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ADDING SPATIAL LOCATION ATTRIBUTES TO ENHANCE HOUSING TRANSACTION DATA

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Abstract:

Queensland Valuation and Sales System is the data base used by the Department of Natural Resources and Mines for the storage, update and retrieval of valuation and associated property and sales information. The system contains datasets that include property details, sales dates and sale prices. The records contain land area for house transactions but not for unit transactions. Furthermore, the system stores no information as to how the houses sold, by auction or private treaty, and no further housing attribute information is available from the system.

Home buyers consider location as a major factor when deciding their preference to purchase in a specific area. This paper describes a study for adding location attributes to housing transaction records to enable spatial analysis of the housing transaction records. The study will utilise two major datasets of spatial attributes. The first set is the property location attributes such as orientation, height, aspect, frontage and street hierarchy. The second set is the property linkage defined as the proximity of a particular location and ease of access to major shopping centres, transportation nodes, schools and the Central Business District.

This paper reports the process of creating a dataset of the spatial location for each housing transaction record and applying this attribute to the transaction record thereby improving the useability of this latter data for graphical display, querying and spatial analysis. This enhanced dataset will be shown to improve the quality of housing transaction data so as to facilitate housing

transaction modelling and analysis. This paper will report also on the creation of the property linkage dataset and describe further study that utilises this second dataset to facilitate transactional analysis and its impact on the effectiveness of auction in housing transaction.

Keywords: spatial science information, housing transaction data, location attributes, linkage, auction

1. Introduction

Susilawati and Lin (2006) stated that high real estate appreciation expectation over the decade had a direct influence on the choice of housing transaction method. In addition, there is an increase of interest in auction as an alternative to private negotiation for marketing real estate by buyers. However, the data available for details transaction is very limited and does not support for building a good model for investigating variables which determine the house transaction method.

The main source of information for property and sales transaction information in Queensland is compiled by the Department of Natural Resources and Water (NRW). Queensland Valuation and Sales System (QVAS) is the data base for the storage, update and retrieval of valuation and associated property and sales information such as property details, sales dates and sale prices. It only recorded land area for house transaction as internal property characteristics. Furthermore, the system stores no information as to how the houses sold, by auction or private treaty, and no further housing attribute information is available from the system.

Home buyers consider location as a major factor when deciding their preference to purchase in a specific area. Lin and Susilawati (2006) reported Brisbane's auction and private treaty sales transaction data analysis using property attributes, location attributes, time and price attributes. The location attributes were limited to suburbs and postcode data as well as road names.

This paper describes a study for adding location attributes to housing transaction records to enable spatial analysis of the housing transaction records. The study will utilise two major datasets of spatial attributes. The first set is the property location attributes such as orientation, height, aspect, frontage and street hierarchy. The second set is the property linkage defined as the proximity of a particular location and ease of access to major shopping centres, transportation nodes, schools and the Central Business District.

This paper reports the process of creating a dataset of the spatial location for each housing transaction record and applying this attribute to the transaction record thereby improving the useability of this latter data for graphical display, querying and spatial analysis. The final section of this paper describes in brief the modeling potential on integration of geographical characteristics with QVAS records.

2. Property information and sales database

Queensland Valuation and Sales System is the data base used by the Department of Natural Resources and Water (NRW) for the storage, update and retrieval of valuation and associated property and sales information. The system contains datasets that include property details, sales dates and sale prices. The records contain land area for house transactions but not for unit transactions. Furthermore, the system stores no information as to how the houses sold, by auction or private treaty, and no further housing attribute information is available from the system.

NRW has final and accurate transaction data which registered in the title. For the new development, the lot has finally 'created' when it has been registered by NRW after council approval on subdivision of allotments and plans are sealed (Josipovic and Kapetanic, 2006). The transaction changes are also recorded in the Queensland Digital Cadastral Database (DCDB).

Rapole (2006) stated the history of the DCDB which was developed by manually digitising the best available cadastral maps. The digital capture was completed at the agreed standard in 1992. It was a seamless database of the cadastral network compiled to a range of accuracy ratings (between 0.1 metre to 250 metres) which derived as a factor of the map scale and the precision of the digitising. Data in the DCDB consists of spatial and attribute components. The spatial component is used to depict the position and boundaries of parcels and the attribute information contains details about each parcel. Rapole (2006) discussed the upgrade projects in response to the increasing need of the accuracy of the spatial component.

