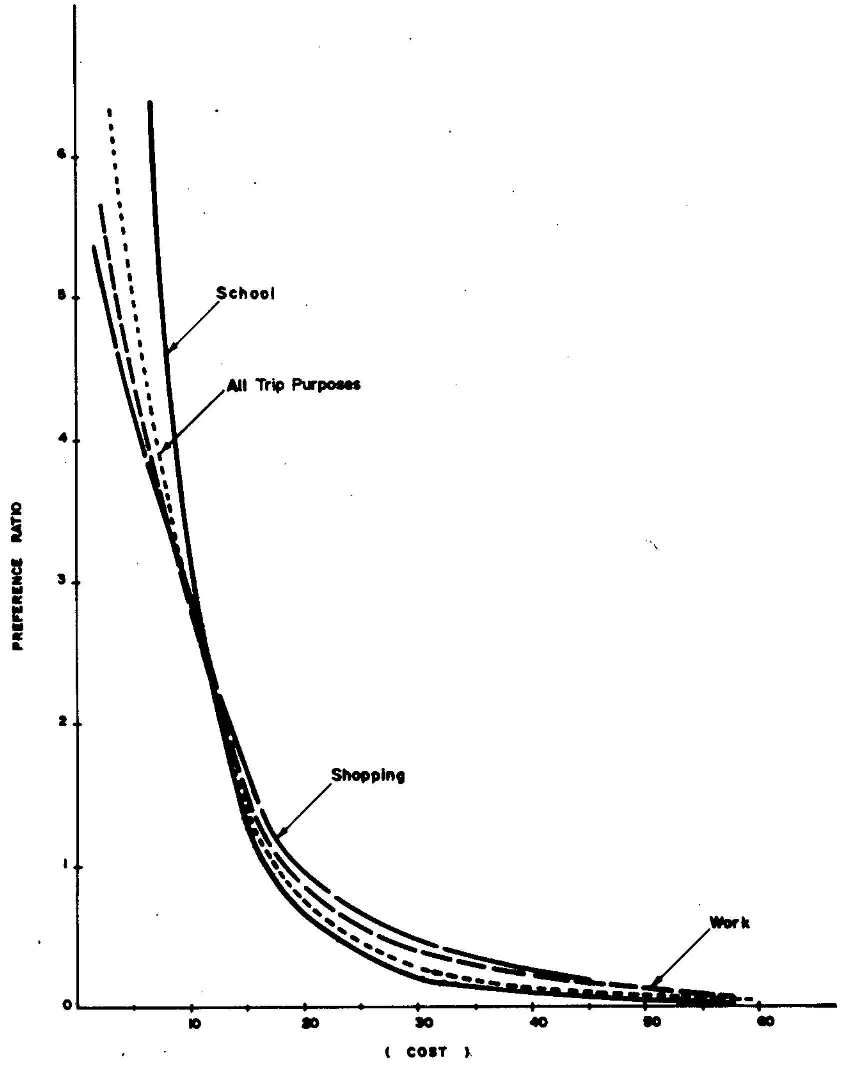

Figure 5 — Preference Function by Trip Purpose

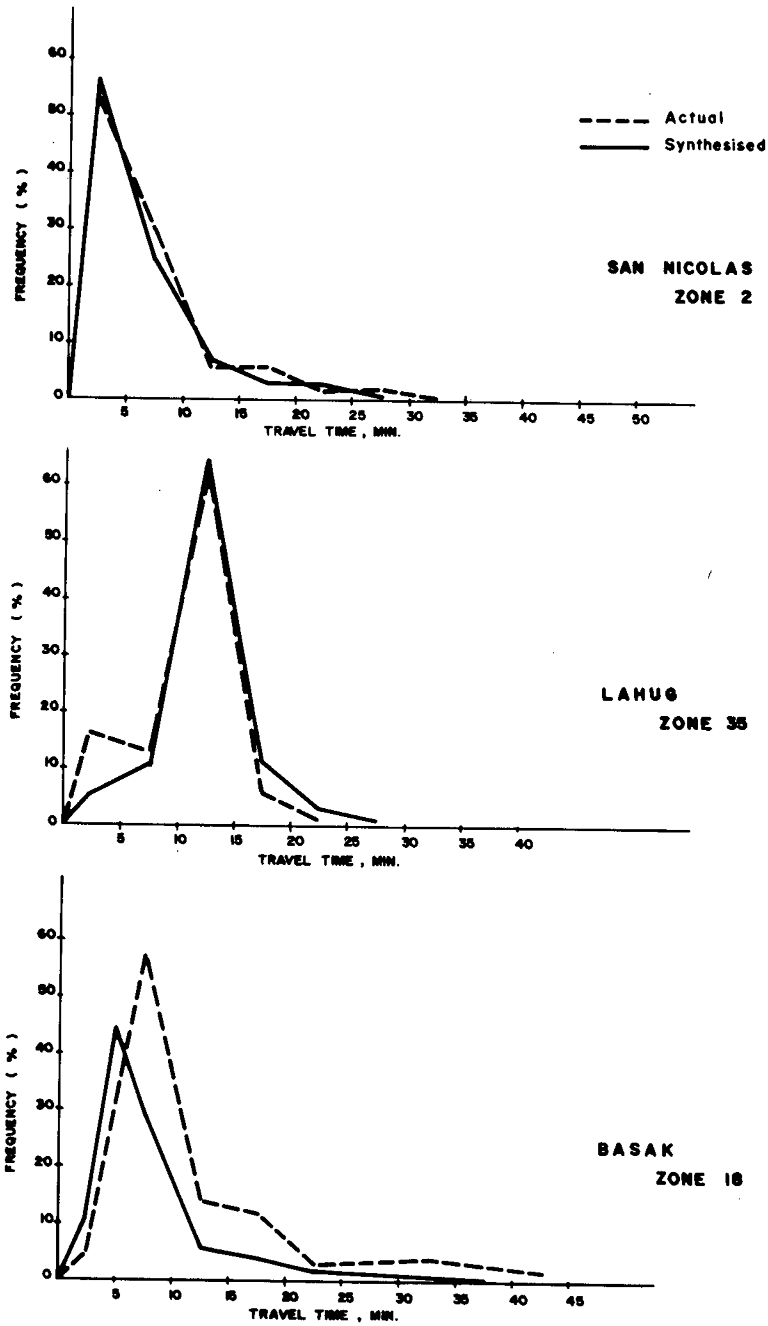

Figure 6 — Trip Length Frequency Distributions

expansion and at the same time be consistent with the formulated planning objectives.[7] As an aid to the selection of a preferred plan, it was necessary to determine the travel impacts of each plan to enable its performance to be evaluated against the base plan, i.e., a plan derived through the pursuance of a "do nothing" policy. The computer model TRANSTEP was used to test each plan. Figure 7 shows the TRANSTEP application procedure. For strategic planning purposes, it was decided to apply the model with all modes and trip purposes merged and travel expressed in vehicular trips.

The production of interzonal trip matrices was divided into two activities:

- Forecasting internal Study Area trips and
- Forecasting external and through trips as well as trips to and from the Mactan Airport zone

The forecasting of trips external to, and through the Study Area as well as the trips to and from Mactan Airport was fixed for a specific design year and land use. The resulting table, therefore, was unaffected by feedback relationships built within the modelling process.

The use of the TRANSTEP model involved iterations between the Acitivity Patterns Model and the Assign Trips Model. This enabled the degree of congestion produced on the transport network to influence trip generation and distribution. The process was continued until a state of equilibrium was attained as shown by insignificant differences in regional trip ends and average interzonal costs between the preceding and succeeding cycles.

Preparation of Land Use and Transport Data

The basic data requirements for the modelling process consisted of a land use data file and a transportation networks file. The land use data file contained, among others, the coordinates and area of each zone and zonal values of population, total employment, retail employment and school enrolment.

The highway network was represented by a node/link format. Each intersection in the network was represented by a node, which was given an exclusive number and the road sections represented by links.

The network was coded as a one-way link, with each link defined by origin and destination node numbers. The length and number of lanes were specified for each link, as well as the appropriate speed/flow curve. Each link was also classified according to administrative classifications. The public transport modes operating on each link and the corresponding speed and volume were also coded. This enabled the public transport routings to be fixed while assigning the private vehicle trips given the congestion effects of the public transport vehicles.

Trip Generation/Distribution

External, Through and Mactan Airport Trips

As was mentioned in the previous section, the forecasting of external, through and Mactan airport trips was undertaken separately from the main modelling sequence and was fixed for a particular design year and land use. The main reasons for treating these trip categories separately were:

- The total volume of trips generated for these categories in relation to the whole system is small, and
- The opportunity variables associated with these trips are different from those being used for the ACTIVITY PATTERNS model

The external and through movements were divided into private vehicle, commercial vehicle and public tranport movements. Forecasts were made using growth factors which were derived from anticipated growths in population and in vehicle ownership. The forecast trips were then distributed using the Furness growth factor method,[8] with the origin and destination table developed from the 1979 roadside interview survey as a starting point for the iterative procedure.

[7]See paper by Cal and Cholerton appearing in this issue.

[8]Furness, K.P. "Estimating of Traffic by Gravity Model" *Traffic Engineering and Control,* Vol. 3, No. 11, March 1962.

