DISCRETE CHOICE MODEL ON LOCATIONAL CHOICES OF MANUFACTURING FIRMS IN INDUSTRIAL ESTATES: THE CASE OF CALABARZON IN THE PHILIPPINES

Noriel Christopher C. TIGLAO
National Center for Transp. Studies
Univ. of the Phils., Diliman
1101 Quezon City, PHILIPPINES
Fax: (632) 97-5664

Dr. Asaichi MIYAKAWA
Visiting Professor, NCTS
Chief Adviser, NCTS Project
JICA Expert
National Center for Transp. Studies
Univ. of the Phils., Diliman
1101 Quezon City, PHILIPPINES
Fax: (632) 97-5664

abstract: The study is interested in finding out the locational choices of industrial firms in the manufacturing sector, as well as, the application of discrete choice modeling in describing how firms decide among alternative locations as final sites for their facility. The decision model is structured as a binary choice model incorporating both objective and subjective locational factors as explanatory variables. The case study uses data from a questionnaire survey conducted on several industrial estates with individual locator firms as respondents.

1. INTRODUCTION

The country, in adopting Philippines 2000 as its vision for development, seeks to achieve a newly-industrializing economy by the turn of the century. With this, it hopes to join the ranks of Asia's tiger economies like Singapore, Malaysia and South Korea.

Achieving NIC-hood would mean that the Philippines grow at a faster rate. One strategy that would effect this is shifting from an agricultural to an industrial economy. This is the very same strategy adopted by other countries in the region. In South Korea, for example, the share of its agriculture sector to gross domestic product, or the total flow of goods and services produced by its economy, dropped firm 30 percent in 1970 to 7 percent in 1992. Its industry's share, on the other hand, doubled from 24 percent to 48 percent during the same period.

The Philippine government under the present administration has drafted the Medium Term Philippine Development Plan (MTPDP) for 1993 to 1998, the country's socioeconomic blueprint, to embody its aspirations for the coming century. One area pursued for in the plan is Agri-Industrial Development as a strategy for national growth. Thus, the government encourages investments in desirable areas of activities especially those engaged in manufacturing, processing or production. Enterprises of this nature are considered as pioneer areas of investments under the government's investment promotion policies.

2. STUDY OBJECTIVES AND METHODOLOGY

Discussions on the overall subject of industrial location is merited on several points. First, there is a need to rationalize the present industrial structure as the country is gearing up for the attainment of an NIC-status by the Year 2000. The second is taken from the point of view of infrastructure development. The national government, as it is, is tied up with its present budget and it needs all the information it can get in order for it to manage its meager resources efficiently.

If investments in the areas of manufacturing could be attracted more effectively, there has to be a clear understanding on the current structure of the manufacturing industry in the country. This is the particular concern of the study. Its objective is two-fold: it seeks to examine the factors that affect industrial locations and the manner by which industrial

firms decide on the site of their facility.

It does this by considering the location choices that manufacturing firms make. With constraints in time and finances, there was a need to scope down the study area to a manageable level. A case study approach was consequently adopted with CALABARZON chosen as the study area.

The study is likewise concerned with the development of an empirical discrete choice model that will describe the locational choices of manufacturing firms in industrial estates. The particular situation of interest is when these firms choose among several alternative sites as final locations for their facility. The approach taken is to formulate the decision making behavior of firms as a binary choice situation. Using this formulation, a firm selects between two distinct choice options: to locate and not to locate.

3. INDUSTRIAL ESTATES DEVELOPMENT IN THE PHILIPPINES

The manufacturing industry in the Philippines historically has been concentrated in Manila. In 1975, some 73 percent of the manufacturing value added and 65 percent of employment was located in Manila and the surrounding provinces. The only industries with a certain degree of dispersion are the resource-based food and wood industries. If these industries were excluded, the 1975 proportion of manufacturing value added of Manila and the adjacent areas would have risen to 87 percent. This practically means that all manufacturing industry, outside of some resource-based industry and some small industry serving local markets, is based in Manila. The NCR dominated all other regions on gross value added in manufacturing for the years 1980 to 1990 with a share of 44.7 percent in 1980 which almost remained unchanged for ten years.

The heavy concentration of industry in Manila has arisen for a number of reasons: political, social and economic. The policies followed during the import substitution during the 1950s and 1960s depended on the availability of imported materials and intermediate goods. The natural location of these industries was near the port of Manila. In addition, the major consumer market was in Manila. At the same time, the government licensing system that arose to administer the imported materials was centralized in Manila. Industries in the regions that relied on domestic resources did not get the same motivation form the government's policies, and consequently, grew slower. The proportion of gross value added in manufacturing in Manila increased from 50 percent to 64 percent between 1948 and 1961. These pressures were reinforced by the lack of industrial infrastructure in the regions. The infrastructure problems, in turn, are worsened through natural difficulties arising from geographic isolation of many areas in the country, with the accompanying need for more efficient inter-island transport.

