Geospatial Technologies Application in the Management of Intensive Field Data Gathering for a Hedonic Price Model (HPM) of Lands

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Key words: Geospatial Technologies, Land Valuation, Hedonic Price Model, Transit-Oriented Development, GIS

SUMMARY

The real estate plays a vital role in the economy of a nation. Knowing the factors affecting urban land value is very important in determining the future of urban land development and anticipating potential land-use changes. The hedonic price model is the major scientific method by which we can observe the effects of one or more attributes on land prices, with the other factors holding constant, since researchers cannot conduct controlled experiments in the laboratory. The hedonic pricing model (HPM) breaks down the item being researched into its constituent characteristics, and obtains estimates of the contributory value of each characteristic. It is always expected that an investment through transit corridor will increase economic development. This study is focused on gathering and tabulating physical and economic property market data for the development of a hedonic price model of properties affected by transit-oriented development. It requires more than 800 samples, with each sample containing 42 parameters, to be accomplished in a very short span of 60 days. This daunting task is made possible with the aid of geospatial technologies. The sampling strategy applied is stratified systematic random sampling. The subject area is strategically divided or segmented into seven (7) regions or strata then sampling locations or areas of interest are systematically selected in each stratum. From each sampling locations, samples of residential and commercial areas are randomly selected using various Geographic Information Systems (GIS) operators. Field valuers need to accomplish the Field Plan before any fieldwork is conducted to list the targeted sample points allowing the easy forecasting of accomplished sample points and the monitoring of field personnel in the field. Every field valuer is equipped with an android phone with a GPS App capable to navigate, manage waypoints, tracks, routes, and build customized dashboard from 45 widgets. The output is primarily presented in a Microsoft Excel spreadsheet containing the master database of the 817 samples, GIS files and maps. The interactive GIS map integrates the coordinate location of samples and the 42 land value parameters. The gathering and tabulation of physical and economic property market data for HPM is both very laborious and challenging, but the application of geo-spatial technologies facilitates the management of intensive field data gathering.

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1. INTRODUCTION

The real estate plays a vital role in the economy of a nation. Knowing the factors affecting urban land value is so important in determining the future of urban development and anticipating potential changes. Real estate property, as a composite goods, is dependent on many unique bundles of attributes for its value (Rosen, 1974; Sirmans et al., 2005). The differences in the value ascribed to real estate property interest by different stakeholders is a direct result of the uniqueness of the stakeholders that interact in the real estate market as well as the heterogeneous nature of real estate properties (Chin and Chau, 2002; Sirmans et al., 2005). This has led to the emergence of the hedonic pricing model (HPM) that generates the contributory power of each of these variables to value formation. The hedonic price models (HPM) infer the impact of attributes on the values of a property. Applications of HPM have been used to estimate different land value attributes.

2. LITERATURE REVIEW

Freeman et al (2014) provided a comprehensive explanation of the history and theory of hedonic pricing. Rosen (1974) was the first to postulate that houses or similar heterogeneous products are not homogeneous and have different characteristics. He defined hedonic prices as the implicit prices of attributes extracted from observed prices of differing products. Geoghegan et al. (1997), incorporated GIS to analyze the pattern of surrounding land uses, which affect land values in Washington, USA. Shonkwiler and Reynolds (1986), determined non-agricultural uses of the land, located at the urban fringe. Tyrväinen (1997) studied how urban forest benefits are capitalized in property prices in Finland. Kong, F. et al. (2007) often used hedonic pricing to value urban green space in Jinan City, China and also to value open space by Irwin and Bockstael (2001).

It is always expected that an investment through transit corridor will increase economic development. Chen, Rufolo and Dueker (1997) studied the impact of the rail system in Portland, Oregon on single family house values using hedonic price model. The study anticipates that proximity to a light rail station may have positive effects on the residential property values. Dueker and Bianco (1998) examined the effects of light rail transit on property values in Portland. Single family house price changes were analyzed statistically. There was a reduction associated with the distance from rail station. Coffman and Gregson (1998) conducted an empirical study about the effect of railroad construction on land values away from the railroad in Knox County, Illinois using a regression equation. During the interstate railroad boom of the 1850s in the United States, land values grew rapidly. Lands within close proximity to new railroads became more valuable due to decreased transportation costs and real land values increased more than 60 % in the regions. Cervero and Duncan (2002) examined the land value impacts of rail transit services in Los Angeles County using hedonic price models. These properties located within a half mile of a station sold more due to positive effects of the railroad station.