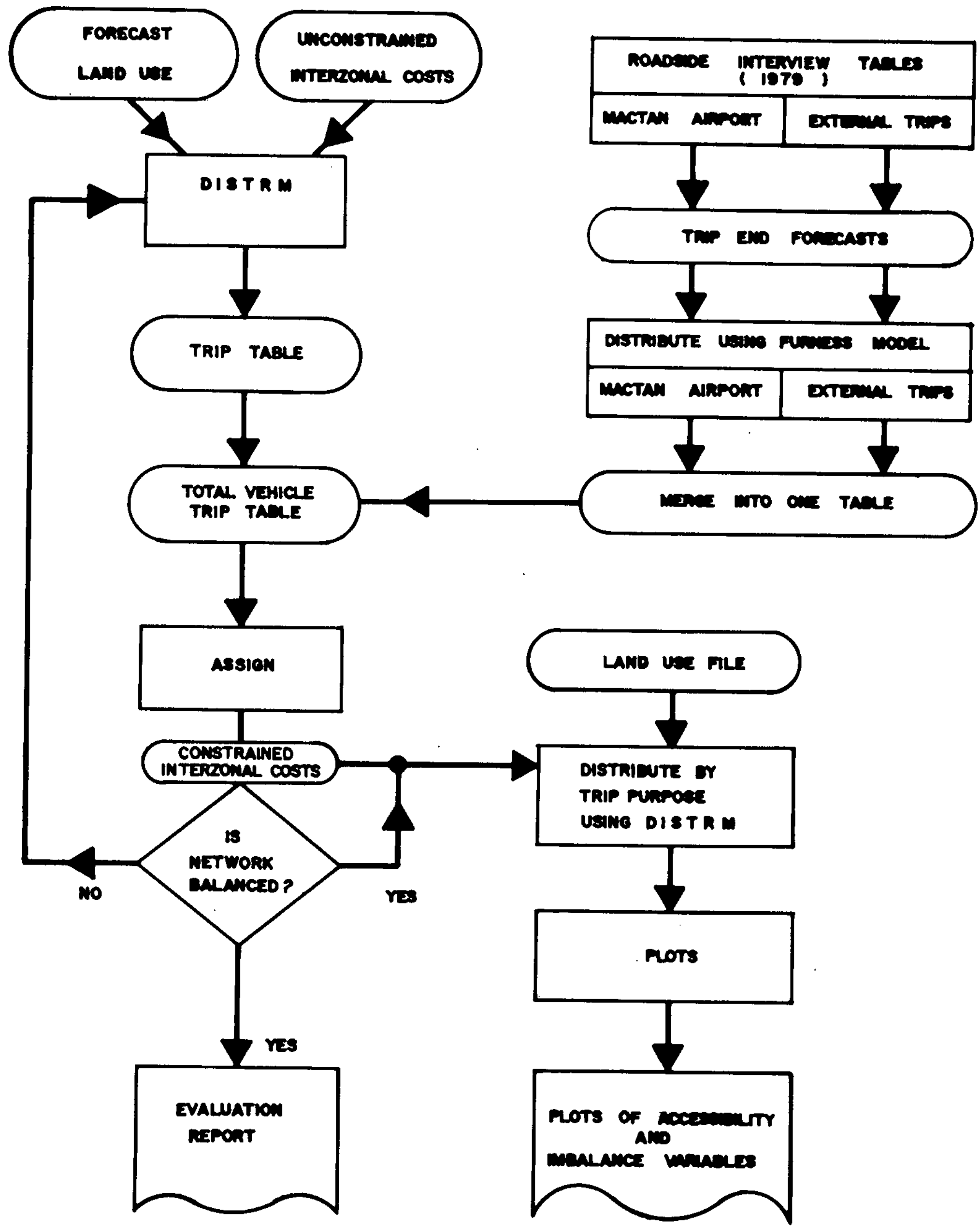

Figure 7 — Model Application Procedure

The number of trips attracted to Mactan International Airport (one zone) was established to be a function of the number of arriving and departing aircrafts. The forecasting of future trips attracted to the airport was therefore based on the anticipated growth in air traffic. The trip ends were then distributed using the Furness model, with the 1979 roadside interview trip table as the first approximation.

Internal Trips

The forecasting of internal trips involved an iterative procedure using the Activity Patterns and Assign Trips models of TRANSTEP. This iteration is necessary because of the inter-relationship between trip generation, trip distribution and interzonal costs.

To start the iterative process, an interzonal cost matrix derived from an unconstrained run of Assign Trips model was inputted into the Activity Patterns model. Naturally, this not only overestimated trip ends but also produced an incorrect trip pattern as the trip length probability distribution is a function of interzonal costs. The resulting interzonal trip matrix, with the external and through trip matrix added and previously derived trips to and from the Mactan International Airport replacing values in the relevant cells of that matrix, was then loaded onto the highway network. This assignment produced a more congested system with relatively high interzonal costs. The new interzonal cost matrix was then used in the next run of the Activity Patterns Model, producing zonal trip ends lower than anticipated. The cycle of trip assignments and trip generation/trip distribution was repeated until a balanced system was attained.

Trip Assignment

The Assign Trips model of TRANSTEP was originally the trip assignment model called TRAFIC developed by Nguyen and James at the University of Montreal and amended by Luk and Wigan. It was later amended and named TRABER by Luk and Makarov. Further amendments were carried out on the model to make it suitable for use in the MCLUTS study.[9] These amendments related to the use of Dial C-2 Algorithm and the inclusion of a mechanism to accept public transport link preloading. The inclusion of the public transport preloading facilities was an important aspect; for example, 40 to 50 percent of vehicular trips on the 1979 transport network were by public transport. The public transport system operates on fixed routes and therefore should not be rerouted in any method of capacity restraint trip assignment.

The Assign Trips Module was run, following the production of a combined interzonal trip matrix, i.e., internal, external and through trips combined. If this was the first trip assignment in the iterative procedure referred to earlier, the interzonal cost matrix output would then be fed onto the Activity Patterns Model to start another cycle.

To assess whether the system was balanced or not, a comparison was made of average interzonal costs and standard deviation of interzonal costs produced between cycles. If differences were small, the system was considered balanced.

Identification of the optimum number of iterations, between trip assignment and trip generation/distribution required before a balanced system is achieved is an important factor. Computing costs can be considerably reduced by having a small number of cycles through the TRANSTEP modules. Sensitivity tests were initially undertaken on a typical land use and transport network and eight iterations were performed. Following analysis of the results, it was concluded that three iterations were the maximum number that needed to be run before the system was considered balanced.

When the final iteration of the TRANSTEP modules was completed, the interzonal costs generated in the Assign Trips model were used to develop evaluation reports and to produce contour plots of accessibility variables. These plots were useful aids in the evaluation of alternative plans.

Feedbacks for Land Use and/or Transportation Planning

Although not indicated in Figure 7, the evaluation and analysis outputs in the final trip assignment provided a means of balancing

[9]See MCLUTS, "TRANSTEP User Manual", Volume 4 Final Report, 1980.

the land use and transportation network components of the plan tested. The aim was to ensure that all the alternative plans would provide more or less the same acceptable highway and public transport levels of service. Plan selection, therefore, became a matter of choosing a plan that was optimum in terms of economic, environmental, political and other planning considerations. All the plans could accommodate the forecast urban growth at acceptable levels of service.

The balancing of the system was achieved by modifying the land use, the transportation network or both. The plots of accessibility variables helped in locating traffic zones where changes in land use distribution would be desirable. Operational statistics like volume-capacity ratios, indicated the links where modifications should occur.

Discussion

It would be useful to discuss certain issues pertaining to the formulation and application of the TRANSTEP computer model. Of interest to transportation planners are:

- Transferability of the model in location and in time,
- Factors affecting trip generation, and
- Equilibrium within the modelling process

Model Transferability

A planning model that is transferable from one place to another and stable over time is invaluable. It would render model calibration, which is usually undertaken everytime a model is used in another area, unnecessary. This is a big saving as calibration takes up valuable resources in travel data collection and computer analyses. This will also give a planner greater confidence in using such a model in monitoring work, e.g., development control and in periodic plan review.

Nairn, et. al., as previously cited, were confident that the preference function within TRANSTEP was transferable. However, their work was limited to Australian cities. It was therefore decided to extend the comparison to Metro Cebu.

Figure 8 shows the preference functions derived for Sydney and for Metro Cebu. The difference in shape of curve is quite noticeable. For example, the Sydney curve is much more pronounced than the Metro Cebu Curve over the lower cost intervals. When the Sydney preference function was used to predict the 1979 travel patterns in Metro Cebu, it produced higher trip ends, shorter average trip duration, higher short distance trips and lower long distance trips than actually observed. In summary, the Sydney function did not accurately reproduce the 1979 travel patterns in Metro Cebu. It is thought that the results could be due to the different socio-economic conditions between Australian cities and Metro Cebu. Further research is suggested to investigate the effect of socio-economic variables on the preference function. Of interest also is to see whether or not the preference function developed for Metro Cebu is transferable to other cities in the Philippines.

Another aspect that may need refinements in the model is the definition of the preference function. Under the present operating mode it is specified in the model as a discrete function with values at five-minute intervals. Inputs at lower intervals, say two minutes, would improve the forecasting capability of the model, particularly in the zero to fifteen minutes range of the preference function.

Factors Affecting Trip Generation

It is a standard practice to divide trip modelling into four phases, namely: trip generation, trip distribution, model split and trip assignment. Except for trip generation, interactions between the phases are provided in most models with the transportation system as a common input. Trip generation is usually a function of certain household socio-economic characteristics such as income, car ownership and number of employed persons. Accessibility is not usually included as one of the factors affecting trip generation.

In TRANSTEP, trip generation has been combined with trip distribution and is made a function of the transportation network only through the trip generation rate adjustment curve referred to earlier. This is a step in the opposite direction, which is considered extreme. Although the incorporation of an accessibility variable in trip generation is an improvement, nevertheless one would expect that some socio-economic variables would be retained. This is important for, as MCLUTS has found out, trip generation is more sensi-

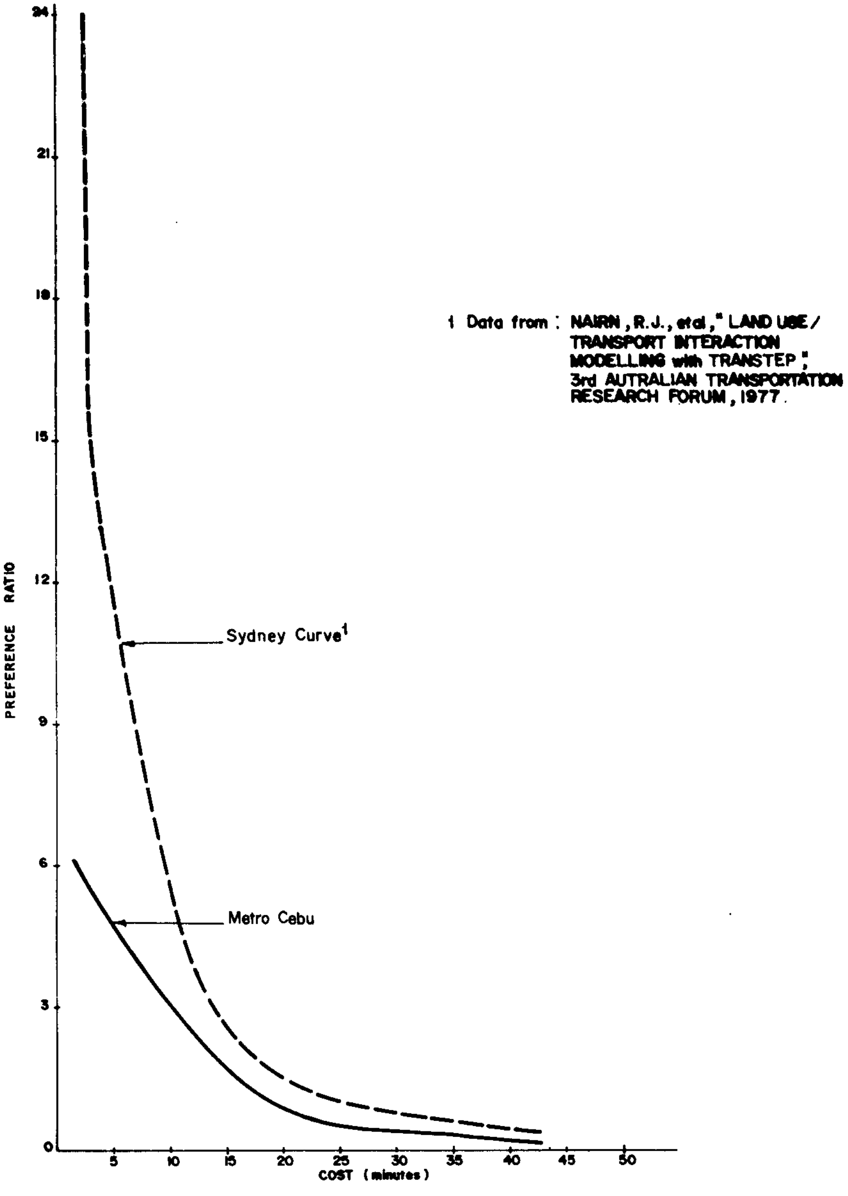

Figure 8 — Comparison of Preference Functions

tive to changes in the shape of the trip generation rate adjustment curve than to changes in the preference function. This aspect needs investigating if the model is to be transferable or is applied to areas with significantly different socio-economic characteristics from those used to derive it.