Since the commencement of the Body Corporate and Community Management Act 1997 in July 1997, all new lots created are described as standard plan (SP). Josipovic and Kapetanic, (2006) stated that prior to the Act, lots were created under three categories, 'RP' (detached housing), 'GTP' (townhouses) and 'BUP' (units and apartments).

For the existing lot and plan, information for every land sales transaction where title ownership is transferred is collected by NRW through the Queensland Valuations and Sales System (QVAS). Due to the time between contract date and settlement date, it can take some time before a transaction is included in the NRW databases.

Although the technique which is explained in the next section to combine spatial location attributes to enhance housing transaction data can be used for general hedonic price modeling, this paper is following up comparative study on Brisbane's auction and search market transaction data. The following paragraphs discussed in brief auction research, preliminary modeling and its limitation to provide background for this study.

Auction research tends to focus on two main thrusts: evaluating the probability of a positive auction outcome and comparing revenues from different auction formats to revenues from private negotiations (Lin and Susilawati, 2006: 3). Auctioned properties should not sell at a premium in comparison to private treaty sales suggested by a number of studies in the USA. Most auction transactions are conducted as a result of mortgage foreclosure, divorce settlement and estate settlement (Mayer, 1998; Marcus, 2001 and Quan, 2002) therefore the result is discounted price compare to the market price. Mayer (1994) also argued that private sellers can wait longer and are able to receive a better price from suitable buyers.

Similar to USA, some Asian auctions are conducted as liquidation process which lead to ineffective auction market and discounted results. Taiwan has foreclosure property auctions which used price-sealed bid leading to discounted results (Lin, Tsai and Chang, 1997; Lin 2005; Lin and Huang, 2005). Ong, Lusht and Mak (2005) suggested that Singapore used the English ascending bid auction for the foreclosure property auctions and also suggested discounted auction results.

In Australia, an English-Open Called bid system is conducted in auction. Property sold for a premium at auction compare to private treaty transaction (Lush, 1996 and Newell et al, 1993). Lin and Susilawati (2006) reported preliminary results of two postcodes, one at inner West and the other one at outer East, as part of their study to explore the efficiency in the Brisbane housing action market (2003 to 2005).

Lin and Susilawati (2006) attempted to control the model's quality through adding a number of variables into the hedonic equation. The Brisbane's auction and private treaty sales transaction data were analysed by their property attributes, location attributes, time and price attributes. This study suggested that data obtained from the QVAS and Australia Property Monitors (2005) have limited internal property and location attributes built in the data. The authors acknowledged that internal property attributes such as number of bedrooms and bathrooms are very essential as value determination factors. However, the time and cost to add those internal property attributes are unjustifiable and therefore investigation in this arena will not be conducted further.

Susilawati and Lin (2006) combined the QVAS data with data compiled by Australian Property Monitor which is records the property transaction in more details. It recorded not just the final auction transaction results, but also the sales processes. The type of auction, tender and private treaty transaction are recorded as the abbreviation below (Australian Property Monitor, 2005):

- AUSD auction sold
- AUSP auction sold prior
- AUPN auction sold prior–price undisclosed
- AUSN auction sold-price undisclosed
- AUSA sold after auction
- AUSS sold after auction-price undisclosed
- AUHB auction passed in, highest bid
- AUVB auction vendor bid
- AUPI auction passed in - price undisclosed
- AUNA auction-no information disclosed
- AUNB auction no bid
- AUFS auction for sale
- AUPP auction postponed
- AUWD auction withdrawn
- PTSD private treaty sold
- PTLA private treaty sold (1)
- PTSW private treaty sold (2)
- PTFS private treaty for sale
- PTAW private treaty address warning
- TNSD tender sold
- TNFS tender for sale

In the preliminary study, it was found that combining the two datasets above will improve the quality of data. However, even with the combination of the two datasets both property and location attributes are very limited.

The data were classified based on their location attributes such as suburbs and postcode (Lin and Susilawati, 2006: 15). This study also analysed the road names into three groups. The first group is avenue, road and street. The second group is circuit, close and crescent. The third group is the balance and includes drive, esplanade, parade, place, terrace and way. The road classification has very minimal meaning since they did not reflect the road hierarchy or proximity to other amenities which may influence buyers' price expectations.