The hedonic price model is a very useful scientific tool. Monson (2009) considers the hedonic price approach as not purely statistical but with a theoretical foundation rooted in consumer theory. This approach, however, is not without limitations. First, the hedonic price model is very data consuming which poses a great problem. For some places, transaction data is simply not available, most often due to thin transactions, or is available at very high prices from companies that sell them.

3. OBJECTIVES AND SIGNIFICANCE OF THE STUDY

This is a study to gather and tabulate physical and economic property market data for the development of a hedonic price model of properties affected by transit-oriented development. The objective is clearly to gather and tabulate physical and economic property market data. With sufficient data, this tool allows us to estimate the individual effects of different land attributes on land prices. Since researchers cannot conduct controlled experiments in the laboratory, the hedonic price model is the major scientific method by which we can observe the effects of one or more attributes on land prices, with the other factors holding constant. A regression analysis can then be calculated to determine the correlation for each of the characteristics measured against the transaction price. Those correlation measurements are then used to create a hedonic pricing model which will help determine the expected price of the so called transit-oriented development (TOD) affected property markets.

As an alternate real estate valuation method, hedonic price modeling can be used by professional valuers and other stakeholders to determine which land characteristics add significant value to the potential transaction price. The results produced can provide important information for future decisions and help each party better understand the economics surrounding each asset, thus improving asset underwriting.

4. STUDY AREA

The study area is the North-South Commuter Railway (NSCR) North Line from Tutuban to Clark International Airport, the NSCR South Alignment from Solis Station to Los Banos Depot and areas several kilometers away from the railways around Metro Manila and neighboring provinces of Bulacan, Pampanga, Rizal, Laguna and Cavite. This is actually the subject area covered by the Northrail project of the Philippine National Railways (PNR). The Northrail project involved the upgrading of the existing single track to an elevated dual-track system, converting the rail gauge from narrow gauge to standard gauge, and linking Manila to Malolos City in Bulacan and further on to Angeles City, Clark Special Economic Zone and the Clark International Airport. Requirements of the study include the collection of more than eight hundred (800) samples of land values and specific data that influences the land values of sample lots selected from all over the subject area. Map of the whole study area indicating the alignment of the railways is shown in Figure 1 below.

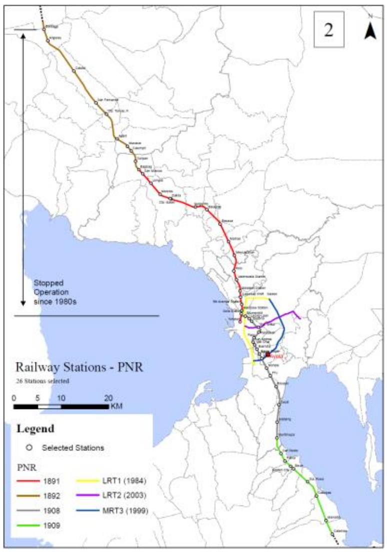

Figure 1. Map of the North-South Commuter Railway

5. METHODOLOGY

Hedonic pricing is a model identifying price factors according to the premise that price is determined both by internal characteristics of the good being sold and external factors affecting it. This method uses observed data of actual preferences which is standard, accepted economic techniques. Eight (8) major steps are needed to accomplish this study. The general process flow is shown in Figure 2 below.

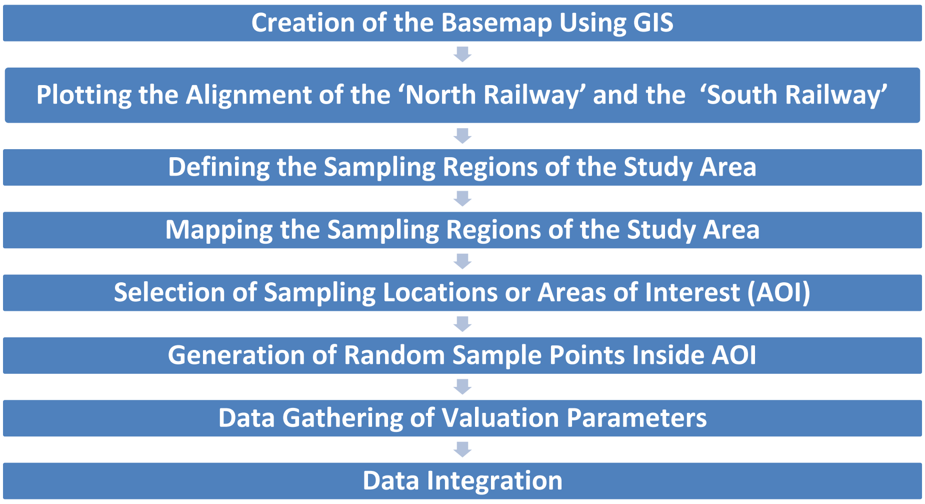

Figure 2. General Process Flow of the Study

5.1. Creation of the Base Map Using GIS

Every property to be valued must be located somewhere and GIS can handle the spatial aspects and database management of large data volume. GIS hastens large-scale valuation especially mass appraisal. To implement the selection of sample points, a basemap was created serving as visual representation of the area. Geographic Information Systems (GIS) particularly ArcGIS or an open source software, Quantum GIS, were used to create the basemap from a free online satellite image source like the GoogleEarth images covering the entire subject areas of the study.