Equilibrium within the model

The incorporation of an accessibility variable in the trip generation/trip distribution phase allows realistic modelling of the relationships between transportation system supply and travel demand. In the real world, travel cost reduction would generate demand just as increases would suppress it. Travel demand therefore tends to be in equilibrium with system supply. This equilibrium condition is simulated within TRANSTEP by iterating between the Activity Patterns and Assign Trips modules. The user decides when equilibrium has been attained following analyses of outputs between successive iterations. It is suggested that equilibrium checks be incorporated into the model so that iteration continues until the prescribed level of equilibrium has been achieved. This should reduce the amount of manual intervention required in the iteration process as is currently the practice. An equilibrium index might be formulated as a function of regional trip ends produced by the Activity Patterns Model, and average trip length and standard deviation of trip lengths produced by the Assign Trips module.

Conclusion

The TRANSTEP model has played a key role in the strategic planning work of MCLUTS. It was used to test a number of alternative plans and to balance the land use and transportation network components of each plan. The model was found simple, flexible and economical to use. Although it was run on the main frame computer of the Infrastructure Computer Center, the model is, in fact, operational on a 16-bit minicomputer, which is a big advantage.

In its present form, the model is best suited for strategic planning studies, especially where there is a need to formulate, test and evaluate a number of radically different land use and transportation plans. However, the various functions within TRANSTEP such as the preference function and trip generation rate adjustment curve would have to be calibrated prior to applications in other study areas. Calibration may be done using secondary and inventory data on the existing land use and transportation systems as well as limited amount of travel data.

Further work is suggested to refine the trip generation/trip distribution phase of TRANSTEP to include the effects of socio-economic variables in trip-making. This is particularly important if the model is to be used in detailed planning work or in the study of specific areas such as a growth corridor. □

TRAFFIC ENGINEERING ACTION PROGRAMS

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INTRODUCTION

Background

The first two papers in this issue outlined the approach adopted by MCLUTS and identified some of the transport issues and problems pertaining to Metro Cebu. The rapid expansion of Metro Cebu has led to problems of traffic congestion, public transport inadequacy, road and traffic engineering insufficiency, and incompatibility in land uses. The strategic planning activity focused attention on the long term planning and development issues, the action programming concentrated activities on identifying measures to provide immediate or short term relief to existing transport problems. This paper discusses the traffic engineering action programs undertaken by MCLUTS.[2]

The Approach

The action programs approach was divided into two activity streams. These were: 1) project identification; and 2) technical advice and assistance to other agencies. The first activity stream of project identification involved data collection, problem identification, identification of traffic management measures, and evaluation. The technical advice and assistance activity involved providing assistance to other agencies on an *ad hoc* basis as and when required.

Data Base

Various surveys and studies were undertaken to collect data on the existing transport system and problems. The following were the surveys and studies undertaken:

- Home interview
- Roadside interview
- Physical inventory of street system
- Inventory of traffic management measures
- Cordon and screenline classified traffic count
- Intersection turning movement count
- Traffic accident analysis
- Speed and delay studies
- Parking study
- Public transport study

Project Identification

From the analysis of the surveys made it became apparent that the area with heaviest concentration of transport activity and with some of the severest traffic problem is the Central Business District (CBD) of Cebu City. The CBD is bounded by the coast, Guadalupe River in the west, and South Expressway/ P. del Rosario Street/Imus Street/T. Padilla Street/and 1st Street in the north and east. This area accounted for 27 percent of secondary and tertiary employment, 40 percent of retail employment and 40 percent of secondary and tertiary school enrolments in Metro Cebu. Residential population was only four percent of the Metro Cebu total. The total traffic crossing into the area was approximately 175,000 vehicles per day; of this total 70,000 were jeepneys. Since the CBD had the major traffic flows it was decided to concentrate most of the action programs within this project area.

A number of projects outside the CBD were also identified for traffic action programs. The M.J. Cuenco Avenue-Cebu North Road is the main arterial route connecting Cebu City and Mandaue City. This road is considered the life line of Metro Cebu as it carries

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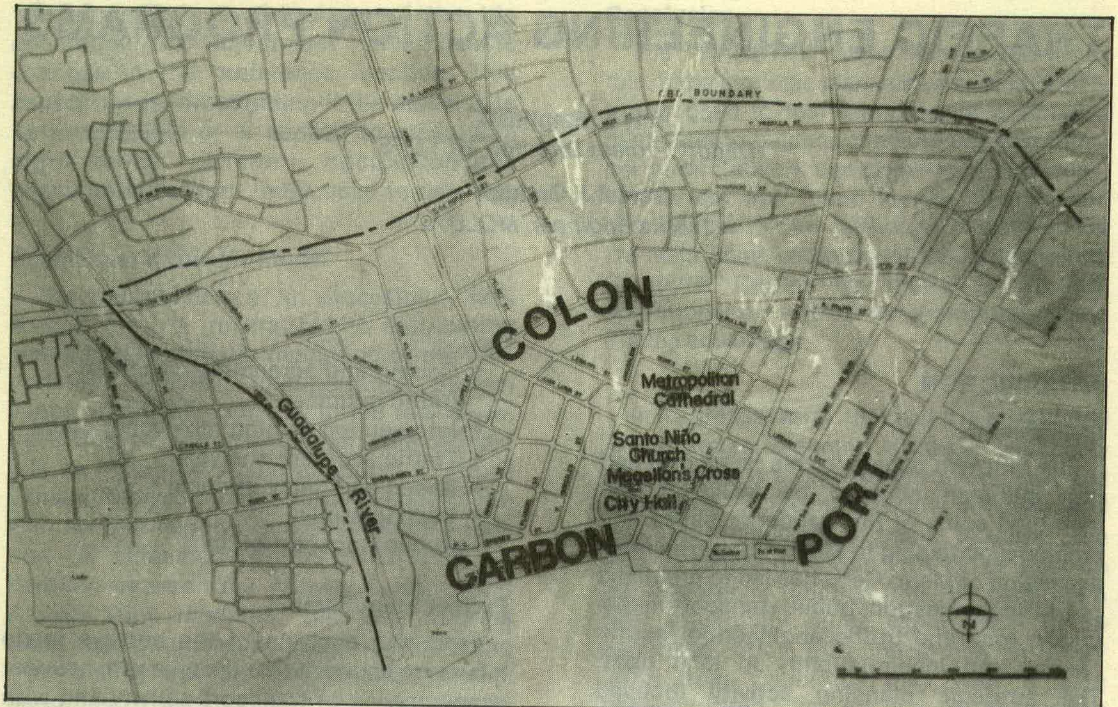
[1]With U.P. PLANADES.

[2]Metro Cebu Land Use and Transport Study, *(Final Report"*, Ministry of Transportation and communication, Metro Manila, Volumes 1, 2, 3, 4 and 5, 1980.



Location of Central Business District (CBD)

passengers, materials and manufactured goods to and from the industrial complexes in Mandaue City. The road is carrying one of the heaviest traffic flows with the highest concentration of goods vehicles in Metro Cebu. Severe traffic delays and congestion are daily occurrence, thus improvement of the road was recommended for an action program.

Certain roads within Cebu City were functioning as arterial roads. To reinforce the road heirarchy principle it is essential that enforcement of traffic regulations be strictly adhered to; this will assist in maintaining an orderly and efficient flow of traffic along the arterials. A special action program was therefore identified to undertake this particular function.

Many intersections within Metro Cebu were uncontrolled. Heavy traffic flows passed through them unregulated causing thereby severe delays and congestion. Operating traffic signals have exceeded their economic life and are not operationally capable of catering to the changing traffic flow patterns. An action program was undertaken to identify the location and scale of investment required for improving the traffic signal system.

CENTRAL BUSINESS DISTRICT

Areas of Conflict

The Central Business District (CBD) of Cebu City has historically been the main center of commercial and retail activity within Metro Cebu.[2] Cebu City has developed radially outwards from the CBD. Major reclamation projects were undertaken within the CBD, close to the main Port. Carbon Market is in fact located on a portion of the reclaimed land.

The Central Business District can be divided into a number of distinct activity centers. Each of the centers exhibits specific function, and traffic and environmental problems that developed in the center are often associated with this function. The basic centers are:

- Carbon Market
- Colon shopping area
- City Hall and Cebu Cathedral environs
- Port Area

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[3]Lavilles, Gervacio L. (1965), *Four Cities and Forty Municipalities, Cebu, A History.*

Carbon Market Proper is located along M.C. Briones Street, near the Port. It is the principal fruit, vegetable, meat, and fish market for Cebu City and also for the Province of Cebu. Adjacent areas extending back to Magallanes Street also function as a market complex with activities being concentrated on the retailing of household supplies. The problems associated with Carbon Market are consistent with the activities going on. Stall holders need access and unloading facilities to have their goods delivered. An efficient waste disposal system is urgently required. Good access should, likewise, be provided for people wishing to purchase goods in the market complex.

Currently, a large number of vendors utilize the road space along M.C. Briones to display their goods. This creates a serious problem as the effective roadway width has been reduced and pedestrians are forced to spill over into the roadway when walking from one stall to another.

Roadside vendors in M. C. Briones St.

Public transport access to Carbon Market is very good with virtually all of the jeepney routes in Metro Cebu terminating at this point. Because of so many jeepneys entering Carbon Market, serious problems with the traffic circulation in and through the area have been created. The jeepneys, for instance, tend to travel slowly because they are practically empty and are seeking passengers for their return journey.

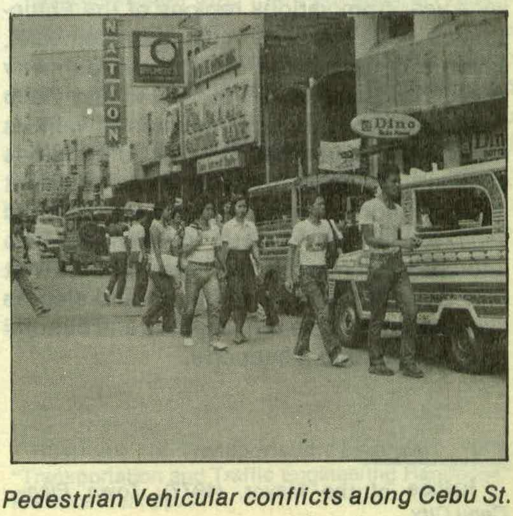
The jeepney routes have a number of entry points into Carbon Market but there is basically only one exit point, this being M.C. Briones. This situation leads to a very high concentration of jeepneys on M.C. Briones resulting in severe traffic congestion on this particular street.

