Use of GIS to Establish and Update CAMA Neighborhoods in Northern Ireland

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Introduction

The ultimate goal of any Computer Assisted Mass Appraisal (CAMA) system or project is to achieve a jurisdiction-wide set of equitable values. This is achieved most often via the full market appraisal of all properties. Appraisal professionals are well aware that locational effects must be taken into account in CAMA systems in order that accurate full market valuations are achieved. In our research we consider the definition of location as it relates to property appraisal and then proceed to describe a practical approach to incorporating locational effects into a CAMA system.

Treatment of Location

Location could be defined as an economic characteristic of real estate composed of immobility, constant change, and elements of special distribution. Location is an economic concept even though a location can be described in physical and legal terms. Locational analysis involves the thorough study of use, environment, time and anticipated patterns of change.

Residential markets are complex phenomena, consisting of an extremely heterogeneous stock as well as diverse producers and consumers of widely varying requirements and financial capabilities.

The idea of thinking of residential markets as a unitary market is in many ways too simplistic, when one considers the discontinuities across locations and dwellings. The task of dividing a large market into submarkets raises several theoretical and methodological questions (Bourassa et al, 1997.) Typically a submarket can be defined as a set of dwellings that are reasonably close substitutes for each other, but relatively poor substitutes dwellings in other submarkets (Grigsby et al, 1987.) This definition leads to difficult questions about how to identify close substitutes and levels of aggregation or indeed disaggregation. In practice these questions are often answered in an ad hoc manner, using pre-defined or otherwise convenient geographical boundaries as the basis for determining and defining submarkets. In some other cases statistical techniques can be applied to determine whether a priori submarkets are in fact distinct. In this research we seek to define a refined ad hoc approach commonly referred to as neighborhood delineation. Our goal is to apply the tools of database analysis coupled with Geographic Information Systems to achieve a semi-automatic means for accounting for location effects in CAMA models.

Use of Neighborhoods in CAMA Systems

One of the most frequent methods of accounting for location influences in CAMA systems is the use of one or more neighborhood codes in the CAMA database. It can take the form of a single field containing a reference to a contiguous homogenous region. In such cases the jurisdiction to be valued is delineated into **n** contiguous regions, each of which is given a unique identification (NBHD). It can be two fields, one as previously described and another to identify **m** groups of similar, but not necessarily contiguous neighborhoods (NBHDGRP). Thus a given parcel will have fields that indicate it is in NBHD 57 and NBHDGRP 4. Often the NBHD variable is

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formatted for future maintenance by allowing it to be split into 99 sub-neighborhoods as future changes may dictate.

The use of such fields occurs in the modeling, calibration and valuation processes. Models are constructed that include NBHD or NBHDGRP variables to account for variations in value due to location effects. An example of a predictive model employing NBHD is given in the following expression:

$$ESP = b_0 * size^{b_1} * b_2^{NBHD1} * b_3^{NBHD2}$$

Where ESP is Estimated Selling Price and NBHD is a binary variable

The model is, of course quite limited, but it illustrates one mechanism for using NBHD in a model structure.

Systems that identify and adjust comparable sales as part of the valuation process also use NBHD or NBHDGRP to limit the search to areas that have been predefined as "comparable" via the location variables. For example the scheme might be to search the NBHD of the subject parcel first to see if there are sufficient comparable sales to estimate value. If there are, the algorithm computes an estimate of market value based on the given sales. If there were not, the algorithm would search the NBHDGRP to obtain the sales needed for the analysis.

Traditional Neighborhood Delineation Process

Appraiser uses a variety of tools and information sources to accomplish neighborhood delineation. Regardless of the process used to identify neighborhoods, they are ultimately translated to map sheets to create a visual display and to ensure that all geographic areas have been accounted for.

Factors considered in neighborhood delineation include at least the following:

Zoning
Land use
Lot size
Available utilities
View
Building style
Building size
Building age
Quality of construction
Sale price

There are more factors that could be listed, but generally the data the appraiser needs to perform neighborhood delineation could be found in a typical CAMA database coupled with ownership maps and preferably an aerial photo. Establishing neighborhoods frequently involves driving the streets of the jurisdictions with ownership maps and CAMA record printouts to make in-field determinations of changing neighborhood patterns.