The government has been keenly aware of the imbalanced industrial growth and investments among the different regions of the country. It sought to divert industrial development into the regions. The main concerns have been to ease the overcrowding in Manila with its consequent economic and social costs, and to ease the problems of unemployment and outmigration in the regions.

The problems in Metro Manila with its congested roads and urban slums are obvious, yet it still attracts more people each year. The most efficient way, in the long term, to tackle the problem of regional disparities is to increase income and provide infrastructure and key industrial services, including finance in the already industrializing regions outside Metro Manila. The key to increasing income lies in industrial investments leading to increasing manufacturing output and absorbing work force increases that cannot be handled by increasing agricultural production.

4. EARLIER STUDIES

Several studies on industrial locational factors have been carried out in the past. These past studies provided the bases for this study. Although the general purpose of these studies differ, several essential information can be derived from them. There are two particular studies that are precedent to this study: Moran(1978) and Louis Berger International(1986).

The study by Moran attempted to assess the influence of the government's various regional policies in the 1970s on plant location decisions of some manufacturing firms. These policies were pursuant to the passage of the Export Incentives Act (R.A 135). The approach taken was to determine the factors that guided the firms to their present plant location and assess the subjective views of the entrepreneurs on these various policies.

The Louis Berger International Study, an ADB-funded study, undertook a policy and institutional review on the planning and management of Industrial Estates and Export Processing Zones. In relation to this, the Nationwide Industrial Survey was undertaken by the National Industrial Estates Program (NIEP) between December 1984 and March 1985. The respondents of the said survey were firms located in secondary cities of nine regions in the country.

## 5. INDUSTRIAL ESTATE LOCATOR SURVEY

The area identified for the study is the CALABARZON Region. Figure 1 shows the location map of the study area. The area is comprised of the five provinces of Cavite, Laguna, Batangas, Rizal and Quezon. It covers a land area of 16,299 km² corresponding to 5.4 percent of the total national land. It is part of Region IV (Southern Tagalog) which occupies the southern central portion of Luzon. The total population in the area was estimated at 6,349,000 in 1991 accounting for 10.5 percent of the total national population. The area was chosen for two important reasons: the extent of development in the area and the future role that it will play.

The industrial estate locator survey was conducted in order to obtain information regarding the current locational choices of manufacturing firms. To achieve this, representatives of each firms was requested to accomplish a questionnaire form. It was thought at first that an interview survey would be appropriate. However, it was later realized that securing individual appointments for each of the respondents will prove to be very difficult. The only recourse was to distribute the forms and later retrieved them. The difficulty in securing the responses were due to the fact that the respondents were the top management personnel in the firms.

Respondents to the survey are persons connected with the firm and has been involved in making company decisions especially those referring to the choice of its present location. The sample firm has to be already operating in any one of the IEs in the study area.

The questionnaire has two distinct sections. Section A deals with industry information. The questions asked in this portion are concerned with determining the characteristics of the sample. Questions 1 thru 5 asks about the particular manufacturing activity that the sample is engaged in. Questions 6 thru 8 asks about the industrial estate where the firm is located in. The rest of the questions in this section, questions 9 thru 11 pose questions on the operation side of the activity. Items of interest in these questions are the workforce employed by the firm, the source of its raw materials and its markets. Section B is concerned with the choice of location of the sample firm.