Existing traffic problems in Carbon Market can be summarized as follows:

- High concentration of jeepneys in M.C. Briones Street
- Too many traffic entry streets and insufficient exit streets
- Inefficient use of road space by vendors and stall owners who encroach on the roadway
- Serious pedestrian vehicular conflicts
- High traffic delays

The Colon shopping area extends along Colon Street from Leon Kilat to D. Jakosalem. The influence of the area extends to Manalili and Borromeo Streets. This area is the center of the retailing trade in Cebu and contains a number of large department store complexes. This area also contains cinemas, restaurants and the University of the Visayas. The activities in this area attract a very large number of pedestrians. But the existing sidewalks are narrow and the spaces available are further reduced by the operation of sidewalk vendors.

The activities within the Colon area indicate varied traffic, transport and environmental requirements. The convergence of activities lead to a number of conflicts that cause transport and pedestrian problems. Colon is located in the center of the CBD, and is bisected by the major CBD street systems. These streets not only have to cater for traffic wishing to go through Colon, but also all the traffic waiting to enter the southern area of the CBD; that is, the streets are functioning



Pedestrian Vehicular conflicts along Cebu St.

both as access and through routes. The problem then becomes one of balancing the traffic access and environmental requirements of the Colon area with the provision of a major distributor system within the CBD.

The precinct from City Hall to Cebu Cathedral assumes a totally different function form either that of Carbon or Colon. It consists of administrative, religious and cultural attractions. The City Hall is the center for City government activities; adjacent to the City Hall is Magellan's Cross Monument, one of the most widely known historical landmarks in the Philippines. Next to Magellan's Cross is Basilica del Sto. Niño, the first Basilica to be consecrated in Southeast Asia and is a Monument to the patron saint of Cebu.[4] This church attracts large numbers of pilgrims each year from various regions of the Philippines. Two blocks away is the Cebu Cathedral, where a large number of devotees go every week. The Basilica del Sto. Niño and Cebu Cathedral generate high volumes of visitors at commencement and at height of religious ceremonies. These peak movements result in heavy concentration of pedestrians and vehicles in the streets surrounding the churches. Generally, this area should not only be accessible to all but should also be allowed to preserve the religious and cultural environment that it supports.

Magellan's Cross: Symbol of Cebu.

In volumes of goods and passengers handled, the Port of Cebu is second only to Manila in the Philippines; it handles 2.5 million tons of cargo and more than 2.0 million passengers annually.[5] The Port area constitutes the southern and eastern boundaries of the Central Business District. The area extends from Carbon Market to the northern reclamation area and influences transport and traffic activities; it generates large numbers of heavy goods vehicles as well as public transport vehicles. Access to the port from the north is good, as heavy goods vehicles can enter via M.J. Cuenco Avenue and Gen. MacArthur Avenue. However, access from the south is very poor as the most direct route is through the center of the CBD. The biggest problems is to rationalize access to and from the port area, with the maintenance of traffic and environmental standards within the CBD area.

System Deficiencies

Within the CBD there are many deficiencies in the transportation system and these include:

- lack of a defined heirarchy and network of traffic dominated routes
- lack of continuity and connecting links
- lack of segregated service roads to the major retail center
- lack of continuous north-south arterial road

Currently there is no well-defined route that passes around or through the CBD to carry traffic from north to south of Cebu City. The national highway from north to south via M.J. Cuenco and Cebu South Roads does not have a direct connection through the CBD.

During peak traffic flow periods and for a large proportion of the day, severe traffic congestion occurs along Magallanes, Colon and Juan Luna Streets. This congestion results from insufficiency of capacity at major intersections due in part to badly timed traffic signals, lack of traffic signal coordination, parking of vehicles at the approaches to intersections and insufficient road space. Within the CBD, the majority of the inter-

[4]Office of the Mayor, (1977), *Town Plan—Cebu City.*

[5]Ports Feasibility Study and Design Project (1979), Philippine Ports Authority/National Economic Development Authority, Volume 4.

sections are at-grade uncontrolled intersections, some with substandard geometric layout. The lack of control or clearly defined priority leads to confusion and accidents particularly at the heavily trafficked intersections. There is a need for channelization and traffic signal control at some intersections, to separate conflicting turning movements and reduce delay and congestion.

The existing traffic signals were installed in the mid 1960's mainly along the principal traffic arteries of Colon, Juan Juna, Magallanes and P. del Rosario. There are 22 intersections within the CBD controlled by traffic signals. Of the 22 signalized intersections, 19 are automatically controlled, while three are manually operated. Of the 19 automatically controlled signals there are two isolated intersections and 17 intersections interconnected in four systems. Each of the linked systems are controlled by only one controller, making the coordination either simultaneous or alternate. The existing signals are poorly maintained, and have limited capability to accommodate changing traffic flow patterns. The existing signals need immediate rehabilitation; this problem is aggravated by the lack of a specific maintenance budget for traffic signals. An example is that of broken light bulbs which can remain unreplaced for days, weeks or even months.

Traffic problems are also encountered with providing for goods vehicle access and delivery. Commercial vehicular volume accounts for only 10 percent or 17,000 vehicles per day. The majority of this traffic are in the one ton range or small pick-up vans. There are, however, some 650 15-ton or larger vehicles entering the CBD per day. They are concentrated on:

- General MacArthur Avenue
- M.J. Cuenco Avenue
- C. Padilla Street

Those operating on General MacArthur Avenue and M.J. Cuenco have principally the Port Area as their destination, while those on C. Padilla travel through the Colon Area creating therein traffic congestion and severe conflicts. All retail goods deliveries to major department stores have to be made through the front doors, as there are no rear service road entrances to allow for loading and unloading of merchandise. This creates serious traffic congestion, particularly along Colon when goods deliveries are made during the peak period.

Private vehicle parking is causing severe problems mainly because of:

- Insufficient off-street parking facilities within close proximity to major activity centers
- New or renovated buildings that do not provide for the required car parking spaces as recommended in the city zoning ordinance

The lack of parking spaces is causing rampant violations of the No Parking Ordinances currently in force.

Traffic signs and pavement marking are important features of any good road system. The road signs being erected within the CBD are non-standard and non-reflectorized; the signs are also badly positioned such that it is difficult for motorists to clearly see them. Traffic signs are also being established without appropriate government ordinances being passed to ensure strict compliance. The lane markings established have been deteriorating very quickly soon after painting. The common causes of premature paint failures include.[6]

- Insufficient cleaning of pavement
- Over-thinning of paint
- Damp or wet pavement
- Presence of limestone or other alkaline material that breaks down the paint
- Application of insufficient paint film

Administration Problems

At the present time there are several government agencies and *ad hoc* bodies that have overlapping functions in the field of traffic engineering and management. This situation necessitates the creation of other bodies to coordinate the activities of established agencies. Despite this, a number of traffic engineering components are not being given due attention such as traffic signing, pavement marking, and traffic signal operation.

[6]Institute of Transportation Engineers (1976), "Transportation and Traffic Engineering Handbook", Prentice Hall, pp. 777.

Road traffic within Metro Cebu are governed by the following regulations:

- Regulations for the Use of Traffic on National Roads (A.O. No. 14 of 1958)
- Land Transport and Traffic Rules (R.A. No. 4136)
- Traffic Code of Cebu City (Ordinance No. 801)

A review of these regulations combined with an inventory of existing traffic control devices indicates that a number of regulatory signs and devices currently in place in the CBD do not have any legal basis. This arises from the lack of a clear division between the traffic planning and traffic enforcement areas of traffic management in Metro Cebu. Presently, the police act both as a traffic planning and as traffic enforcement body.

Public Transport

The jeepney forms the main mode of public transport to the CBD. All jeepney routes pass through this area and a large number terminate at Carbon Market. The total number of public transport passengers traveling into and out of the CBD is approximately 730,000 persons per day.

The high concentration of jeepney routes along M.C. Briones, Colon and Leon Kilat has resulted in traffic congestion, severe vehicle-pedestrian conflicts particularly within Carbon Market and Colon, and a lack of public transport services in other areas of the CBD.

A contributory factor to the traffic congestion is the indiscriminate stopping of jeepneys along their routes. Most jeepney drivers pick up and unload passengers at the corners of the intersections; this reduces the intersection capacity and causes interference to other road users. The fact that passengers tend to wait for their ride at the intersection corner aggravates the situation.

Another problem with public transport operations within the CBD is the lack of clearly defined waiting areas for the long distance jeepney routes. There are only few long distance jeepneys and the number of passengers per jeepney is small, so drivers prefer to wait in the CBD until their vehicle is full before starting on their return trip. The existing situation leads to jeepneys cruising the streets of the CBD or alternatively parking in restricted areas.

The tartanilla, or horse drawn carriage, still provides a public transport service to certain areas within the CBD. The carriages operate mainly in the western sector, but are allowed to enter the CBD via Sanciangco Street and Tupas Street. There are approximately 6,500 units per day entering and leaving the CBD.

Tartanilla and PU mini car (Cebu City)

The tartanilla when compared with motorized vehicles is uneconomic in the use of road space; it has a low operating speed and very poor maneuverability. The tartanilla is not suited for operation on heavily congested routes, particularly when these routes are serviced by a more efficient mode such as the jeepney. The mixing of tartanilla and jeepney within the CBD reduces road capacity and leads to serious conflicts and high accident potential.

Future Trends

The Central Business District is expected to continue to function as the center for commercial and educational activities for Metro Cebu well into the foreseeable future. An example of this trend is the increase in secondary and tertiary employment; it is forecast that there will be a 7,000 increase in this sector by 1990. Three thousand of these jobs are expected to be within the wholesale and retail trade.

The secondary and tertiary enrolments are only going to increase marginally from the present number to 1990. The majority of the increase in educational demand are assumed to be taken up by establishments outside of the CBD.

The current redevelopment projects taking place within the CBD are concentrating on expansion of retailing and commercial sectors. No projects are being undertaken within the housing sector and only a small increase in the resident population of the CBD is forecast to 1990.

The volume of traffic crossing the CBD boundary is expected to increase from its 175,000 vehicles per day to approximately 260,000 vehicles per day by 1990. Development of the Mandaue and Cebu South Reclamation areas will attract further traffic to the CBD and put an additional strain on the capacity of the road system within the CBD.

Large scale highway construction within the CBD is considered undesirable for many reasons, and one of them is the high cost of land acquisition, property demolition and service relocations. Historically, development trends will confirm this opinion as the road pattern within the CBD has changed very little in the past 40 years.

It is under this scenario of continued growth in traffic, but with virtually no options for major road construction that the future of the Central Business District has to be planned. This means making the most economic and efficient use of the existing road system, by judicious use of traffic engineering and management programs.