As mentioned in the previous section, home buyers consider location as a major factor when deciding their preference to purchase in a specific area. The immobility characteristic of land has a great influence in pricing determination process. Some of the land attributes may be created using spatial data such as property location attributes and property linkage. The next section explains the process of geocoding housing transaction data.

3. Process of adding spatial data on house sales transaction

The records of the QVAS dataset obtained for this study contain locational attributes in the form of street number and address for house transactions and unit number, street number and address for unit transactions. Each record contains also lot number and plan number, the legal description of the property, the subject of the transaction.

The GIS based spatial analysis proposed for the later stages of this study requires the geocoding of each QVAS record with a spatial coordinate to graphically display the location of an individual transaction and to facilitate the spatial analysis of all transactions. The process of manually geocoding each QVAS record with a spatial coordinate matching the locational attribute was considered to be labor-intensive, time-consuming and excessively beyond the budget of the study. A less expensive process was investigated.

The Property Information 2006 CD
A standard product of the Queensland Department of Natural Resources and Water (NRW) was identified as fit-for-purpose for the study. This product - The Property Information 2006 CD – comprises three related types of data supplied as a series of individual datasets:

1. The **Property Location data** contains the street address (street number, street name, locality name, local government name) and a property identifier (lot number and plan number.) The Property Location data is supplied in ASCII pipe delimited format
2. The **Property Boundaries data** contains a spatial cadastral boundaries layer with lot/plan identifiers (lot number and plan number). The data is designed to meet the needs of individuals and organisations that require a graphical representation of cadastral boundaries. This dataset is offered as a series of individual local government data files.
3. The **Administrative Boundary data** contains locality boundary and local government boundary information. Coverage of the locality boundaries reflects those current as at February 2006. The Local Government area of Brisbane shows a composite of both current and proposed locality boundaries. The locality boundaries in the local government of Brisbane area approximate the boundaries of the similarly named postcode areas.

The Property Boundary and Administrative datasets are available in both MapInfo and ESRI shape file formats – industry standard proprietary GIS packages. The datum for the datasets is GDA94 datum (coordinates in Latitude and Longitude). This datum is not applicable for the Property Location data. Metadata is supplied with the product.

Geocoding QVAS Records with Spatial Coordinates

The process developed to add a spatial coordinate to each QVAS record consists of these steps:
1. Create table of Lots
2. Create table of Lot on Plan
3. Create table of Centroids
4. Add Lot Centroid to QVAS dataset
5. Import QVAS dataset (Centroid appended) into MapInfo
6. Create Proximity Layer

Step 1. Create table of Lots for a Postcode Area
The Lots – the spatial cadastral boundaries layer (see Figure 1)– contained within each postcode area were extracted from the Property Boundaries dataset as follows:

- The Property Boundaries dataset for the Brisbane Local Government Area was imported into MapInfo.
- The Administrative Boundary dataset was imported into MapInfo
- A SQL query was run to create a new table of lots within the postcode area using the administrative boundary layer for the postcode area to select those lots within the postcode area from all lots within the Brisbane Local Government Area