A total of 27 locational factors were incorporated into the survey: (1) Cost of capital, (2) Estimated revenue, (3) Estimated cost of raw materials, (4) Estimated labor costs, (5) Estimated transport costs, (6) Travel time to NAIA, (7) Travel time to Port of Manila, (8) Land price/ Rentals, (9) Availability of desired labor, (10) Roads, (11) Water, (12)
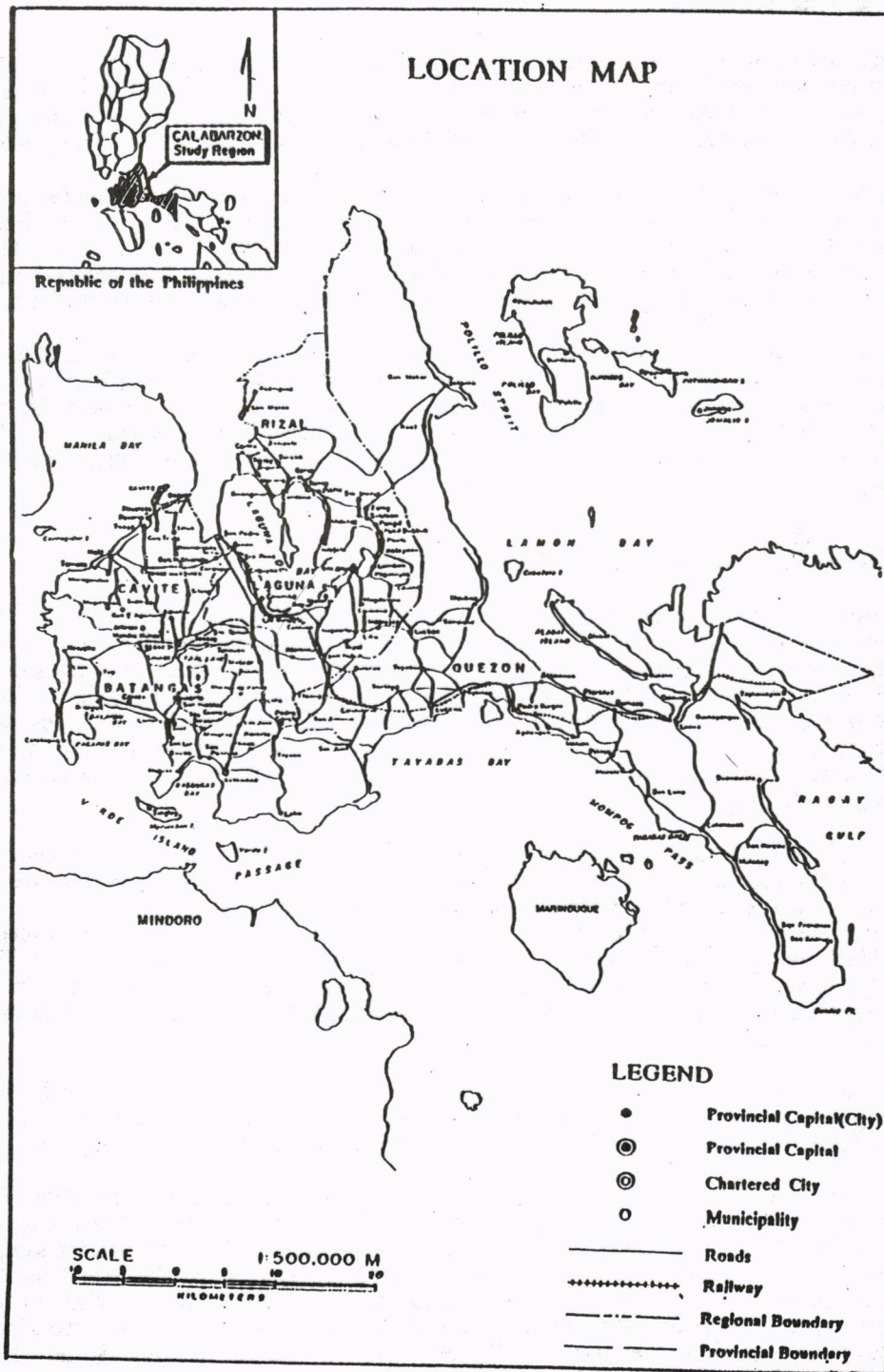
Figure 1   Location Map of the Study Area

Sewerage, (13) Waste disposal, (14) Telecommunications, (15) Amenities, (16) Access to government/ business services, (17) Availability of transport facilities, (18) Availability of housing facilities, (19) Proximity to residential centers, (20) Peace and order, (21) Availability of financial incentives, (22) Geographical location, (23) Climate, (24) Community attitudes, (25) Convenience, (26) Family influence and (27) Marketing and promotion.

All of the above factors are measured using ordinal scales. The respondent will be asked to consider two of its choices: its best and next best options during the time it was making the decision. These two alternatives are evaluated by the respondents on the basis of the different factors. Factors 1 thru 8 are measured using the scale as follows: 1-Significantly High, 2-High, 3-Middle, 4-Low, and 5-Significantly Low. The rest of the factors are measured using the following scale: 1-Excellent, 2-Very Satisfactory, 3-Satisfactory, 4-Good and 5-Unsatisfactory.

The objective of the survey was to obtain data that is good enough to develop and calibrate a binary choice model to describe the locational choices of firms. After having found out that such a model could be developed, it is recognized that a possible extension of the study would then be to obtain a statistically representative sample, this time that will be able to explain the behavior of the population.

Nine industrial estates were contacted as possible survey sites. Out of the nine, only five agreed to the administration of survey. Overall, about 150 forms were distributed of which 18 responses were retrieved. The retrieval rate stands at about 12 percent.

6. SURVEY FINDINGS

Figure 2 shows the distribution of respondents according to type of industry. Industries engaged in the manufacture of electrical machinery comprises the larger portion of the total samples which stands at 38 percent. Wood industries comes in second with 19 percent of the total samples. Chemical and textile industries have the same share in the number of samples at 14 percent.

Figure 3 shows the distribution of samples according to the type of lot, that is, whether the lot was bought or leased. Close to 60 percent of the samples bought their lot.

Figure 4 shows the distribution of samples according to the classification of lot, that is, whether it is an Export Processing Zone, a Special Export Processing Zone or a General Industry Zone. Almost 80 percent of the sample are special EPZs.

Figure 5 shows the distribution of respondents according to percent foreign equity. The figure shows that more than half of the samples have foreign equity greater than 60 percent.