Action Programs

CENTRAL BUSINESS DISTRICT

Road Network Improvements

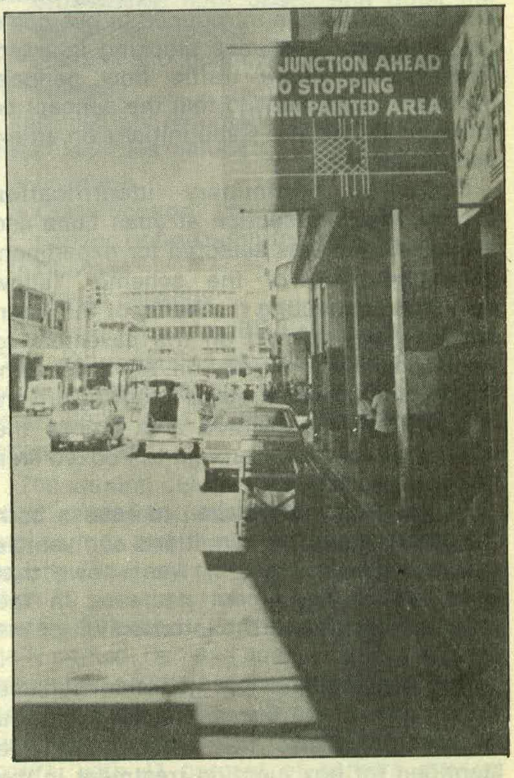
No major highway links were proposed within the CBD. However, a priority project has been identified on the fringe area that will greatly benefit traffic movements within the CBD. The reason for the new link is the lack of an effective bypass of the CBD. This road will connect P. del Rosario Street to M.J. Cuenco Avenue utilizing the old Philippine National Railway reservation. The route location is the only realistic one within Cebu City where a road of arterial standard can be constructed to connect the Cebu North and Cebu South Roads.

Within the CBD a number of streets are operating as one-way. MCLUTS undertook an evaluation of this system and concluded that aside from a few minor changes the existing system could operate effectively in the short term. It was recommended that the following changes be made on the system to improve traffic circulation and to reduce vehicular-pedestrian conflict points:

- Reversal of the one-way flow along Pelaez/Legaspi Streets between Manalili and R.R. Landon Streets, from northbound to southbound movements.
- Opening of Junquera Streets between R.R. Landon and Colon Streets to two-way traffic
- Prohibition of vehicle entry into Magallanes, between D. Jakosalem and Burgos Streets. This will facilitate the development of an environmental precinct comprising the Magellan's Cross, City Hall and Sto. Niño Basilica.

The implementation of the one-way street system is awaiting the final recommendations from the comprehensive CBD traffic management plan.

The preliminary design of the new road connection from P. del Rosario to M.J. Cuenco has been included in the IBRD funded Central Visayas Urban Project, and will be included in the IBRD 5 year urban investment program.



Box Junction—Advisory Sign

Box Junction—Road Markings

Box Junction

The box junction concept has been successfully employed in Singapore and other countries as a means of controlling traffic. The box junction is introduced to overcome the problem of vehicles blocking intersections during heavy traffic flow periods. MCLUTS recommended that the concept be introduced to Metro Cebu initially on an experimental basis.

Following preliminary identification studies, the intersection at Juan Luna and Manalili Street was selected for experimental introduction of the scheme. Yellow markings connecting the kerbs of the intersection were painted on the pavement to form a box-like configuration. Advance warning signs were also erected to advise drivers not to enter the painted area unless the vehicle can proceed through the boxed area without stopping.

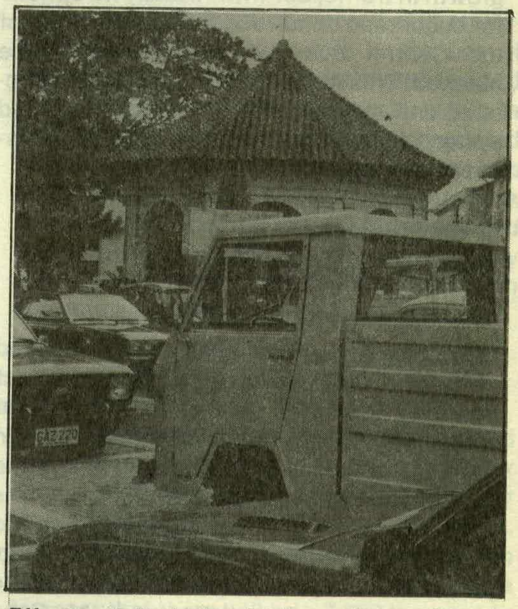
Studies were undertaken to assess both the before and after conditions and vehicle delays were recorded. It was shown that there was a significant decrease in the vehicle delay due to the introduction of the scheme.

The experimental box junction scheme was shown to be successful in the Cebu environment. More intersections will be identified for box junction treatment in the CBD traffic management plan.

Magellan's Cross Environmental Precinct

MCLUTS I final report recommended that the area surrounding Magellan's Cross be developed into an environmental precinct. In June 1981 the Cebu City government requested MCLUTS to study the effect of closure of Magallanes Street in the vicinity of Magellan's Cross, and report on the traffic impact of such a closure and prepare a traffic management plan for the area.

A number of studies were undertaken to collect data on traffic movements and road widths in the area. After evaluating a number of proposals it was recommended that Magallanes Street between D. Jakosalem and P. Burgos could be closed to vehicular traffic without detrimental traffic impact, provided jeepneys will be re-routed from the area according to MCLUTS plan. The traffic signal timing of some intersections are to be altered to accommodate the revised traffic movements; pavement markings shall be employed; and parking restrictions will be enforced at approaches to intersections.



Effects of Parked vehicles adjacent Magellan's Cross Monument.

The Magellan's Cross proposal was presented to the public at an open forum and the reaction of the general public towards the scheme was obtained. Modifications to the original proposals will be made in light of the recommendations from the public participation exercise.

PUJ Rationalization

MCLUTS initiated a comprehensive study on the routing of jeepneys to determine whether or not changes were necessary. Objectives of the study were to:

- Minimize operating cost of jeepneys and other road users
- Make jeepney routes more adaptive to desired travel patterns
- Improve service to lightly traveled corridors
- Integrated jeepney routes with other public transport modes

Data were collected on existing route structure, registered units and occupancy levels and were analyzed to devise a plan of operation. A rationalization plan was prepared which includes the following components:

- Jeepney re-routing scheme
- Route numbering system
- Vehicle sticker system

The re-routing scheme will provide:

- Shortened routes to effect savings in operating cost
- Dispersal of jeepneys among as many viable routes as possible
- Adaptation of routes to cater for travel demand

Significant changes were made on a number of routes to widen the catchment area of the jeepney system and to decongest certain streets within the CBD by spreading the jeepney traffic more evenly over the road system.

It was proposed that a numbering system be adopted for the convenience of both passengers and enforcers. This procedure involves assigning a unique number to each route. Each jeepney, which will be given only one route, will be required to display the number in a prominent location on the unit. This system will enable the traveling public to quickly identify jeepney routes from the numbers. In addition, route maps and commuter billboards were prepared showing routes and numbers as well as route description.

A sticker system was proposed to complement the numbering system. This issuance of stickers is to ensure that route numbers are properly controlled and regulated. The sticker system will also assist in the identification of colorum jeepneys.

The PUJ rationalization process is a continuing MCLUTS project involving the cooperation of the police, Bureau of Land Transportation and Board of Transportation.

Parking Plan

Many streets within the Central Business District (CBD) are inadequate to carry the large volume of traffic plying the area. The situation is aggravated by extensive and uncontrolled parking of vehicles. Drivers of public transport and delivery vehicles complain that their operations are adversely affected by illegally parked vehicles. The conversion of some vacant lots into parking areas has not met the increasing demand for parking within the CBD. Violation of parking regulations is rampant and enforcement is sporadic.

MCLUTS undertook a detailed inventory of existing parking facilities and conducted demand surveys. For on-street facilities the following data were recorded:

- Parking regulations that were in force
- Abutting land uses, e.g., office, shops, open space, etc.
- Location of gates, driveways, pedestrian crosswalks, light posts, and other important land marks
- Number and location of available parking spaces

Information recorded regarding the off-street facilities included:

- Location
- Classification, i.e., private, pay public parking or free public parking
- Charges
- Size or capacity

The inventory identified streets within the CBD where parking was not allowed, which were surveyed by car; and those where no restrictions were applied, which were surveyed on foot.

The parking charges levied for use of pay parking lots vary from ₱0.75 to ₱2.00 per parking period, and from ₱30.00 to ₱80.00 per month. On-street parking accounts for more than 70 percent of all parkers, and approximately 30 percent of these parkers are illegally parked. Demand analysis indicates that more than one-half of the CBD is deficient in parking spaces. The average parking duration was calculated to be approximately two hours, with 41 percent of parkers staying less than half an hour and 15 percent staying longer than 3 hours. Daily turnover averages 4.5 vehicles per parking space.

A principal purpose of CBD on-street parking is to provide parking space for persons doing business in the city. For this purpose, there should always be 5-10 percent vacancy to give an acceptable level of service and to avoid the added congestion which arises from "cruising." Furthermore, all motorists may be through traffic at one time and parkers at other times, so that all will gain from policies which:

- Prevent parked vehicles from blocking through traffic
- Make available spaces for short term use
- Make maximum use of existing street space

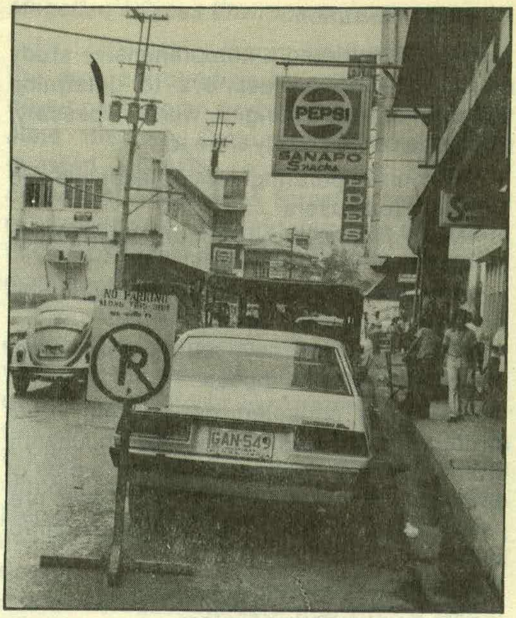
The above can only be achieved by a combination of off-street parking provisions, on-street policies providing for deliveries and jeepney stops and short-term parkers, and firm enforcement of regulations with official support.

Control over the parking of motor vehicles within the CBD should be aimed at:

- Minimizing the obstruction to moving vehicles by eliminating double parking and parking on driveways and crosswalks
- Making effective use of all available space
- Recovering the cost of providing parking space
- Providing access for people with short-term business in the CBD
- Improving environmental conditions of certain areas

The enforcement of parking regulations is quite loose, as evidenced by rampant violations. Most of the violators are drivers of private and commercial vehicles. Some parking lots at certain periods are not fully occupied; yet within 100 meters or so from these facilities vehicles are parking illegally. Compliance with the parking regulations is therefore necessary to encourage the use of off-street facilities. This should be done gradually and with discretion so that the concept of regulation is not brought into disrepute.