5.2. Plotting the proposed alignment of the 'North Railway' and the existing 'South Railway'

The accurate and precise locations of the existing and proposed stations of the North Railway' (Tutuban to Clark International Airport) and the existing 'South Railway' (Solis station to Los Banos station) has to be known from a reliable source. The stations are plotted using available coordinates and estimated from Google. This provided a good perspective of the whole area of study. Uncertain future alignments of stations at the time of the survey were assumed to be the same or located near the current location of the PNR stations.

5.3. Defining the Sampling Regions of the Study Area

The sampling strategy applied for this study is stratified systematic random sampling. The subject area was strategically divided or segmented into seven (7) regions or strata. These are:

A. Railway Stations inside Metro Manila - LRT and MRT
B. Railway Stations outside Metro Manila – PNR Stations
C. Planned Railway Stations
D. No Railway Station Area inside Metro Manila
E. No Railway Station Area from Malolos to EDSA
F. No Railway Station Area from Tutuban to Clark International Airport (CIA)
G. No Railway Station Area North to South Along Major Commuter Roads

5.4. Mapping the Sampling Regions of the Study Area Using GIS

Based on the situation of existing railway system and planning for the railway construction, two regions were strategically created in selecting sample points. These are Inside Metro Manila region (IMM) and Outside Metro Manila region (OMM). GIS is used to distinctly map the Metro Manila region and outside. Using basic functions of QGIS particularly buffering, areas around stations and along the railroad tracks are mapped within one (1) kilometer inside MM and two (2) kilometers outside MM. In region IMM, the area near railway station is limited within radius of 1000m around station (if the distance between two stations is less than 2000m, 1/2 distance was set as radius of these two stations), and the NRPs were selected within this range. In the OMM region, the radius was expanded to 2000m (around a station), and the NRPs were selected within this expanded range (if the distance between two stations is less than 4000m, 1/2 distance is set as radius of these two stations). This procedure will determine the areas defined by regions A, B, and C above. Regions D, E, F, and G defined as No Railway Station Area are outside the buffered A, B, and C regions.

5.5. Selection of Sampling Locations or Areas of Interest (AOI)

A detailed proposal of how to choose points in these regions is shown in Fig. 3 to Fig.8 respectively. Points or AOIs are selected to ensure sufficient coverage of the stations and the whole subject area. In Fig.3, selected stations in IMM region were marked (green), around each selected station, within the radius of 1000m (if the distance between two selected stations is less than 2000, the radius could be setup as 1/2 distance between these two stations), NRPs were selected. Sample points selection is based on radius between 0 and 1000m. 5 residential land use points and 5 commercial land use points should be selected respectively. It should be mentioned here that all these 5 points must be in different distances from the station. Fig. 4 is the railway station of PNR (excluded/stopped operation of railway from 1980s). There are 26 stations selected from Solis station to Calamba station. Rule of sample point selection is the same. If the distance between two stations is less than 2000m, the radius of station is limited within 1/2 distance. Stations within IMM region, the radius is set as 1000m. Stations in OMM region, the radius is set as 2000m (if distance of two station is less than 4000m, 1/2 distance could be setup as radius). Same as Fig. 3, around each station, within its defined radius, 5 residential land use points and 5 commercial land use points should be selected as sample points respectively. Fig. 5 is 9 planned railway stations (marked with red). Sample point selection method and rule are the same as in the explanation of Fig.4. Fig. 6 shows the possible selected ORPs points in the IMM region. All selected points are marked with yellow. 3 residential land use sample points and commercial land use (if it is available) in each selected point were chosen. Fig. 7 is selected points of no railway station area from Malolos to EDSA (commuting range to Manila). As explained in Fig.6, 3 residential land use sample points and commercial land use (if it is available) in each selected point were chosen. Fig. 8 is selected points within no railway station area from Tutuban to CIA. In each selected point, 3 residential land use sample points and 3 commercial land use (if it is available) sample points were chosen. Fig. 9 is selected points of no railway station area along major commuter roads from north to south around Manila (marked with yellow). 3 residential land use sample points and commercial land use (if it is available) sample points in each selected point were chosen. Figures 3 to 9 are shown below.and arranged from left to right.