Figures 6 and 7 shows the distribution of samples according to their source of raw materials and the mode used in transporting these raw materials, respectively. It can be observed that a majority of the samples import their raw materials. This can be explained by the very fact that most of the samples belong to the export-oriented industries. Only about 35 percent of the samples source the raw materials locally. The raw materials are brought in by a combined use of road and water-based modes of transportation.

Figures 8 shows the distribution of samples according to the location of their respective markets. Almost 90 percent of the sample firms export their products to other countries. Figure 9 shows the share of the modes used in transporting the processed products. Shipping is most widely used, that is 48 percent of the samples utilize such mode. Air transportation comes in next at 38 percent.
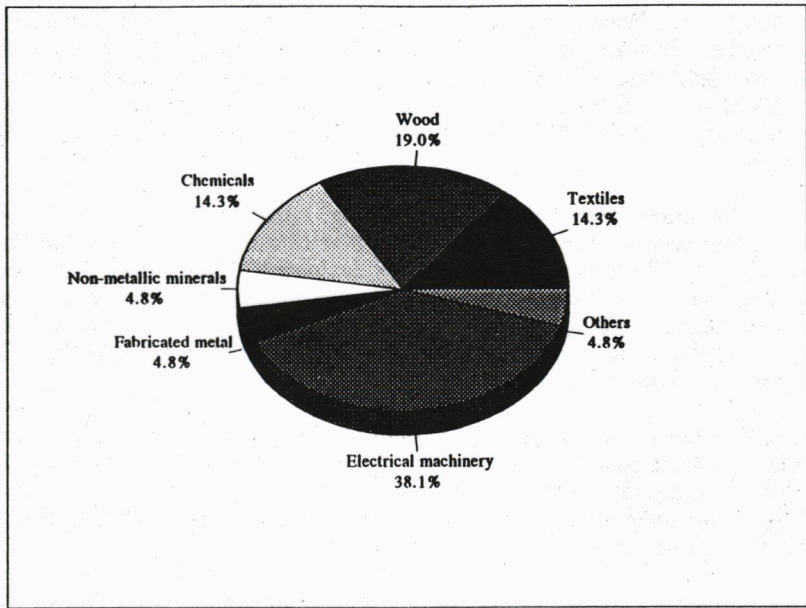
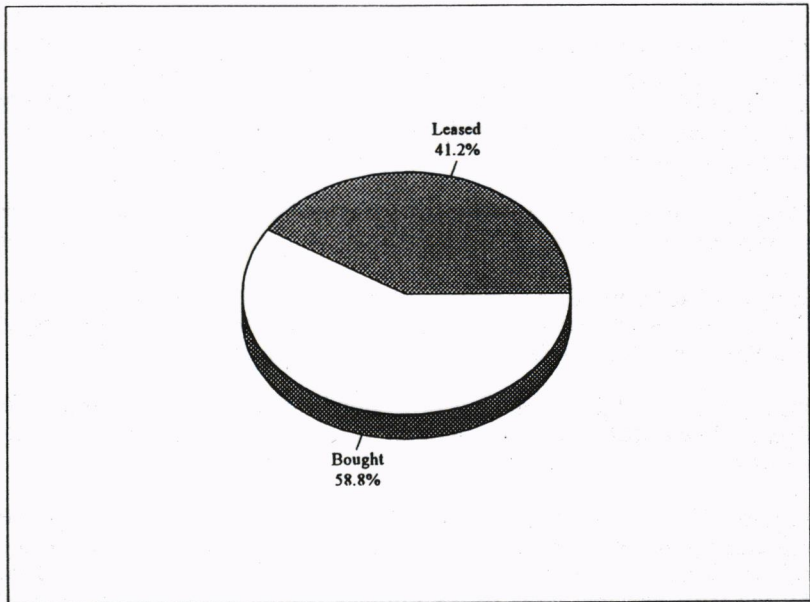**Figure 2   Distribution of Respondents
According to Type of Industry**

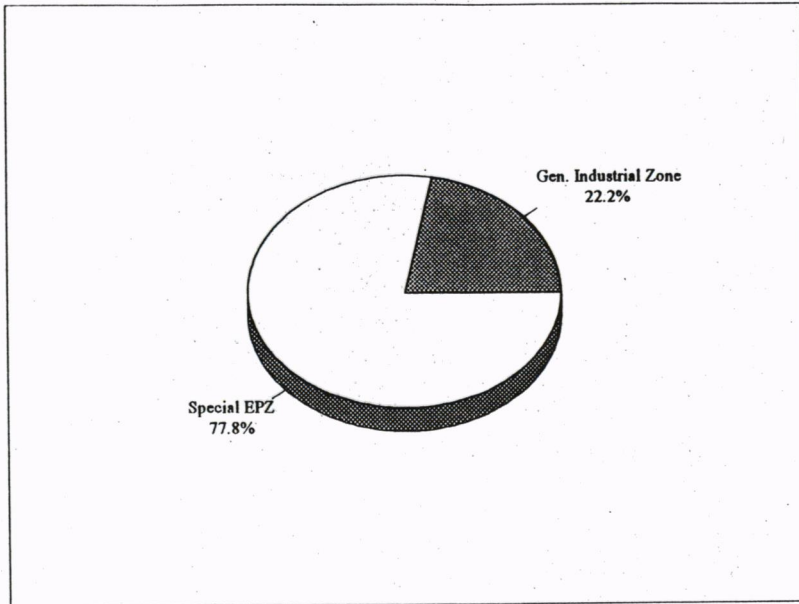**Figure 3   Distribution of Respondents
According to Type of Lot**