The requirement for establishments to provide parking spaces should be implemented strictly. The appropriate parking standards are contained in the 1979 Zoning Ordinance of Cebu City. The National Building Code is applicable only in areas without



Parking violations along Pelaez St.

an official Zoning Plan; therefore, in Cebu City the local ordinance takes precedence.

The main findings of the MCLUTS study on parking facilities were:

- There is a deficit of over 500 parking spaces in the CBD
- About 30 percent of on-street parkers are illegally parking
- Double parking, and parking on crosswalks and jeepney stops cause significant delays and congestion to moving traffic
- The distribution of restricted spaces can be improved to allow for deliveries and short-term parkers
- Enforcement of parking regulations is very poor
- Some major building developments have been permitted without conforming to the parking requirements
- The amenity of the Magellan's Cross precinct is marred by excessive number of parked vehicles

The following are recommended:

- Off-street parking provisions should be increased by making available and paving the lot bounded by Junquera and Sanciangko, and by enforcing parking provisions embodied in the Zoning Ordinance

- Parking regulations should be progressively and firmly enforced, concentrating on violations which have the effect of obstructing moving traffic
- Parking prohibitions should be lifted in the following locations:
  - Southern side of Pelaez/Legaspi Street from Manalili to Sanciangko Street
  - Eastern side of Colon Street from Jakosalem to Mabini Streets
  - Both sides of Plaridel Street
  - One side of Gonzales Street
  - Both sides of Juan Luna Street from P. Burgos to M.J. Cuenco Streets

The importance of the CBD parking plan is that higher parking fines for illegal parkers will be introduced, together with a computerized summons system that will improve the enforcement of the parking penalties. A resolution has been passed by the Sangguniang Panlungsod of Cebu City endorsing the introduction of on-street pay parking on specific streets within the CBD.

Summary

In summary the CBD short term action programs resulted in:

- Identification of new arterial road links
- Modifications to the one-way street system
- Experimentation with the box junction concept
- Identification of environmental improvements to Magellan's Cross environs
- Recommendations on improvements to jeepney routings within the CBD
- Development of a comprehensive car parking policy for the CBD

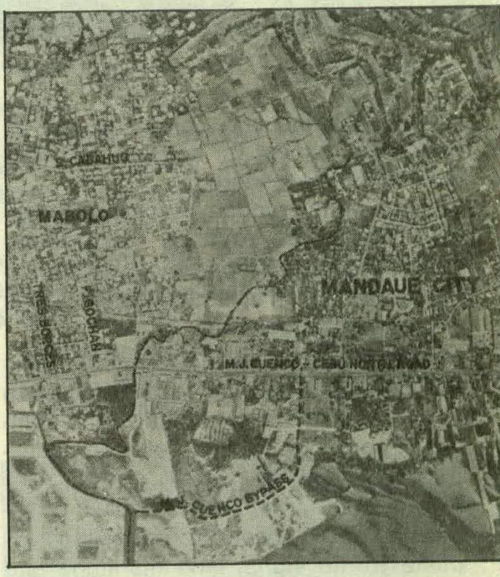
M.J. Cuenco-Cebu North Road

EXISTING SITUATION

This study was formulated to identify measures to alleviate traffic congestion along the section of M.J. Cuenco-Cebu North Road between San Jose dela Montaña in Cebu City and Lopez Jaena in Mandaue city. This road carries some of the heaviest traffic flows and is one of the most congested routes in Metro Cebu. A minor traffic accident or a stalled vehicle anywhere along the section can cause a major slow down and back up of vehicles.

The section is a two-lane roadway with width, including shoulders, varying from nine to 13.5 meters. The pavement consists of an asphalt wearing course and granular base course, except for a 275m section at the northern end which is of concrete construction. The condition of the pavement is good during the dry season, but deteriorates quickly during the wet season due to poor roadside drainage.

There are an average of 31,000 vehicles per day traveling on this section of road, and it is operating at or below level of service E for 30 percent of the day.[7]



Location of M.J. Cuenco Avenue

SHORT TERM PROPOSALS

Recommendations for immediately improving the traffic conditions along M.J. Cuenco included:

- Undertaking effective periodic maintenance of the road section
- Declaring the section an "Urban Clearway"[8] during the morning and evening peak periods, whereby on-street parking,

[7] "Highway Capacity Manual", (1965), Highway Research Board-Special Report 87, Highway Research Board, Washington, D.C.

[8] A clearway is a length of carriageway generally defined by signs along which vehicles may not stop or be left standing at times of the day as prescribed on the signs.

M. J. Cuenco before and after improvements

waiting, loading and unloading will be prohibited, except for setting down and picking up of passengers

- Controlling the random stopping of jeepneys along the road by designating specific jeepney stops which will constitute the only pick up and set down points for jeepney passengers
- Providing pedestrian crossings at regular intervals along the road to facilitate easy crossing and to minimize the number of points of conflict between pedestrians and vehicles
- Providing the intersection of M.J. Cuenco and San Jose dela Montaña with adequate traffic signs, lane markings and installing traffic signals with provision for three-phase operation to accommodate an exclusive left turning phase. (Prior to the installation of traffic signals, the intersection should be manned immediately to control traffic during peak periods)
- Re-routing Mabolo jeepneys so that they turn left from M.J. Cuenco into San Jose dela Montaña, turn right into S. Cabahug Street and return to M.J. Cuenco by turning right from Tres Borces or F. Gochan Street
- Fielding adequate traffic personnel to strictly enforce traffic rules and regulations, to control traffic at intersections and to deal with traffic accidents speedily

LONG TERM PROPOSALS

The following two actions were recommended to effect medium to long term improvements of M.J. Cuenco:

- Program urgently an engineering feasibility study on alternative routes. (This should be considered a top priority project as no widening of M.J. Cuenco should start until there is a viable route onto which traffic can be diverted)
- Undertake a feasibility study on the introduction of higher capacity public transport vehicles to ply along M.J. Cuenco

PROJECT IMPLEMENTATION

The widening and resurfacing of M.J. Cuenco between the intersection with San Jose dela Montaña and the Subangdaku River Bridge was completed in January 1981. Jeepney stops have been located and pedestrian crossings established along the route. The preliminary engineering design of the M.J. Cuenco bypass route has been included in the project preparation component of the IBRD funded Central Visayas Urban Project.

Traffic Enforcement on Arterial Road System (Operation Tears)

BACKGROUND

The arterial road system in Cebu City, particularly the portion within the Central Business District (CBD), is becoming more and more congested. This is brought about by increasing traffic demand, without a corresponding increase in road network capacity, and aggravated by bad practices of drivers and pedestrians. Specifically, the problems include:

- Indiscriminate stopping of jeepneys to pick up and set down passengers
- Jaywalking
- Blocking of intersections by vehicles during peak traffic flow conditions.
- Illegal parking

THE APPROACH

Operation TEARS is aimed at improving the flow of traffic on arterial roads by better traffic surveillance, strict enforcement of traffic rules and regulations, and deployment of traffic aides to control traffic at critical points.

The operation will entail the following measures:

- Identification of public utility jeepney (PUJ) stops in the CBD
- Strict enforcement of parking rules
- Control of traffic at critical points along the identified corridor

The operation will be a coordinated approach between MCLUTS, Integrated National Police (INP) traffic division, Constabulary Highway Patrol District (CHPD), Bureau of Land Transportation (BLT) and the "Flying Squad." The stationary traffic personnel will be complemented by members of the CHPD, BLT and the "Flying Squad", who will patrol the selected routes to deal expeditiously with traffic accidents and removal of stalled and other vehicles that may obstruct the flow of traffic.

IMPROVEMENTS ALONG GENERAL MAXILOM AVENUE

As a component part of Operation TEARS a number of traffic management measures were recommended for General Maxilom Avenue.

General Maxilom Avenue is approximately one and a half kilometers in length and extends from the junction of M.J. Cuenco to the Fuente Osmeña Rotonda. The road forms a major circumferential arterial route within Cebu City and carries large volumes of traffic to and from the Central Business District. Up until the mid 1970's the road used to have predominantly residential and educational land uses fronting it. In the last five years there has been a substantial change in the land uses fronting the road. A large number of retail and commercial establishments have been constructed; these include the Foodarama Supermarket, Rustan's Department Store and the Manros Commercial Complex. The educational institutions have all remained along the route; namely, Sacred Heart Boys High School, USC Boys High School and St. Theresa's College.

The existing roadway has a 15-meter carriageway which operates as a two-lane, two-way road with parking. Only two junctions along the route are controlled by traffic signals: the intersection with M.J. Cuenco Avenue and the intersection with Gorordo Avenue. The signals are isolated and only operate with manual control.

The interaction of traffic generated by existing land uses with the through traffic, has created a number of traffic problem areas that cause severe congestion and delays during peak hours.

Some of the measures that were introduced to overcome the traffic congestion that occurs outside Sacred Heart Boys High School, included:

- Strict enforcement of U-turn prohibition
- Strict enforcement of "no double parking" regulation

Traffic congestion outside Sacred Heart Boys School.

- Dismissal of some classes through entrance onto San Miguel Street
- Opening of campus grounds to allow vehicles to park

The Foodarama Complex has a serious problem related to entrance and exit from the off-street car park; hence, the detailing of additional traffic control personnel was also recommended.

To improve the traffic flow past USC Boys High School, it was recommended that on-street parking controls be enforced and specific turning movements to and from the campus be prohibited.

Other measures recommended include provision of jeepney stops and installation of stop signs on the side roads. Associated with these traffic management measures is the element of enforcement and the deployment of additional traffic control personnel along the route was strongly recommended.

PROJECT STATUS

A resolution has been passed by the Sangguniang Panlungsod of Cebu City endorsing the Operation TEARS project. A second resolution was passed endorsing the recruitment of traffic aides who will assist the police in the control of traffic at critical intersections. Funds have been allocated for the construction of the necessary works along Gen. Maxilom Avenue as well as for the placement of jeepney stop signs along the other routes identified. In addition to these measures, the fine for illegal parking has been increased along with the introduction of a summons system to discourage illegal parkers.

Traffic Signal Program

BACKGROUND

The existing traffic signal system within Metro Cebu consists of 36 installations, 23 being automatically controlled and 13 manually operated. A detailed traffic signal inventory was completed for all existing signals, and the results indicate that most equipment items are in very poor state of repair. A pre-feasibility survey was undertaken by MCLUTS in March 1980 and initial findings indicated that a minimum of 65 intersections should have traffic signals installed. Further detailed studies have been undertaken which included turning movement counts at 105 intersections in Metro Cebu and analysis was made of required traffic control measures.