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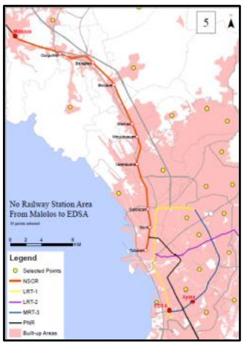

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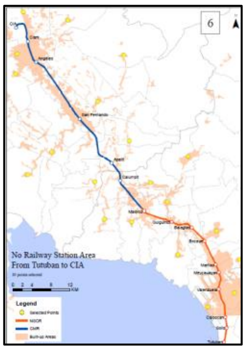

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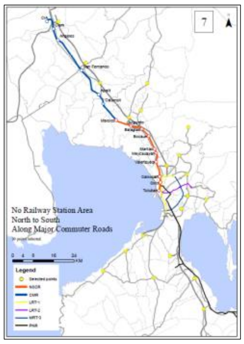

Figures 3-9. Sampling Locations at Different Regions of the Study Area

5.6. Generation of Random Sample Points Inside Areas of Interest (AOI)

The total number of sample locations or Areas of Interest (AOI) for the whole study area is 145. In each of these AOIs, specific number of residential and commercial areas is randomly selected. Regions A, B and C require 5 residential and 5 commercial area samples while regions D, E, F, and G require 3 samples of combined residential and commercial areas. This brings the grand total number of target sample points to 806. Targeting a relatively large number ensures the sufficiency of samples in case of occurrences of rejected samples in the quality control stage and in case some of the sample points are not easily accessible. Table 1 below shows the distribution of the target random samples per region.

Table 1. Target Sample Locations and Random Points per Sampling Region

Represented Sampling Region	No. of Sample Locations or Areas of Interest (AOI)	Description of Samples	Total No. of Samples per Location or AOI	Total No. of Random Samples
A	18	5 Residential and 5 Commercial	10	180
B	26	5 Residential and 5 Commercial	10	260
C	9	5 Residential and 5 Commercial	10	90
D	32	3 residential and commercial	3	96
E	20	3 residential and commercial	3	60
F	20	3 residential and commercial	3	60
G	20	3 residential and commercial	3	60
Grand Total of Random Samples =				**806**

Where:

A = Inside Metro Manila Railway r1
B = CMR to South R1
C = CMR to NCSR R1
D = Metro Manila no railway grid r1 and r2
E = Malolos to EDSA No Railway Built-up Area
F = CMR to NSCR No Railway Built-up
G = North to South No Railway – Commuter Roads

Generating Random Points in ArcGIS

The selection of random points is done in a GIS software ArcGIS. To ensure the selection of random points on built-up areas, Openstreetmap is used as the basemap. The map document is prepared in ArcMap. Layers are then added like the shapefiles from OSM and the sampling locations or AOIs. Open ArcToolbox and open the Data Management Tools > Feature Class > Create random points tool. The interface to create random points is shown in Figure 10 below.

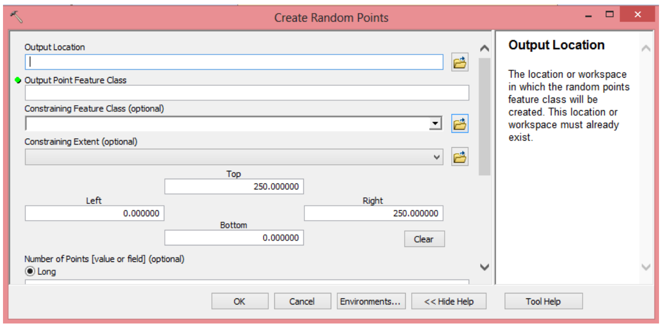

Figure 10. Create Random Points Tool

To identify the random points, open the attribute table and go to Field Calculator. The map and generated random samples are shown in Figure 11 below.

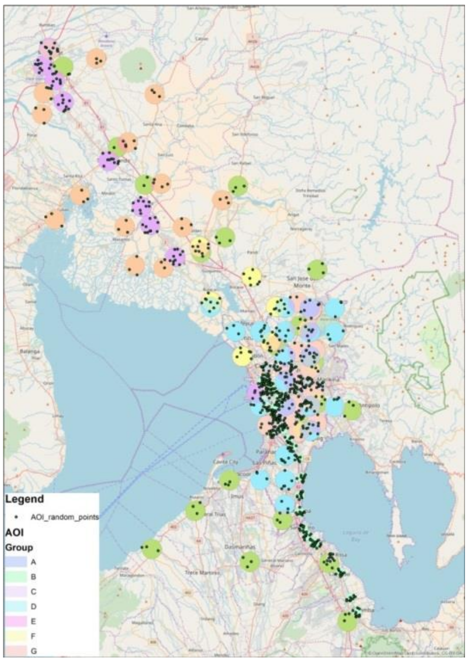

Figure 11. Map of the Subject Area and the Random Sample Points

Each random point generated is given a unique sample "Point ID" in the database. An example is given in Figure 12 below showing sample point D7-1 with its unique sample ID and defined geographic coordinates.