**Figure 4   Distribution of Respondents
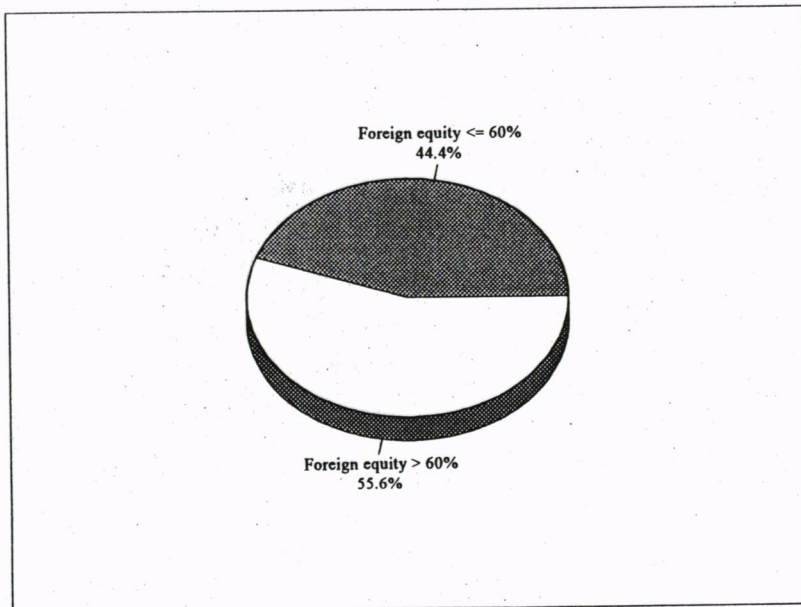According to Classification of Lot**

**Figure 5   Distribution of Respondents
According to Percent Foreign Equity**
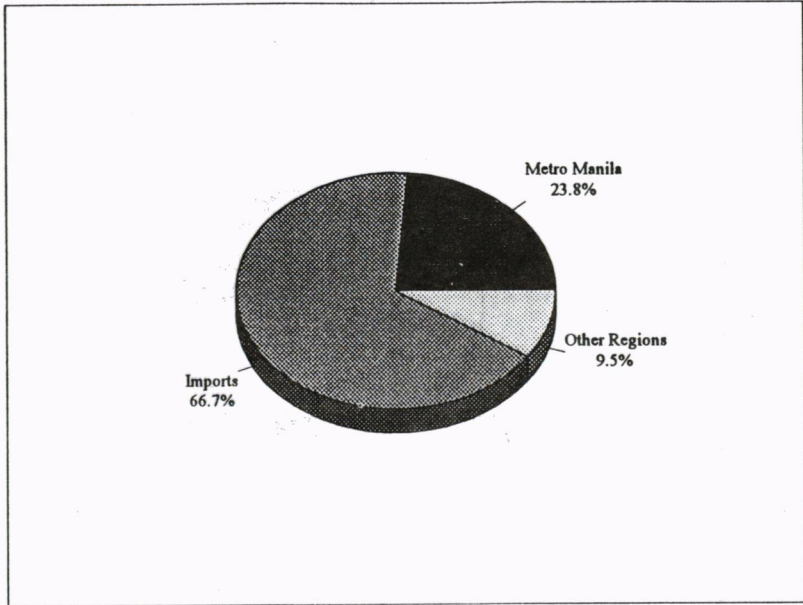
Figure 6   Distribution of Respondents
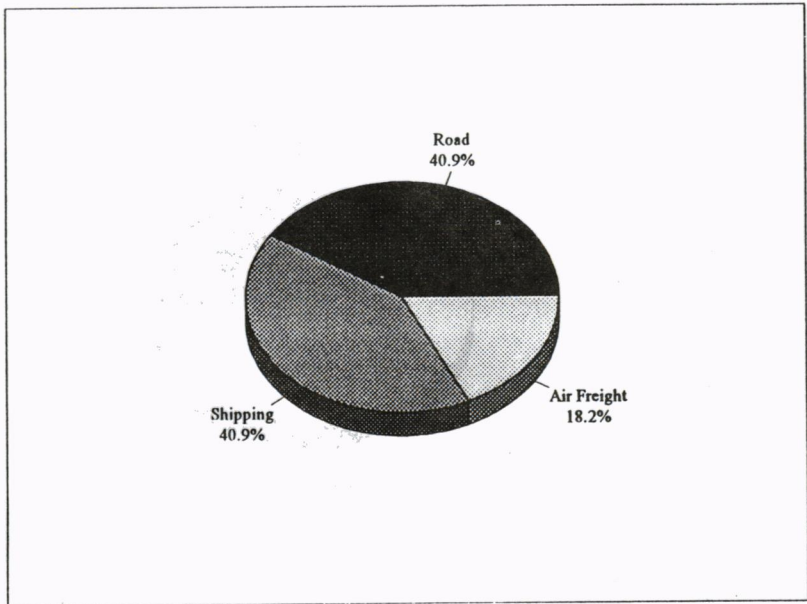**According to Source of Raw Materials**