IDENTIFICATION OF IMPROVEMENTS

To facilitate screening of the 105 intersections, a simplified traffic control warrant technique was developed.[9] This method was produced by analyzing the cost and benefits associated with various traffic control techniques for traffic flow and operating costs applicable for Metro Cebu. Among costs analyzed were:

- Vehicle stopping costs
- Value of time for stopping
- Vehicle idling costs
- Value of idle time

Two alternatives were considered in the evaluation of typical junctions in Metro Cebu; these were the do nothing or no

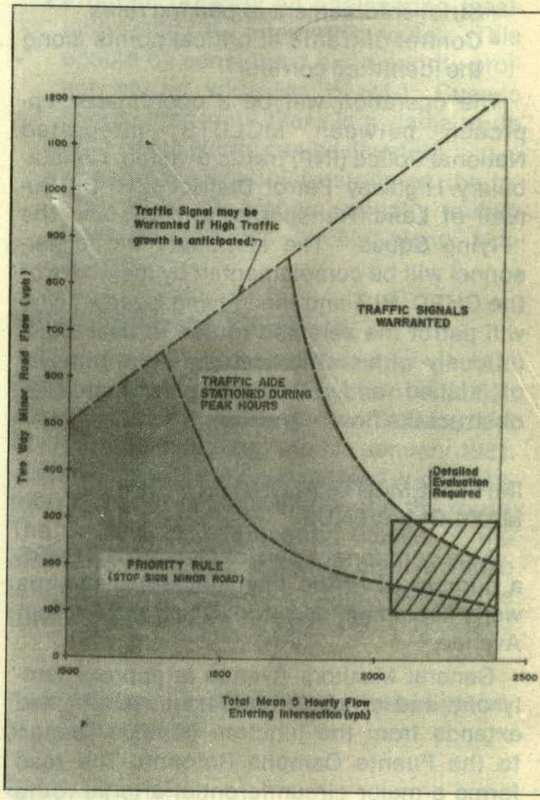


Figure 1 — Warrants for traffic Central devices.

[9]MCLUTS, Technical Note 32.1, (1982), "Warrants for Traffic Control Devices—Metro Cebu."

control and the do something with traffic signal or traffic aide[10] control.

Figure 1 shows the relationships developed for control technique versus intersection flows. Using this chart the 105 intersections were ranked in accordance to whether they required:

- Traffic signal control
- Traffic aides during peak hours
- Priority rule (or stop sign)

IMPLEMENTATION PROGRAM

The traffic signal improvement program has been divided into two tasks for further work. The first task is the plan preparation, design, specification and construction of a new signal system. This will involve procurement of new signal equipment as well as investigation of the desirability of signal coordination and computer control.

A firm of international consulting engineers is to be appointed to advise and assist the MCLUTS staff in undertaking this task. The second task involves the development of a traffic signals maintenance unit under the management of MCLUTS. The maintenance unit will be asigned the task of rehabilitating the existing signal system so that the existing system can be utilized to its maximum potential before the new system is installed. In undertaking this exercise the unit will also be responsible for training a team of technicians in the mechanics of signal maintenance, so that there will be an experienced team of mechanics available for maintaining the new equipment as soon as it is installed.

Technical Asistance

GENERAL

A number of projects have been undertaken as part of the technical assistance program of MCLUTS. These projects have ranged from road alignment evaluation, intersection improvements to public transport facility improvements. Three typical projects are described in the subsequent sections.

[10]A traffic aide is an individual trained specifically in the techniques of traffic control, but has no enforcement powers; his job is to assist in traffic control.

ARLINGTON POND ALIGNMENT STUDY

The Cebu City government, as part of its long term highway plan prepared in the early 1950's, proposed a route which would run from Jones Avenue to V. Rama Avenue through barangay Sambag II. This route was designated the Arlington Pond Extension. The existing road system within Sambag II is badly designed; there is no continuity in road network and public transport routes to Sambag II is limited. As a result the residents experience long walks to the nearest public transport service. The Cebu City government requested MCLUTS to investigate the alternative alignments available for Arlington Pond Extension and make a recommendation. The following recommendations were made to the City Mayor:

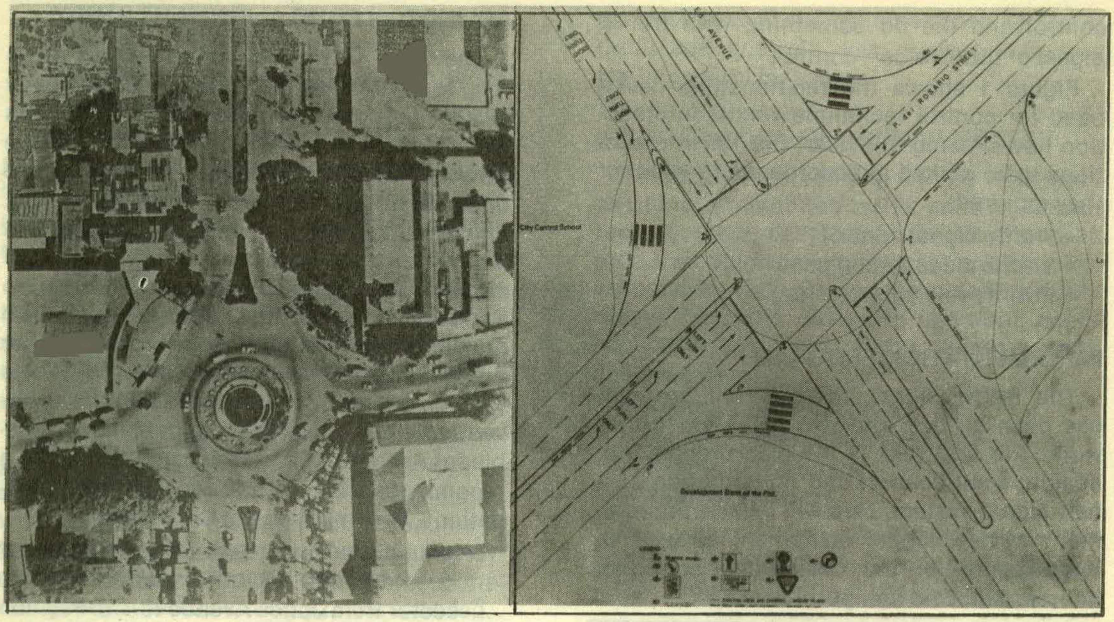
- Arlington Pond Extension alignment should follow MCLUTS route 1 for the sector from Jones Avenue to T.B. Pavilion
- Upgrade the road section from T.B. Pavilion to Guadalupe River following alignment of MCLUTS route 2.
- Further road identification studies need to be undertaken in the following areas:
  - Connection of Aznar Coliseum road to Arlington Pond Extension
  - Identification of a principal secondary through road connecting Jones Avenue and V. Rama Avenue

A resolution recommending the construction of the Arlington Pond Extension in accordance with the recommendation contained in the MCLUTS report was passed by the Sangguniang Panlungsod and approved by the Cebu City Mayor.

INTERSECTION IMPROVEMENTS

Salinas Drive-Gorordo Avenue

The intersection of Gorordo Avenue and Salinas Drive in Lahug was a channelized layout giving priority to traffic movements from Gorordo Avenue to Salinas Drive. Following the commencement of construction of the Cebu Plaza Hotel Complex, and the opening of the hotel annex on Busay Road, Lahug, the Cebu City government requested MCLUTS ro prepare new layout designs for the intersection. These new designs should give priority to traffic movements proceeding along Gorordo Avenue to Busay Road and Cebu Plaza.



P. del Rosario-Jones Avenue Existing and Proposed Layouts

Jones Avenue Intersection

The old intersection layout was modified to include medians in Gorordo Avenue, Salinas Drive and Busay Road. Left turning lane was provided for traffic turning from Salinas Drive into Gorordo Avenue and a separate right turn lane would allow direct movements from Gorordo Avenue to Salinas Drive.

The new layout was constructed in January 1981 in preparation for the papal visit to Cebu City in February 1981.

P. del Rosario Street-Jones Avenue

The intersection of P. del Rosario Street and Jones Avenue has the heaviest traffic movements in Metro Cebu. The existing layout consists of a 25-meter diameter roundabout with traffic signal control. The roundabout has been the scene of a number of accidents. The city government requested MCLUTS to investigate whether the roundabout should be repaired or instead demolished to give way to a new intersection layout.

A number of surveys were undertaken to collect information on:

- Physical characteristics
- Traffic volume
- Pedestrian movements

It was recommended that the intersection could be improved by:

- Demolishing the existing rotonda and constructing in its place a channelized intersection
- Replacing the existing traffic signal controller with new equipment that could accommodate a left turn phase and variable signal plans to operate for varying traffic flow conditions during the day

The channelization of the intersection would have the following effects:

- Decreasing the size of the intersection, therefore reducing delay to vehicles
- Improving pedestrian safety by providing refuge islands and decreasing the distance needed to cross the intersection
- Reducing the number of side-swipe accidents by clearly defining the traffic lanes and reducing the number of merging movements
- Reducing delay to right turning vehicles by providing exclusive right turn filter lanes

It was also recommended that a number of short-term minor. improvements be undertaken to lessen the possibility of traffic accidents. These include:

- Land marking on the approaches to the intersection
- Location of advance warning signs on all approaches
- Provision of large reflectorized directional arrow signs on the rotonda wall to help direct traffic approaching from the northern approach of Jones Avenue.
- Increase green time to 42 seconds on the P. del Rosario approaches.

Project Implementation and the Future

THE FUTURE

The first phase of MCLUTS was completed in December 1980, but because of the successful impact the project has on the local authorities involved, representations were made to the Ministry of Transportation and Communications to maintain the project office and staff to continue work in Metro Cebu. The Ministry initially extended the project to December 1982, but has now agree to the project continuing until December 1983. The World Bank, via the Central Visayas Urban and Rural Projects, will provide financial support to the project in the form of services of foreign consultants to advice and assist the Filipino staff. The support from the Central Visayas Urban and Rural Projects has meant that the method of approach adopted for MCLUTS can be expanded to cover the cities of Dumaguete and Tagbilaran.

METRO CEBU TRAFFIC MANAGEMENT OFFICE

The efficient implementation of the recommended transport and traffic management proposals will require the development of institutional and management systems appropriate for the problems at hand. The present system results in several government agencies and *ad hoc* bodies having overlapping functions and responsibilities. This situation results in the creation of yet more bodies to coordinate the activities of established agencies.This lack of direct responsibility and overlapping authority has resulted in a number of traffic engineering components not being given due attention; these areas include traffic signing, pavement markings and traffic signal operations.

The existing system is further complicated by the fact that existing agencies only operate within given administrative boundaries; however, the problems of traffic congestion, public transport inadequacy, road and traffic engineering insufficiency transcend local authority boundaries. It is felt that the administration of these activities could be tackled more efficiently and economically through an integrated systematic, central approach at the metropolitan level.

MCLUTS is therefore working towards the establishment of a traffic management office which would have the responsibility of coordinating the work of agencies involved in the implementation of traffic engineering and management projects. MCLUTS is currently defining the form, operating procedures, staffing requirements, training programs and budgetary requirements at sufficient detail for the traffic management office to be established.