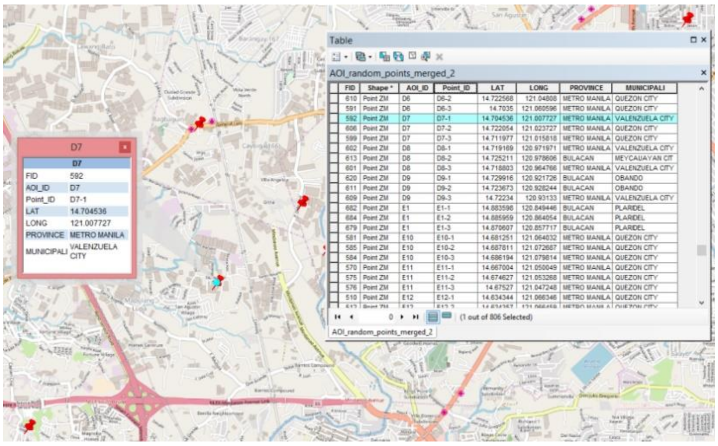

Figure 12. Sample "Point ID"

The complete list of all 806 samples is in a master list showing the Sample Point ID, AOI ID, Latitude coordinate, Longitude coordinate, Province and the city or municipality where it is located. The first 15 samples in the Master List are shown in Table 2 below.

Table 2. First 15 Sample Random Points Showing Coordinates and Political Units in the Master List

No.	Sample Point ID	AOI ID	Latitude	Longitude	Province	City / Municipality
1	G1-2	G1	14.19485151	121.1424895	LAGUNA	CALAMBA CITY
2	G1-1	G1	14.19691744	121.1274406	LAGUNA	CALAMBA CITY
3	G1-3	G1	14.19793021	121.1545851	LAGUNA	CALAMBA CITY
4	B26-2	B26	14.20446268	121.1537701	LAGUNA	CALAMBA CITY
5	B26-3	B26	14.20560138	121.1563125	LAGUNA	CALAMBA CITY
6	B26-8	B26	14.20624564	121.1617577	LAGUNA	CALAMBA CITY
7	B26-4	B26	14.20692509	121.1558679	LAGUNA	CALAMBA CITY
8	B26-7	B26	14.20731115	121.1603857	LAGUNA	CALAMBA CITY
9	B26-5	B26	14.20789405	121.1586039	LAGUNA	CALAMBA CITY
10	B26-6	B26	14.20799064	121.1593476	LAGUNA	CALAMBA CITY
11	B26-9	B26	14.20804048	121.1611642	LAGUNA	CALAMBA CITY
12	B26-1	B26	14.2098496	121.1543556	LAGUNA	CALAMBA CITY
13	B26-10	B26	14.21092282	121.1625727	LAGUNA	CALAMBA CITY
14	B25-7	B25	14.22936698	121.1492817	LAGUNA	CALAMBA CITY
15	B25-8	B25	14.23140721	121.1482686	LAGUNA	CALAMBA CITY

5.7. Data Gathering of Valuation Parameters

This is clearly the objective of this research engagement, the gathering and tabulation of physical and property market data as factors of land value. A team composed of mainly junior valuers was assembled for the job. Six members or half of the team worked full time and the other half worked on their available convenient time or part-time basis. Based on this time availability, all 806 sample points were distributed among the field valuers with the full-time field persons assigned more sample points than the part-time personnel.

There are originally 42 parameters defined. The 42 listed parameters to be procured are shown in Table 3 below.