Figure 7   Distribution of Respondents
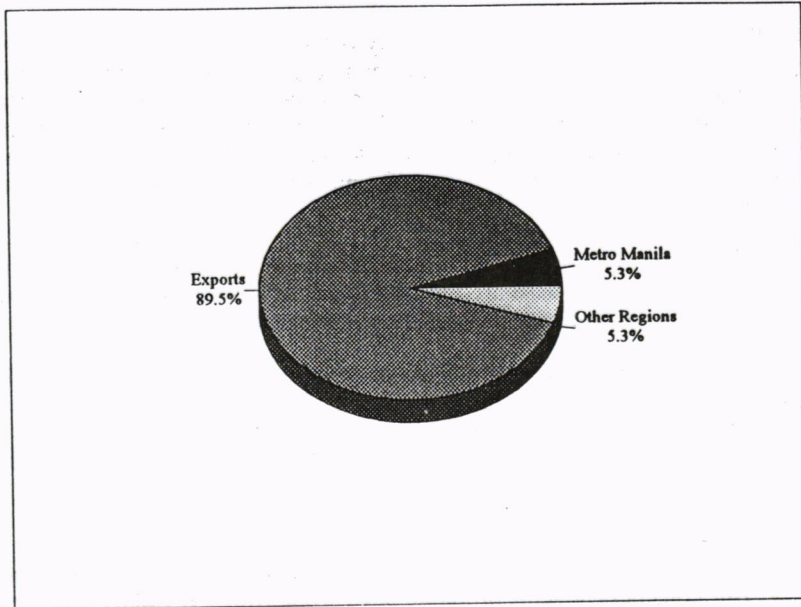**According to Mode Used in Transporting Raw Materials**

**Figure 8   Distribution of Respondents
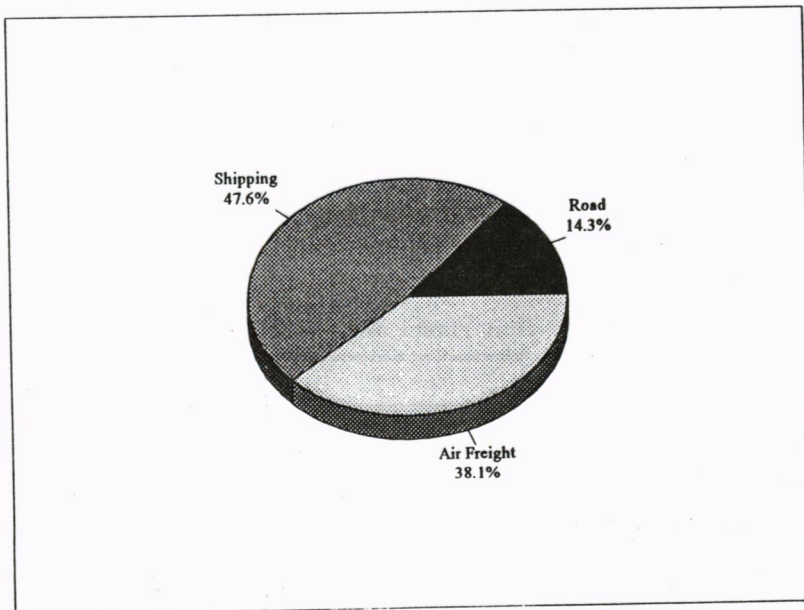According to Location of Markets**

**Figure 9   Distribution of Respondents
According to Mode Used in Transporting Processed Products**

7. MODELING LOCATIONAL CHOICE

A particular firm who wishes to put up a facility is confronted by several alternative sites. In making the final choice, that firm carefully evaluates each probable site on the basis of several locational criteria. Its valuations of these criteria will be subject to the firm's value judgments and attitude towards each locational criteria, market information or perception on the attributes of the alternatives and its expectations and preferences. The firm will then proceed in striking a trade-off among these different considerations to finally come up with the best choice.

Thus, in formulating the decision model to describe the locational choices of firms, several issues have to be considered. These are the locational factors that affect the manufacturing firms' decision and the actual choices that these manufacturing firms make?