CBD TRAFFIC MANAGEMENT PLAN

The present daily traffic demand into the CBD is expected to increase by 50 percent by year 1990. This increase cannot be accommodated without the development of effective traffic engineering and management programs. The initial schemes identified by MCLUTS have to be developed into implementable projects and programs. MCLUTS is therefore currently preparing a comprehensive traffic engineering and management plan for the CBD which will detail for implementation the following:

- One-way street systems
- Environmental precinct
- Re-routing of jeepneys
- Identification of parking controls
- Improvement of the traffic signal system

PUBLIC TRANSPORT IMPROVEMENTS

The MCLUTS remains actively involved in issues related to public transport. MCLUTS is providing technical assistance in the implementation of the rationalization of jeepney operation plan for Metro Cebu. The project is also studying the following aspects:

- Public transport structure
- Improvement plans for jeepney stops and waiting areas
- the operation requirements of taxis and other PU vehicles
- Rationalizing the operation of tartanillas reduce present operating problems. □

PLANNING NEWS

IEP Holds Second Public Service Lecture Series

The U.P. Institute of Environmental Planning held its 1980-1981 Public Service Lecture series from July 25, 1980 to October 14, 1981, at the IEP Training Room. Consisting of nine lectures, speakers tackled various topics relating to the theory and practice of planning, development policy, as well as problems attendant to urban development such as poverty, malnutrition, transportation and land use.

The Public Lecture Series is a continuing activity of the Institute aimed at providing pertinent and timely information as a means by which planning practitioners may keep themselves abreast with current perspectives, emerging trends and prospects of planning in the Philippines. It is likewise envisioned as a vehicle by which graduate students of the Institute may gain an understanding of the relationship between theory and practice, obtain a clearer view of the planning profession and be aided in their choice of specialization.

IEP Conducts Training Program on Planning for Urban Development

A training program on Planning for Urban Development was conducted from April 1 to July 1, 1981 at the Institute of Environmental Planning, U.P.

Designed especially for the personnel of the Office of the Commissioner for Planning, Metro Manila Commission, the program dealt with planning concepts, tools and strategies. Its aims were to provide insights into programs undertaken by the public and the private sectors and to develop the ability of the participants to assess the impact of these programs on development. Special attention was given to (1) the role of Metro Manila in national development, (2) the trend in population growth and distribution, (3) the contribution of particular programs and projects in shaping Metro Manila's development, (4) Sectoral problems involved in planning the city, and (5) the essence of major planning subject areas such as housing, infrastructure and transport.

The four-month course was conducted jointly by the Institute of Environmental Planning, U.P., the U.P. Planning and Development Research Foundation, Inc. and the Office of the Commissioner for Planning, Metro Manila Commission.

Meanwhile, the Training Division also formally opened the 6th Special Course in Urban and Regional Planning (SCURP) last September 5, 1981. This year's six-month Special Course focuses on "Land Use Planning". The program is under the supervision of Prof. Mehretab Tekie, Director of Training of the Institute.

PLANNING NEWS

IEP Faculty Hold Confab

The faculty of the Institute of Environmental Planning held a three-day conference at the Pines Hotel, Baguio City last May 29-31, 1981. While previous conferences focused on the course outline, the 1981 Annual IEP Faculty Conference focused on the curriculum. Other than the teaching function, the Conference also covered the following: the Proposed Diploma and Ph.D. Programs, Books of Readings, faculty participation in the operation and functions of PLANADES and the implementation of the center for Human Settlements Studies, particularly on the prospects for staff development.

Nine Receive MURP Degree

The UP Institute of Environmental Planning graduated nine students under the Master in Urban and Regional Planning Program last summer, 1981.

Junio M. Ragragio was the lone graduate under the thesis program. His area of concentration being in Regional Location Theory, Ragragio successfully defended his thesis titled "The Design and Application of a Manual Scalogram Method for Spatial Analysis in the Bicol IAD Area."

The graduates under the non-thesis program were: Manuel Javier, Oscar Macasa, Josefino Lucas, Ofelia Moso, Medarda Naga and Leandro Xavier Viloria.

Faculty conference at the Pines Hotel, Baguio City last May 1981.

PLANNING NEWS

TEAM Project Implemented

One government response to the problem of traffic congestion is the Traffic Engineering and Management of TEAM Project, a joint undertaking of the Ministry of Public Highways and P.G. Pakpoy and Associates. This project commenced in 1977 as part of the program initiated by the Metro Manila Governor to improve living conditions in the Metro Manila Area. An important aspect of this program is the implementation of measures to improve road safety and to manage traffic more efficiently on the arterial road system.

In the area of traffic management, the TEAM project is expected to continually provide the technical know-how for the installation of a computerized traffic control system. This traffic improvement plan is being funded with a $6.37 million loan from the World Bank. Partial releases of the loan have been responsible for the installation of 110 computerized traffic lights and other traffic aids (e.g., strategically located islands and medians) in the major arteries of the metropolis, thereby alleviating the traffic problem in the area. A survey by the traffic control center of the MPH in July showed that delays by jeepneys and buses particularly at intersection have been reduced.

The TEAM Project will gradually expand outwards to cover Efipanio delos Santos (EDSA) by 1984.

Proposed Revival of Traffic Management Authority

A proposal for the revival of the disbanded Traffic Management Authority (TMA) as the set-up of a new but similar organization has been drafted by TEAM and will be presented to the Traffic Management Steering Committee for discussion.

The proposed TMA is envisioned to be under the chairmanship of the Governor of Metro Manila. The authority will have four major functions, namely: enforcement, engineering, legislation and education and environmental functions. With regard to staffing arrangements, existing personnel in the MPF/INP and MMC will take charge of the enforcement as well as the legislation and education functions while TEAM plus some engineering staff from the MMC-TOC will comprise the engineering arm. Each of the four major groups will be headed by a Director, who will all be under the proposed position of an Executive Director.

In addition to forming the nucleus of the engineering arm of the TMA, TEAM will continue to serve the MOTC in its task of preparing policies, programs and standards at a national level.

MMETROPLAN Propose Short & Long-Term Transport Programs

The MMETROPLAN, a joint project of the Philippine Government and Freeman Fox and Associates, completed in 1977, is considered the most significant comprehensive transportation study to date. Its primary objective was to arrive at a meaningful plan and program to guide transport investments and operations within the context of a national land use pattern. It recommended development planning which provides the framework for the transportation proposals and presents implementable measures which will enable government to coordinate and steer development. This project is charged with establishing strategic policy while the TEAM project is charged with designing and implementing a wide-range of measures including some recommended by the MMETROPLAN.

The project recommended both short and long-term programs. Among the short-term transport actions are: improve bus operations, adjust bus and jeepney fares to help operators expand their fleet, define complementary roles of buses and jeepneys and assign specific routes for jeepneys and buses for a more efficient operations, and introduce cordon pricing. But one significant recommendation for the long-term transport action is the integration of the Light Rail Transit (LRT) System into the Metro Manila transport system.

Since the completion of the MMETROPLAN study, the government has deliberated on its findings and has decided to proceed with the first phase of implementing an elevated LRT also referred to as the MMETRORAIL.

PLANNING NEWS

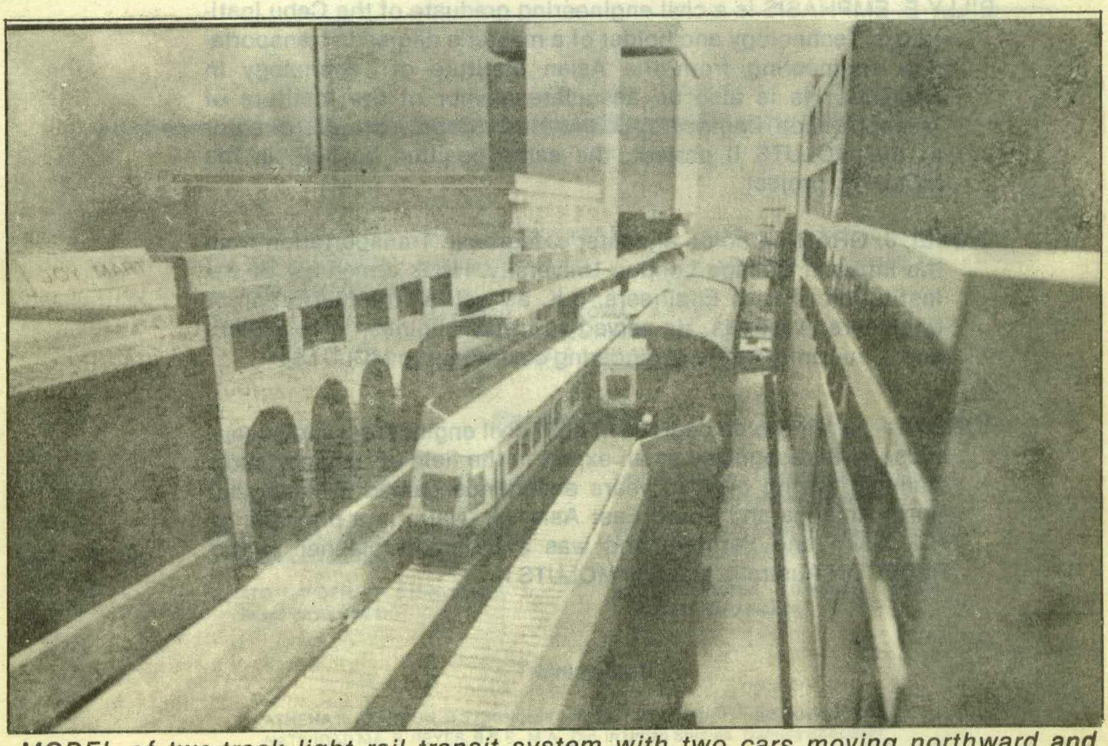
MMETRORAIL Project Started

The MMETRORAIL Project, with its first phase now under construction, is the latest effort by the government to provide a fast and modern mass transit for Metro Manila. This mass transit system is a project of the Metro Manila Commission. The Ministry of Transportation and Communication is in charge of the management of the project, acting through its Project Management Office, together with a group of engineering consultants composed of Swiss, Australian and Filipino firms.

The rationale of the MMETRORAIL envisaged by the MMETROPLAN project is to establish a system that would provide the cheapest form of mass transit at high passenger volume. It would be an efficient user of road space, could be implemented quickly, affordable, and easy to upgrade in the future.

To achieve effective operation, the railway system will be strongly linked to the rest of the transport system—to the buses and jeepneys. The buses and jeepneys will act as carriers to and from the LRT. The important and vital linkages are to be made at three terminals, in-between are stations where minor interchanges are foreseen.

The MMETRORAIL is envisioned in the long-term as a network of lines whose construction can be staged to matched the travel needs of the main travel corridors and where performance can be progressively upgraded in the future. It is expected to be operational by 1984.



MODEL of two-track light rail transit system with two cars moving northward and southward along Rizal Avenue in downtown Manila with sheds (stations) on both sides.

About the Contributors

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DANIEL J. GRAHAM holds a master's degree in Transportation from the Imperial College London University. He is a member of the Institution of Civil Engineers, U.K. as well as the Institution of Engineers, Australia. He served as traffic engineer in MCLUTS I and is currently traffic engineering consultant to MCLUTS II.

ROBERT J. NAIRN holds degrees in both civil engineering and economics. He is recognized as an expert in the field of transportation planning having over 20 years experience gained in Australia, North America and South East Asia. Mr. Nairn is a principal of R.J. Nairn and Partners and was a transport planner in the REDECON-Australia team on MCLUTS I.

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