Table 3. List of Parameters to be Collected per Site

No.	Parameters
1	Sample No.
2	Latitude Coordinate
3	Longitude Coordinate
4	City or Municipality where the Sample is Located
5	Barangay where the Sample is Located
6	Name of Street where the Sample is Located
7	Other address info of the sample point such as block number or lot number of barrio or subdivision name
8	Elevation of Sample Point Above Mean Sea Level
9	Region of Sample like Inside or Outside Metro Manila
10	Category – Near RP or ORP
11	Nearest Railway from Sample Point
12	Land Use Zoning of Sample Point
13	Land Price
14	Year of Available Land Price Data
15	Distance of Sample Point to the Nearest Station
16	Distance of Nearest Station to the Central Station
17	Time Required to Travel by Train from the Nearest Station to Central Station
18	Time Required to Travel by General Transportation Mode from the Nearest Station to Central Station
19	Floor Area Ratio (FAR) at Time s (before Railway was constructed)
20	Water Supply Coverage/Accessibility/Service Level (High/Medium/Low)
21	Telephone Coverage/Accessibility/Service Level (High/Medium/Low)
22	Sewage Coverage/Accessibility/Service Level (High/Medium/Low)
23	Power Coverage/Accessibility/Service Level (High/Medium/Low)
24	Garbage Coverage/Accessibility/Service Level (High/Medium/Low)
25	Cable TV Coverage/Accessibility/Service Level (High/Medium/Low)
26	Internet Coverage/Accessibility/Service Level (High/Medium/Low)
27	Accessibility to Public Market (distance in kilometers)
28	Accessibility to Shopping Malls (distance in kilometers)
29	Accessibility to Hospitals and Clinics (distance in kilometers)
30	Accessibility to Schools (distance in kilometers)
31	Accessibility to Police Stations (distance in kilometers)
32	Accessibility to Government Centers (distance in kilometers)
33	Neighborhood Classification (Formal/Informal)
34	Distance of Informal Settler Families (Adjacent/Near/Far)
35	Number of Informal Settler Families (Many/Few)
36	Crime Rate (average rate per 100,000 people)
37	Accident Rate (average rate per 100,000 people)
38	Width of Adjacent Road (Measured or estimated in meters)
39	Road Condition (Excellent/Good/Damaged)
40	Road Easement (Excellent/Good/Damaged)
41	Corner Effect (Yes/No)
42	Risk to Flood/Other Hazards (Yes/No)

With so many parameters to gather and the potential variation of all parameters on the ground, it is very easy for the field valuers to be confused. There is a real need to standardize the collection of information on the ground and the way field persons record the data. Long discussions among the field valuers and the researchers expounded all the 42 parameters and resulted to the creation of guidelines for field data gathering. Clarifications and explanations of each parameter are given in a separate document. A set of guidelines is simplified and issued to the field valuers to facilitate and standardize the gathering of field data. Table 4 is shown below.

Table 4. Guidelines for Field Valuers

Guidelines for Field Valuers

No.	PARAMETER	GUIDE
1	SAMPLE NO.	Sample number from 1 to 806 (we changed this to sample ID number)
2	LATITUDE	In decimal degrees.
3	LONGITUDE	In decimal degrees.
4	ELEVATION	In meters.
5	CITY / MUNICIPALITY	City or Municipality where the Sample is Located
6	BARANGAY	Barangay where the Sample is Located
7	STREET NAME	Name of Street where the Sample is Located
8	ADDRESS	Type the complete address
9	REGION	Write IMM if Inside Metro Manila or OMM if Outside Metro Manila
10	CATEGORY	Write NRP if near Railway Project or ORP if Outside Railway Project
11	NEAREST RAILWAY	Name of Nearest Railway Station from Sample Point
12	LAND USE	Residential / Commercial
13	LAND PRICE	Type the numerical value in Php /sqm
14	LAND PRICE YEAR	As of quotation date (year).
15	DIST_1	Distance of Sample Point to the Nearest Station (Straight-Line Distance in kilometers)
16	DIST_2	Distance of Nearest Station to the Central Station (Straight-Line Distance in kilometers)
17	TIME_1	Average Time (Peak and Off-Peak) Required to Travel by Train from the Nearest Station to Central Station (estimated time in minutes)
18	TIME_2	Average Time (Peak and Off-Peak) Required to Travel by General Transportation Mode from the Nearest Station to Central Station (estimated time in minutes)
19	FAR	Floor Area Ratio (FAR) at Time s (year before Railway was constructed).
20	WATER SUPPLY	High is continuous supply of water from faucet with pressure that can push an extended hand. Medium is continuous (without interruptions) supply of water with weak pressure barely noticeable by the hand. Low is intermittent (scheduled) supply of water with weak pressure (trickle or droplets).
21	TELEPHONE	High is strong signal with full bar indicator producing continuous clear and crisp voice volume accessible anytime. Medium is below full signal bar indicator with interference producing interrupted voice volume. Low is choppy signal and unreliable service.
22	SEWAGE	High is connection to a system of sewer pipes (sewers) with a sewage treatment plant, Medium is connection to septic tanks. Low is connection to damaged septic tanks or simply absence of septic tank.
23	POWER	High is no power interruption or brownouts in a week. Medium is few (up to 3) interruptions or brownouts in a week. Low is many brownouts in a week or no electricity provider or localized (home solar panels).
24	GARBAGE	High is regular (4 or more a week) garbage collection and no visible trash in the streets. Medium is 2 to 3 times garbage collection in a weak resulting to some piles of trash in the streets. Low is once or irregular garbage collection resulting to piles and scattered garbage in the area.
25	CABLE TV	High is the presence of multiple cable providers and many channel options. Medium is one cable provider or monopoly of service. Low is the absence of cable provider or personal Satellite Dish type of service.