The approach taken in the study was analyzing the decision-making behavior of firms on a microscopic level. The unit of observation considered was one individual firm. The behavior of these firms are further conceptualized as binary choice situations. With this analytical framework, a firm selects between two distinct choice options: **to locate** or **not to locate**. Different locational factors make up the set of explanatory variables to explain the observed choices. These factors are measured using ordinal scales.

Figure 10 shows the conceptual framework of analyzing the locational choices of firms. Generally, a firm considers several probable sites from which it finally chooses the final location of its facility. Thus, in general, one can look at such situation as a multinomial choice problem. However, it is hypothesized that the process of selecting the final site can be brought down to a level where the firm selects between only two choices. That is, the **best** and the **next best** options. The **best** option is obviously that site where the firm actually decided to locate in. On the other hand, the **next best** option refers to that site where the firm considers to be the second best. Thus, in adopting such a framework, the decision situation can be formulated into a binary choice problem.

8. DETERMINANTS OF INDUSTRIAL LOCATION

In the conduct of the survey, the respondent were made to rank several major factors according to its level of importance in influencing its decision to locate. Table 1 shows the result of the rankings made by the respondents.

Table 1   Importance of Locational Factors

Factor	Rank
Peace and order	1
Financial incentives	2
Access to desired labor	3
Access to utilities	4
Access to business/ gov't/ social services	5
Land price/ Rentals	6
Availability of local transport facilities	7
Proximity to airport/ harbor	8
Access to markets	9
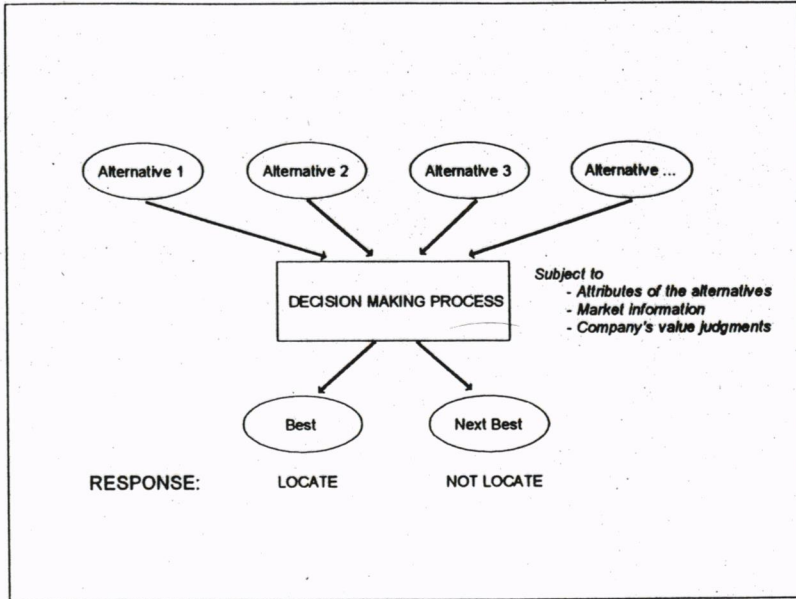
Figure 10   Framework for Analyzing Locational Choices of Firms

Access to raw materials	10
Availability housing facilities	11
Personal preferences	12

Peace and order was given the most importance among all the other factors. This may be explained by the fact that a majority of the respondents are located in Cavite where industrial peace is actively promoted as the main advantage of the region over other sites. Personal preferences commands the least consideration in firm location decisions.

Correlation analysis was performed on the different explanatory variables in order to determine which factors possess strong explanatory powers or whether a strong relationship exists with the observed choice. Table 2 shows the factors with relatively high correlation coefficients.

Table 2   Correlation Coefficients Against Observed Choice

Factor	Correlation Coefficient
TTNAIA	0.42029
REVENUE	0.41442
INCENTV	0.3808
ROADS	0.25453
LOTSIZE	0.22811

The above variables make up the set of possible explanatory variables. The variable TTNAIA refers to the firm's perceived value or advantage of the site with regards to travel time to the NAIA which is the major airport in the country. This variable could also reflect the firm's perceived cost in either transporting the raw materials or the finished products. The variable REVENUE, on the other hand, refers to the firm's perceived value on the revenue once it chooses to locate in a particular site. INCENTV refers to the firm's perceived value on the level of financial assistance that its firm is enjoying. ROADS is a variable that stands for the firm's perceived value on the road facilities of the site. The variable LOTSIZE is a socioeconomic variable referring to the size of the lot of the sample firm in terms of hectares of land.

9. MODEL RESULTS

Table 3 shows the estimation results of the best model. The parameters were estimated using the statistical software SAS. The model specifies three explanatory variables: REVENUE, TTNAIA and LOTSIZE. One advantage of this particular model is the inclusion of a socioeconomic variable of the decision maker. The size of the lot is a clear and good indication of the financial capacity of the firm. Although another socioeconomic attribute that was incorporated in this study is the firm's capitalization in putting up the facility, however, it did not seem to have a strong correlation against the observed choices.