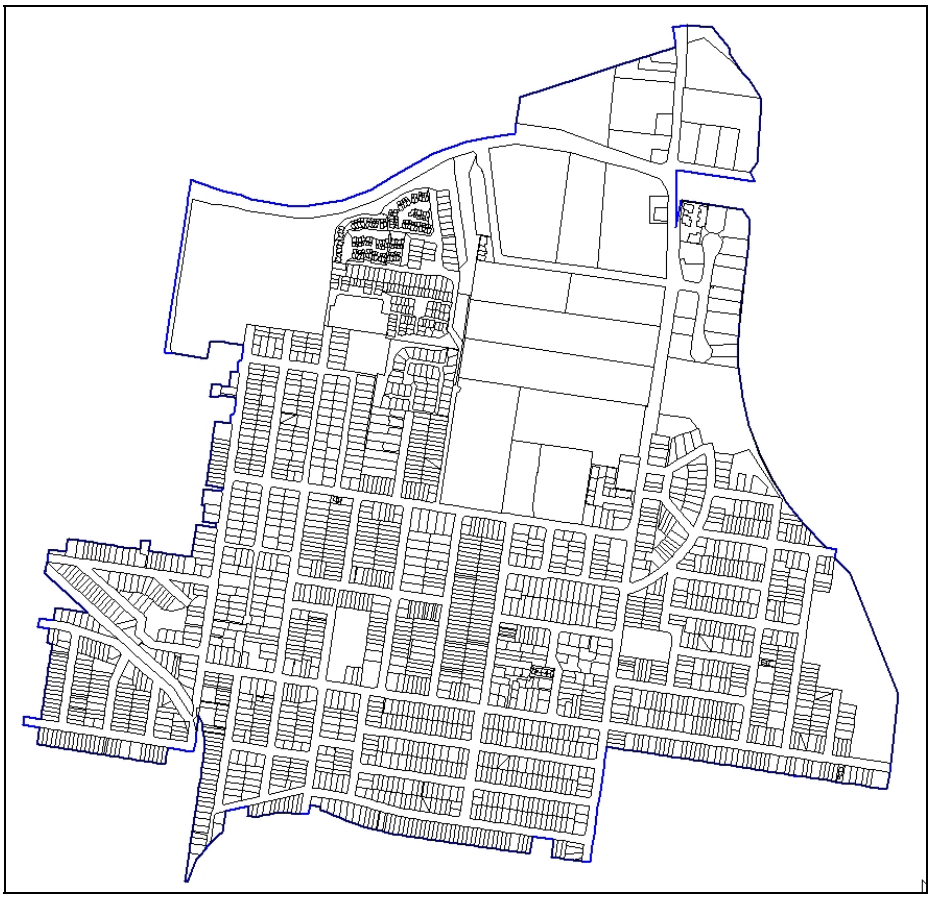

Figure 1: Spatial Cadastral Boundaries Layer – Hendra Locality

The study then took advantage of the MapInfo export facility to create two MapInfo format files - .MIF and .MID format – from each new table of lots to facilitate later processes (see Table 1). The former file contains information including a series of coordinates for each corner for each lot (Region) and the coordinates of the centre, the centroid, for each lot. The centroid is labeled with the title “Center” in the file. The latter file contains the Lot on Plan description for each lot in a comma delimited, text file. The polygons are in the same sequence in the .MIF format file as the Lot on Plan description is in the .MID file.

Table 1: MapInfo Export Files Format

MIF format	MID format
Region 1 5 153.0355318 -27.46247661 153.035532 -27.462482 153.0355323 -27.46249592 153.035532 -27.46248242 153.0355318 -27.46247661 Pen (1,2,0) Brush (1,0,16777215) **Center** 153.0355321 -27.46248626	"4","RP52849"
	"2","RP64992"
	"17","B31671"
	"22","RP8531"
	"1","RP42010"
	"5","RP42010"
	"1","SL805627"

Step 2. Create table of Lot on Plan for a Postcode Area

The .MID format file was then imported into MSAccess to create a new table containing the lot number and the corresponding plan number. A unique identifier was added to each record.

Table 2: MSAccess Lot on Plan Table Format

ID	Lot	Plan
1	4	RP52849
2	2	RP64992
3	17	B31671
4	22	RP8531
5	1	RP42010

Step 3. Create table of Centroids for all lots in a Postcode Area

The .MIF format file was then imported into MSAccess to create a single column table. An SQL query was run to identify the records containing the "Center" values and a further SQL run to create a new table containing just the Center for each lot in two columns – latitude and longitude (see Table 3). The lot Centers are in the same sequence as the lot on plan description in the Lot on Plan table.

Table 3: MSAccess Lot Center Table Format

ID	Longitude	Latitude
1	153.0355321	-27.46248626
2	153.0353177	-27.46186599
3	153.0330602	-27.46178113
4	153.0330232	-27.4614307
5	153.0326831	-27.46224082

A SQL query was then run to merge the Lot on Plan and the Lot Center tables. The resultant table, Lot Centroid table is shown at Table 4.

Table 4: MSAccess Lot Centroid Table Format

Lot	Plan	Longitude	Latitude
4	RP52849	153.0355321	-27.46248626
2	RP64992	153.0353177	-27.46186599
17	B31671	153.0330602	-27.46178113
	BUP101864	153.0346018	-27.46340062
	BUP103686	153.0325735	-27.46286008

The last two records do not show a Lot number as the Building Unit Plans are referred to by Unit numbers that are not recorded in the Property Boundaries dataset but are in the QVAS dataset.