Before the deployment of the individual field valuers, land related government agencies and local government units (LGUs) were visited to check for any available data among the 42 listed parameters. In particular the Land Management Bureau (LMB), assessors' office, planning office and even the police precincts were checked for cadastral maps, tax maps, comprehensive land use plan (CLUP) and crime rates in order to save time, efforts and resources by the field survey team.

The field valuers need to accomplish first the Field Plan and submit to the researcher before any fieldwork is conducted. The field plan simply list the targeted sample points to be surveyed for that particular day. The individual field persons also need to sign on a ledger before engagement in the field. This allows the easy forecasting of accomplished sample points and the monitoring of field personnel in the field. Every field valuer is equipped with an android phone with a GPS App preferably the GPS Essentials. GPS Essentials is one of the most complete GPS tool on Android Market where you can navigate, manage waypoints, tracks, routes, build your own dashboard from 45 widgets. This App allows the field valuers to navigate to their assigned points looking for the coordinates listed in the Master List in Table 2 above. The high resolution camera is very important for documentation and review of significant parameters.

6. RESULTS AND DISCUSSIONS

6.1 Data Integration

After almost 60 working days of doing fieldworks for all the targeted 806 samples on the ground by the twelve field valuers, there are now 817 samples encoded and completed. Each sample point accomplished is encoded and subjected to quality check before adding it to a master database using Excel file format. All the sample lot locations are plotted in GIS using their original coordinates or, in case of alteration of sample location, using the coordinates gathered from the field observations. A GIS map is created to integrate the coordinate location of samples and the land value parameters. The produce maps are basically good in showing and evaluating spatial relationships.

6.2 Challenges Encountered

There are few, among the 42 parameters, that are proven to be more difficult to determine than the others. Land prices and Floor Area Ratio (FAR) particularly at time S (year before the station was established) are not immediately available and initiated delays in the completion of the study. Other challenges met in executing this study is the existence of inaccessible sample points, the presence of sample points that have no comparable properties, and inaccurate land price estimates from the junior field valuers. Senior appraisers and planners were hired to help in determining appropriate land values and FAR. Veteran appraisers went through the submitted values and made review valuation works. Even friends and acquaintances helped in solving access issues.

6.3 Additional Parameters Collected

In the course of the study other parameters not included in the 42 have been added to make the data more useful for analysis in the HPM. The FAR at time S (the year the railway station was established) was originally the only FAR to be determined. But the present FAR was thought to give a good comparison on the effect of TODs in land development and optimization. Another parameter added is land prices at time S to give a good comparison on the effect of TODs in land values. Images or pictures of the property is not initially part of the data to be collected but foreseen as good for internal use. These additions, however, increased the required number of parameters to be collected and, consequently, increased also the time required and expenses to gather data. These additions will provide more dimension in the analysis of this economic experiment.

The output is primarily presented in a Microsoft Excel spreadsheet containing the master database of the 817 samples and GIS files and maps. Figure 13 below shows the Google Map interface and the location of sample points. The mapped data can be reviewed using this shared link:
https://drive.google.com/open?id=1rWgw6KahbXizUWMFjNzw4gZgNEKQ3SiY&usp=sharing

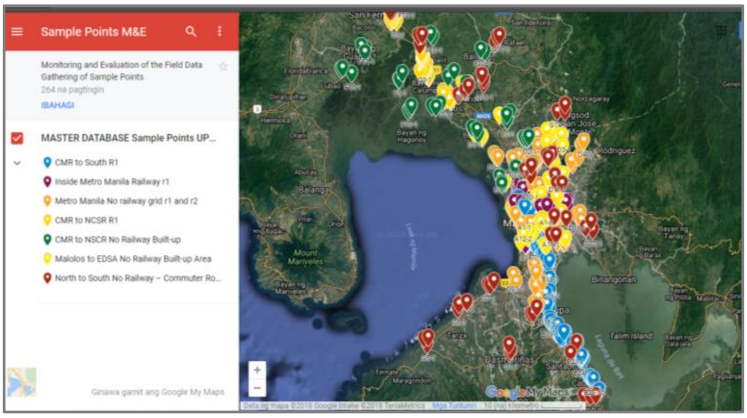

Figure 13. Google Map of the Sample Point Locations

The seven sampling regions are displayed on the left side of the image and we can click each to display all sample points belonging to that particular region. You can scroll down to review the different sample points and click on a particular point to view the parameters encoded on each sample point. Figure 14 below shows a particular sample point with the displayed details on the left side of the image. Scrolling down will show all 45 parameters of land values.

