Valuation of Small Industrial Properties Using MRA

Paul D. Campbell
Paul D. Campbell is Senior Manager, Industrial
Municipal Property Assessment Corporation, Pickering, Ontario, Canada

Brian G. Guerin
Brian G. Guerin is Senior Manager, MRA
Municipal Property Assessment Corporation, Pickering, Ontario, Canada

Robert J. Gloudemans
Robert J. Gloudemans is a partner in Almy, Gloudemans, Jacobs & Denne

Acknowledgements

The authors would like to acknowledge the efforts of Jason Moore, Craig Handsor, Chris Stylianou, Mark Cheyne, and Robert W. (Bob) Caines in completing this major research project, as well as James A. (Wink) Petrin for providing his unique perspectives on modelling and life.

Abstract

The Municipal Property Assessment Corporation (MPAC) is the assessment authority for the Province of Ontario, Canada, the largest assessment jurisdiction in North America. Over its past two provincial general revaluations, MPAC has successfully valued over 3.5 million residential, recreational waterfront, small commercial properties and industrial condominiums using MRA. MPAC views light industrial properties, which frequently sell, as the next frontier.

Market activity for industrial properties is typically more active for smaller properties, in this case, properties with a combined gross floor area of less than 50,000 square feet. This trend is also apparent for commercial properties that share many of the same physical characteristics but conduct non-manufacturing or processing activities.

This paper will test the hypothesis that small industrial properties can be successfully valued using Multiple Regression Analysis (MRA). The research will also test whether vacant and improved sites can be analyzed with a single model.

Current Methodology

Most jurisdictions principally rely on the cost approach for industrial properties. This would include purpose built, speculative and turnkey developments. This approach requires the assessor to estimate land and improvement values inclusive of depreciation and obsolescence. Often both vacant land sales and land residuals are analyzed to determine land values. Land residuals for improved sales are determined as follows:

Sale Price - RCNLD At Time of Sale = Land Residual

MPAC determines RCNLD using an automated cost system (ACS) with special adjustments for functional obsolescence. In many cases, this results in negative land residuals, which are excluded from further analysis. This anomaly has become more apparent in recent years resulting in many arm’s length transactions being excluded from land residual analysis.

Once land values and RCNLD are established, a market data analysis is conducted for all improved sales to determine the need for a Market Adjustment Factor (MAF). The MAF is required to reconcile cost and market and to account for the fact that, during the land residual analysis, all negative land residuals (sales where the building component is greater than the sale price) are removed from the analysis. This means that once the land residuals are developed and cost values determined, the level of appraisal, for built-on properties is greater than 1 since the sales removed from the land analysis are now re-entered into the ratio study. This makes appraisal sense since most resale industrial buildings do not meet specific requirements of the new purchaser. The MAF adjustments are necessary to meet the mandate of assessing at current value as required under Sections 1 and 19 of the *Assessment Act, R.S.O. 1990*.

Although this cumbersome approach works reasonably well, in future valuations MPAC would prefer to utilize the direct market approach, which has proven so successful for other property types.

Market Background & Database Summary

The study area for this project is part of the Greater Toronto Area (GTA). The GTA consists of the City of Toronto and four surrounding regions - Halton, Peel, York and Durham. Each region is comprised of several cities, towns and small rural areas. The four surrounding regions together constitute the study area for this research initiative.

The GTA is one of North America's fastest-growing regions. With a population of five million people, including the City of Toronto, it represents one of the world's most diverse consumer and commercial/industrial marketplaces.

Manufacturing in the GTA employs more than 500,000 people and continues to be a strong and vital part of the area's economy. Strategic business sectors in the GTA include (1) information technologies and telecommunications; (2) automotive and manufacturing; (3) business and financial services; (4) bio-medical; and (5) agri-business and food processing.

The total inventory for industrial properties less than 50,000 square feet in the study area is approximately 9,500 including 2,469 vacant land parcels. This represents 82.8% of the total number of industrial properties in the study area.

A total of 842 sales from the period, June 1999 to December 2001, were available for the analysis. After removing sales involving commercial zoning, farmland zoned industrial, large acreage developmental land, sales involving some functional obsolescence and invalid sales, 762 sales remained including 380 vacant land sales. The number of sales is as follows:

Table 1: Regional Sales Counts

Count

		Property Type		
		Improved Properties	Vacant Land	Total
Municipality	13 Durham	37	51	88
	14 York	58	168	226
	15 Halton-Peel	287	161	448
Total		**382**	**380**	**762**

Table 2 summarizes the improved property and vacant land sales used in the analysis. Sale counts show the number of properties with the listed features: obsolescence area (functionally unusable area), total floor area, first floor area, second floor area, and so forth. Notice that the average vacant site price ($738,560) is almost three-fourths of the average improved sale price ($1,082,722).