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Data Sources

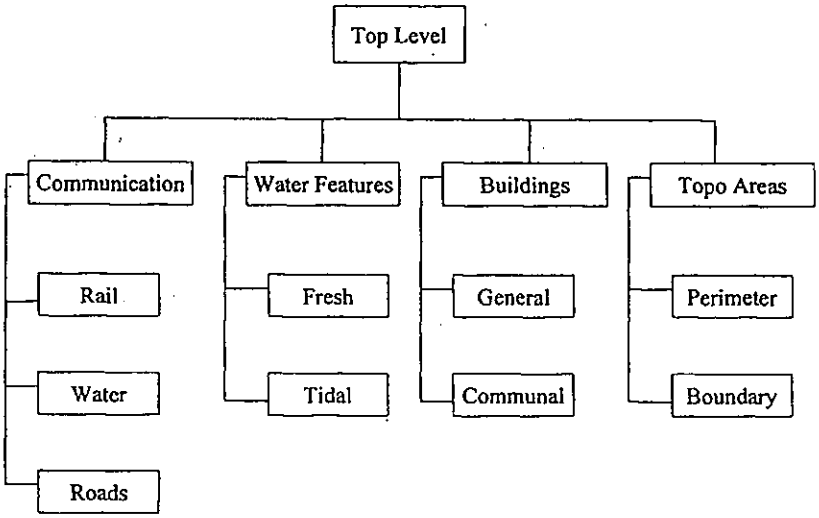
The study area is a dormitory town located approximately 7 miles north of Belfast. It has a population of approximately 30,000. Over the past ten it has seen rapid growth in residential development. Residential properties are predominantly owner occupied and further characterized by significant numbers of semi-detached and detached dwellings.

The data used for the purposes of this research were supplied from two government agencies, the Valuations and Lands Agency (VLA) and Ordinance Surveys of Northern Ireland (OSNI.)

The VLA is responsible for determining the values used for property tax purposes on approximately 670,000 residential properties and 66,000 commercial properties. To fulfil the statutory function with regard to property tax assessment the VLA has a comprehensive database incorporating a range of specific attributes for each property. In relation to this work, information on the following variables was supplied:

Sale price
Sale date
Gross floor area
Number of bedrooms
Presence of garage
Presence of central heating
Effective age
Property type
Property class

OSNI is responsible for the creation and maintenance of the topographic archives of Northern Ireland. Digital information is available in vector form for 1:1250, 1:2500, 1:50,000 and 1:250,000 scales. Color and monochrome raster information is also available. The vector digital database consists of 190 feature codes or themes capable of handling points, lines and polygons. The following diagram illustrates the range of themes available:



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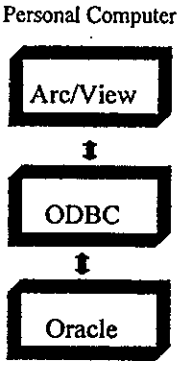
OSNI supplied vector maps at 1:1250 scales for the study area incorporating the following themes:

Buildings
Plot boundaries
Geographical wards
Roads
Railways

The Integration of CAMA and GIS

The research was performed on a personal computer in which a GIS (ArcView) was integrated with a Relational Database (ORACLE) to allow for the convenient analysis of characteristic data in a GIS session. The following figure depicts the architecture used:



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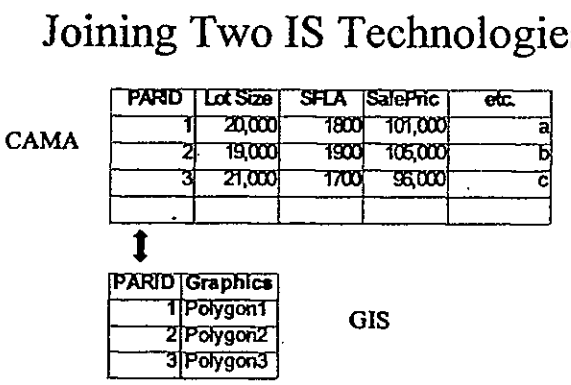
This achieves integration between the graphic shapes and the CAMA database as depicted in the following figure:



The linkage between the GIS and the CAMA databases is shown as Parcel ID. Other possibilities for joining the data include parcel address as well. Once the data are joined, the concept of an "Analyst's Workbench" can be achieved. Constructing user friendly applications via the customization tools available from the GIS vendor does this. In this case the Avenue programming extension was employed to allow for neighborhood analysis and modeling without extensive training in the GIS product itself. The following figure illustrates this concept:

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