Table 3   Model Estimation Results

Variable		Parameter Estimate	
INTERCEPT		-24.6095	
TTNAIA		5.3362	
REVENUE		2.7436	
LOTSIZE		0.8146	
Summary statistics			
p-value	0.031	Concordant	90.9%
-2L(c)	14.548	Discordant	6.1%
-2L(β)	5.676	Tied	3.0%
-2[L(c)-L(β)]	8.872	Somers' D	0.848
Rho-Square, ρ^2	0.610	Gamma	0.875

The model is significant at the 95% confidence level having a p-value of 0.031. Its concordant value is high and the various measures of association are close to unity indicating that a good model.

One informal test for goodness-of-fit is the ρ^2 which is calculated as

$$\rho^2 = 1 - \frac{L(\beta)}{L(c)} \tag{1}$$

This index is particularly useful in comparing different models using the exact data. It is interpreted much like the correlation coefficient in linear regression calculations for continuous variables. Among all the other models tested in the study, this particular model yielded the highest ρ^2 value of 0.610 indicating this model to be the best formulation.

10. CONCLUSION

Reinforced by past studies, the different factors were incorporated into the overall framework of the study. They also form the set of possible explanatory variables to explain locator choice. From among the set of possible explanatory variables, several variables showed a relatively high correlation with choice. Secondly, the relative importance of the factors were determined from the results of the industrial estate locator survey. The survey showed that the locators tend to give a higher importance on the peace and order situation. Financial incentives come in second in the ranking of factors. Personal preferences are given the least importance. Finally, the locational choices of manufacturing firms were described through the application of discrete choice analysis. A binary choice model with which is able to explain locator choice was developed. The model specifies firm's perception on revenue and travel time to the airport and lotsize as the socioeconomic attribute.

11. RECOMMENDATIONS FOR FURTHER STUDY

It is recommended that more detailed data gathering be pursued further in order to develop the model more fully. This can be done with a re-design of the survey questionnaire in order to collect more precise information on locator choices. Surveys of this dimension require substantial amount of time and money. Secondly, after such data can be available, several other specifications of the model can be explored. This time the model may be able to describe a bigger population that can be expanded to a national level.

It is recognized that other economic and social factors or policy affect locator choices. Therefore further studies on such fields is highly recommended to explain industrial development in the country. With such considerations, the model may be able to answer several questions such as the industry's sensitivity to government's economic policies. It may somehow provide a guide for future policy-making.

Another extension of this study is an in-depth discussion on the transportation demand of manufacturing industries. With such limited transportation infratructure, there is a need to rationalize the impact that industrial firms impose on the existing transportation network.

REFERENCES

Agresti, A. (1984), Analysis of Ordinal Categorical Data, John Wiley & Sons, Inc.

Bautista, R.M.(1979), Industrial Promotion Policies in the Philippines, John H. Power and Associates, The Philippine Institute for Development Studies (PIDS)

Ben-Akiva, M. and Lerman, S.R. (1985), Discrete Choice Analysis: Theory and Application to Travel Demand, MIT Press

Bonded Export Marketing Board (1992), Philippines' Industrial Estates, June 1992

Borsch-Supan, A. (1987), Econometric Analysis of Discrete Choice: With Applications on the Demand for Housing in the U.S. and West Germany

de Ortuzar, J.D. and Willumsen, L.G. (1994), Modeling Transport, Second Edition, John Wiley & Sons

JICA (1991), The Master Plan Study on the Project CALABARZON, Executive Summary Report, October 1991

Lamberte, M.B. et. al. (1993), Decentralization And Prospects For Regional Growth, Philippine Institute for Development Studies (PIDS)

Lim, J.Y. and Nozawa, K. (1992), Decentralization and Development in the Philippines, Institute of Developing Economies (IDE)

Morikawa, T. and Sasaki, K. (1994), Discrete Choice Models with Latent Variables Using Subjective Data, Paper presented during the Seventh International Conference on Travel Behaviour, 13-16 June 1994

National Economic and Development Authority (NEDA) and Louis Berger International, Inc.(1986), Industrial Dispersal in the Philippines : A Policy and Institutional Review of Planning and Management of Industrial Estates and Export Processing Zones, February 1986

NEDA Publications Board (1994), Philippine Development Magazine, March-April 1994, Volume 21, No. 2

Pante, F. Jr. and Medalla, E.M. (1990), The Philippine Industrial Sector: Policies, Programs and Performance, PIDS Working Paper Series No. 90-18, Philippine Institute for Development Studies (PIDS), July 1990

Parel, C.P., et. al. (1978), Social Survey Research Design, PSSC Social Survey Series No.1

Ramos, J.M. and Sazanami, H. (1991), Industrial Estates and Regional Development In Selected Asian Countries: A Review of Experience, United Nations Centre for Regional Development (UNCRD)

SAS Institute Inc., SAS/STAT User's Guide, Version 6, Fourth Edition

The World Bank (1980), PHILIPPINES : Industrial Development Strategy and Policies, The International Bank for Reconstruction and Development/ The World Bank