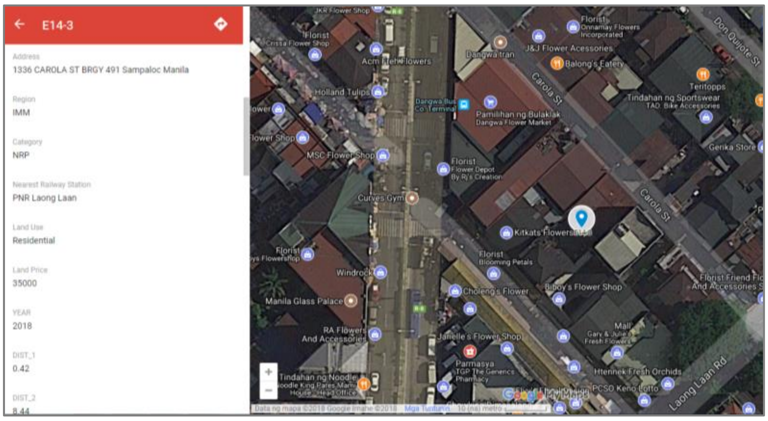

Figure 24. Google Map of a Sample Point

Figure 15 below also shows the ArcGIS online interface.

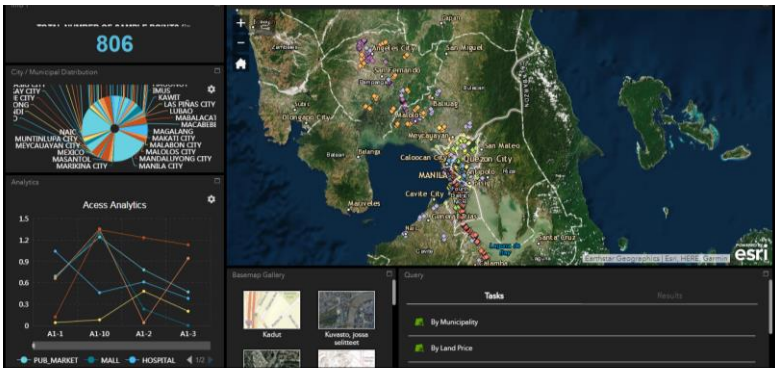

Figure 35. ArcGIS Online Interface

7. CONCLUSION

The gathering and tabulation of physical and economic property market data for HPM is both very laborious and challenging, but the application of geo-spatial technologies facilitates the management of intensive field data gathering. It involves a certain number of highly qualified technical manpower of field valuers and geodetic engineers with GIS expertise to accomplish this huge task which consequently involved a relatively great cost. There are also many challenges addressed in executing this study.

The hedonic price model is a very useful scientific tool which requires not only technical skills but also experiences and judgements. This paper is a preliminary study to gather necessary data and establish a Hedonic Price Model that aims to create an accurate predictive model of land values in transit-oriented development areas. These models are developed by using the coefficients generated from a regression analysis which will be the objective of the succeeding research.

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BIOGRAPHICAL NOTES

The main author, Florence Galeon, is a licensed geodetic engineer and presently teaching at the University of the Philippines. He received his Bachelor of Science in Geodetic Engineering from the University of the Philippines (UP) in Diliman, Quezon City, Philippines in 1989 and Master of Engineering Science in Remote Sensing from the University of New South Wales (UNSW) in Sydney, Australia in 1994. In 2007, he became Chair of the UP Department of Geodetic Engineering and Director of the Training Center for Applied Geodesy and Photogrammery (TCAGP). Engr. Galeon's research interest is in the field of geomatics and spatial technology applications. He also work as a consultant of Aviso Valuation & Advisory, a valuation and advisory firm assisting top corporations in the fields of Real estate, Development Finance, Hospitality, Infrastructure, Power and Manufacturing, among others. He has done several Japan International Cooperation Agency (JICA) funded projects in property market studies as a Project Leader. The most current is a research survey to gather relevant market and legal information required in preparing the conceptual plans of a Transit-oriented Development (TOD) and detailed design of intermodal facilities for the Metro Manila Subway Project (MMSP).

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