Table 2: Sales Database Summary - Improved Properties

	Sales	Minimum	Maximum	Mean	Std. Deviation
Obsolescence Area	16	360	4708	1278.10	1215.508
Total Floor Area (in square feet)	382	520	49933	17534.08	11727.183
Total First Floor Area	382	192	49933	16502.25	11308.248
Total Second Floor Area	85	300	15600	3905.91	3339.369
Total Third and Upper Floor Area	14	540	9232	4439.79	2506.683
Total Basement Office Area	1	859	859	859.00	.
Total Basement Area	25	212	8175	2273.24	1808.662
Total Mezzanine Area	94	85	5932	1563.69	1337.412
Total Mezzanine Office Area	17	85	3635	1675.06	1243.082
Total Interior Office Area	283	43	31718	2909.44	3751.796
Sale Amount (Canadian Dollars)	382	$80,000	$4,350,000	$1,082,722.26	$701,581.066
Sale Date	382	199906	200112	200020.96	75.291
Lot Size (measured in acres)	382	.11	24.89	1.9600	2.80981
Weighted Year Built	382	1947	2000	1980.21	10.346
Weighted Height	382	8.00	32.00	18.1832	3.46984
Weighted Quality Class	382	1	3	1.73	.484

Sales Database Summary - Vacant Land

	Sales	Minimum	Maximum	Mean	Std. Deviation
Sale Amount (Canadian Dollars)	380	$18,000	$4,080,600	$738,559.94	$782,961.686
Sale Date	380	199906	200112	200019.01	70.069
Lot Size (measured in acres)	380	.14	17.81	2.9287	2.96139

Modelling Theory

MPAC employs linear MRA to develop models for residential, small commercial and industrial condominium properties. However, in order to develop accurate value estimates and meet legislative requirements with respect to tax classification, a different model structure is required for small industrial properties.

Ontario legislation and regulation requires that all property be assigned a realty tax class (RTC) and a realty tax qualifier (RTQ) code based on the property's use. Thus a property may be valued as industrial, based on zoning, construction type and grade, etc but taxed using non-industrial tax rates. In most instances, industrial values are partitioned into separate tax classes and qualifiers. In order to partition a value into the various tax classes and qualifiers, the value must be broken down into separate land and building estimates. Traditional MRA can only accommodate a land and building breakdown if vacant land sales are used in the analysis and a binary variable to indicate vacant land (or improved property) is used to partition the constant into separate land and building components. Hybrid models, utilizing non-linear MRA provide this land and building breakdown with or without the inclusion of vacant land, since there is no constant and the model can be easily structured to permit decomposition. Separate land and building values also allow obsolescence to be applied to the building only.

Hybrid models also provide the benefits of being able to accommodate dollar and percentage adjustments and fit nonlinear relationships more efficiently, important advantages for heterogeneous property types.

Modelling Issues

Industrial buildings often require adjustments for construction quality, age, wall height, etc. Under the cost approach, each building component is valued separately. That is, if a steel frame building has 50% at 16 feet wall height and the other 50% at 12 feet wall height, separate rates per square foot are applied to recognize the difference in cost to erect the walls. To accommodate this requirement within MRA, weighted averages, based on gross building area were used. In the above example, a weighted average wall height of 14 feet would be used in the model. To provide for construction quality, cost rates per square foot were banded into three quality classes for analysis purposes.

Many industrial properties include such additional features as yardwork, paving, refrigeration, etc. It is not likely that MRA would be able to develop accurate adjustments for these items. In any event, these items are better valued using a cost estimate. Therefore, the cost values of these items was removed from the sale price prior to modelling and added back to MRA estimates.

The existing cost approach land table boundaries were used to adjust for location. For the most part, the land table boundaries are geographically contiguous and have sufficient sales for analysis purposes. In areas where insufficient sales exist, land table boundaries were combined to ensure adequate samples. A total of 35 land tables were combined to create 32 industrial neighbourhoods.

As previously mentioned, another objective of the project was to analyze improved properties and vacant land together using a single model. The rationale for attempting this approach is to increase the sample size and data available for analysis, particularly with respect to location. The ability to model both improved and vacant land using a single model would also eliminate the need to conduct a land residual analysis for vacant land and ensure a seamless transition between vacant and improved property values.