Step 4. Add Lot Centroid to QVAS dataset

This step appends the Centroid information to the QVAS dataset. The process involves importing the QVAS dataset into MSAccess and then running an SQL query to locate the RPD description of a QVAS transaction in the Lot Centroid table and appending the latitude and longitude of the centroid to the QVAS record. However, the records in the QVAS dataset contain locational attributes in a format not conducive to such a query. In particular, the 'RPD' column contains Lot Number, Plan Number and Parish name – all in the one column. (Table 5) This required the reformatting of the QVAS dataset records to allow the SQL query to operate. (Table 6)

Table 5: QVAS Dataset Format (Part)

Street Number	Street Name	Suburb	Post Code	RPD
198	ADELAIDE ST	BRISBANE CITY	4000	L28 SP129278:PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	L28 SP129278:PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	L9 SP129278:PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	L6 SP129278:PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	L34 SP129278:PAR NORTH BRISBANE

Table 6: QVAS Dataset Re-format (Part)

Street Number	Street Name	Suburb	Post Code	Lot	Plan	Parish
198	ADELAIDE ST	BRISBANE CITY	4000	28	SP129278	PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	28	SP129278	PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	9	SP129278	PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	6	SP129278	PAR NORTH BRISBANE
198	ADELAIDE ST	BRISBANE CITY	4000	34	SP129278	PAR NORTH BRISBANE

The SQL query was then run in MSAccess to append the Centroid longitude and latitude values to the QVAS transaction, the Lot and Plan value of which matched the Lot and Plan value in the Lot Centroid table.

Step 5. Import QVAS dataset (Centroid appended) into MapInfo

The table created in Step 4 was then imported into MapInfo. Point symbols were created using the MapInfo 'Create Points' facility for each QVAS transaction record at a spatial location based on the latitude and longitude appended to the transaction record. The centroid enables the spatial location to be plotted within the GIS graphic interface and is a prerequisite for spatial analysis operations. Any particular transaction can be interrogated by clicking on its symbol on the graphic interface and displaying the complete QVAS transaction in the GIS environment.

Figure 2 displays a query of a property in the Newfarm locality for which a transaction record appears in the QVAS dataset. The lots in the QVAS dataset have been assigned the symbol '8' to indicate only those lots for which there is a transaction record in QVAS.

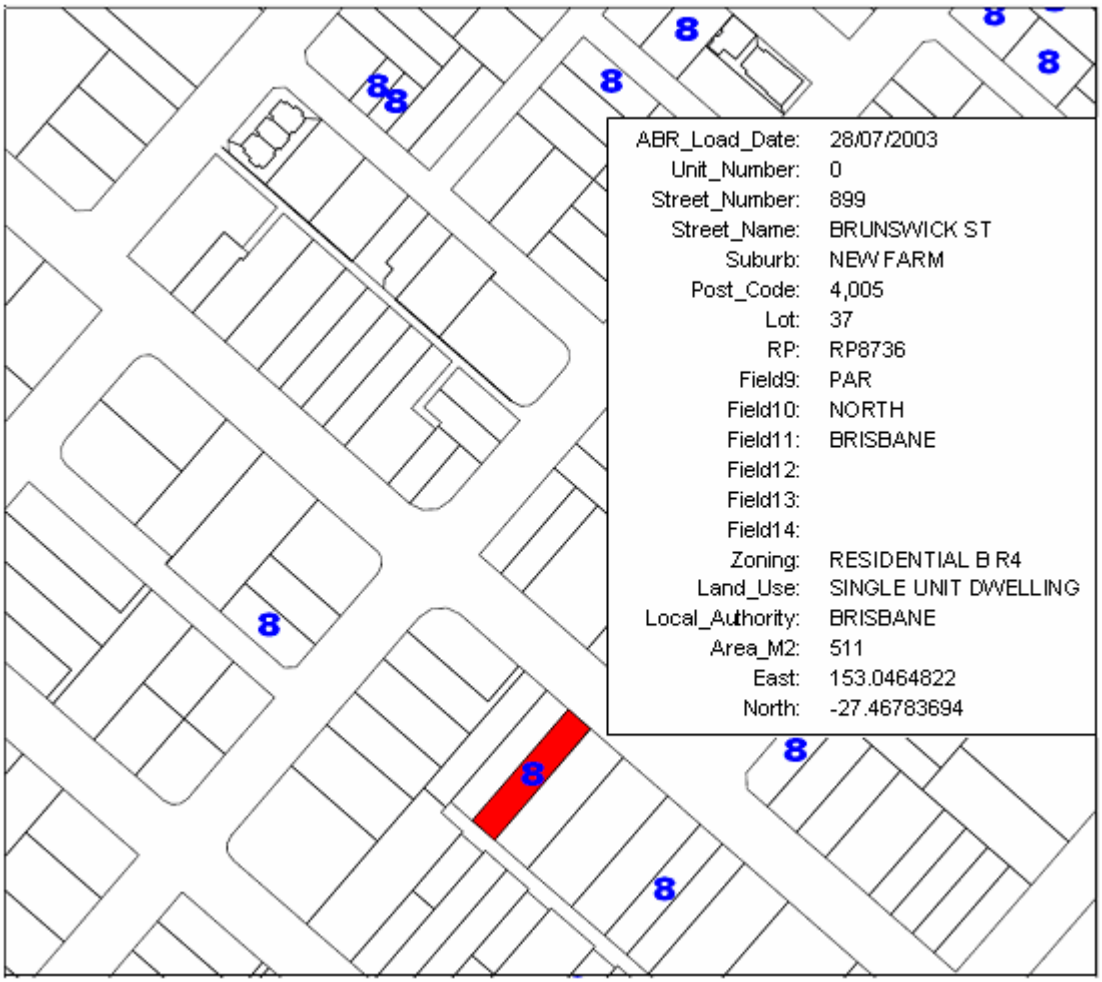

Figure 2: QVAS Query – Newfarm Locality

Step 6. Create Proximity Layer

This stage creates the layers needed for the spatial analysis operations proposed for the study. These layers contain the spatial location and attributes of infrastructure and include vector and raster imagery related to:

- Road and street hierarchy network
- Public transport network
- Schools and other educational institutions
- Open space and parkland locations
- Regional commercial centres
- Census datasets
- Industrial centres
- Health and related facilities

These layers were compiled by utilizing a variety of supplementary spatial datasets, including aerial photography, street directories and other standard spatial products published by NRW.

4. Modeling potential on integration of geographical characteristics

This method will be used to add additional property and location attributes of each Brisbane's auction and private treaty sales transaction data. Then those attributes will be used to control the model's quality through adding a number of variables into the hedonic equation. The improved model will be able to facilitate transactional analysis and conducting further analysis on its impact on the effectiveness of auction in housing transaction.

The additional attributes will be determined by utilizing spatial analysis facilities within a GIS environment. By way of example, the determination of the distance of the route between an individual lot and important amenities such as CBD, regional commercial centres, public transport network and schools will be integrated with the lot's QVAS record. The analysis of the road hierarchy of the route also will be analysed and attributed to the transaction record. Similar spatial analysis facilities will be utilized to integrate location specific attributes such as orientation, elevation, aspect, frontage, lines of sight and street hierarchy.

The integration of location or geographical attributes on housing transaction data allows researchers to conduct experimental study on the value determination factors. Further hedonic modeling will be conducted on the basis of housing transaction method, limited property characteristics, price and time, and locational characteristics.

Some potential applications after integration of data are listed below:

- Identifying external factors determine housing market value
- Comparison factors for different location or geographical categories
- Comparative study on the effectiveness of housing transaction method
- The influence of geographical characteristics on different period of time
- The impact on road network planning and proximity to amenities on market value determination

5. Conclusion

Location, location and location is very important on the home buyer's decision. The available sales transaction data collected by NRW contains very limited property and locational attributes. Additional spatial data, collected at minimal cost, is seen to improve the quality and useability of the transaction dataset.

This paper describes the process to add location attributes to housing transaction records to enable spatial analysis of the housing transaction records. The initial process is geocoding of each transaction record to facilitate the integration of QVAS data with other spatial data layers for spatial analysis. The transaction data can then be displayed, analyed and qeried in a graphical interface. Further querying will be able to determine proximity (distance) to important amenities such as CBD, regional commercial centres, public transport network and schools.

Finally, integration of location or geographical attributes on housing transaction data allows researchers to conduct experimental study on the value determination factors. Further house modeling analyses will be conducted on the basis of housing transaction method, limited property characteristics, price and time, and locational characteristics.

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Authors want to acknowledge Prof. Dr. Vickey C. C. Lin, Department of Land Economics, National Cheng Chi University, Taipei, Taiwan who suggested investigating the possibility of combining geographical factors and road classification data. The outcome of this study will be used for further collaborative research of QUT-National Cheng Chi University.

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