Historically, MPAC has not used time adjustments in the cost approach. For this project, however, time variables were created based on month of sale centred on the valuation date of June 30th, 2001. Separate time adjustments were tested for improved and vacant land.

Model Specification and Calibration – Vacant Land

The first step in the research was to develop *separate* models for vacant land and improved properties. A multiplicative model was developed for vacant land and additive and non-linear models were developed for improved properties.

The vacant land model was relatively simple in that it only included variables for the natural logarithm of site area, binary variables for location (neighbourhood 1401 was left out of the model as the base), and time centred on the valuation date – June 30th, 2001. The time variable, MONTHS, was calculated as follows:

MONTHS = MNTH_NUM-25.5.

MONTHS ranges from –24.5 (25 month prior to the valuation date) to 5.5 (six month after). Since the variable increases with time, a positive coefficient indicates inflation and a negative coefficient indicates deflation over the sales period.

The model was calibrated at 10% significance (90% confidence level) with the natural logarithm of sale price as the dependent variable. Two neighbourhoods with only one sale each were excluded from the analysis. All variables entered the model with at least 95% confidence with the exception of one neighbourhood. The model produced a coefficient of .85 for the natural log of site area, which produces an economy of scale factor of .85 for vacant land. The time coefficient of .009 indicates about 1% inflation in the marketplace over the sales period.

The model produced an adjusted R-square of .952 and overall COD of 17.17. Ratio study statistics for the overall model and each region are listed below in Table 3. The overall and regional results all meet international ratio study standards as outlined in the International Association of Assessing Officers' (IAAO) *Standard on Ratio Studies (1999)*.

Table 3: Sales Ratio Study Statistics - Vacant Land Model

Municipality	Median	95% CI for Median Lower	95% CI for Median Upper	Minimum	Maximum	PRD	COD
13 Durham - 51 Sales	1.022	.973	1.074	.600	1.837	1.000	16.93
14 York - 168 Sales	.999	.969	1.040	.526	1.813	1.043	16.39
15 Halton-Peel - 159 Sales	.997	.949	1.058	.623	1.654	1.072	18.10
Overall - 378 Sales	**1.003**	**.980**	**1.031**	**.526**	**1.837**	**1.053**	**17.17**

The model also showed good equity with respect to site area, time, neighbourhood, and value (defined as ½ sale price + ½ predicted value).

Model Specification and Calibration – Improved Properties

Improved properties were modelled using both an additive model and a hybrid model. The additive model includes variables for weighted 1st floor and basement area (QMAREA1); second, upper, and mezzanine floor area (QMAREA2U); and office area (QMOFFARA). Figure 1 lists how each variable was factored to adjust for municipal locale and construction quality:

Figure 1: Factor Tables for Construction Quality and Municipal Locale

Weighted Quality Class	Quality Adjustment Factor (QU_FACT)	Municipal Locale	Municipal Adjustment Factor (MUN_FACT)
1	.95	Durham	0.95
2	1.00	York	1.25
3	1.20	Halton and Peel	1.00

QMAREA1 = QU_FACT*MUN_FACT*(AREA1*PER_OBS+.95*BSMTAREA)
QMAREA2U = QU_FACT*MUN_FACT*((AREA2+AREA3UP)*PER_OBS+(.90*MEZ_AREA))
QMOFFARA = QU_FACT*MUN_FACT*(MEZ_OFF+OFF_TOT+BSMT_OFF).

The factors used in MUN_FACT and QU_FACT were derived from market analysis through previous iterations of the additive model. The variable PER_OBS is computed as 1 minus the ratio of unusable building area to total area and is used to net out unusable area. Other variables included in the equation are: non-linear depreciation on a square foot basis, time expressed on a square foot basis, and site area raised to the power of .80. Inferior and superior locations are handled through "pseudo-binary" site area variables (one site area variable for each location), thus providing per-acre adjustments to the standard rate. The model was calibrated at 90% confidence using SALE_ADJ as the dependent variable as a result of constraining the value of yardwork and miscellaneous improvements to their cost values.

SALE_ADJ = SALE_AMT-YARDCOST-ADDCOST.

The coefficient for MOSF indicates inflation over the sale period of .324 per square foot per month. This converts to a rate of change of approximately 0.5% per month.

Table 4 lists ratio study statistics for the overall model and each region. The results exceed international ratio study standards for level of appraisal and uniformity except for the COD in Durham Region. However, based on the sample size, the COD is within acceptable tolerance limits (Gloudemans, 2001).

Table 4: Sales Ratio Study Statistics for Improved Properties - Additive Model

		95% CI for Median					
Municipality	Median	Lower	Upper	Minimum	Maximum	PRD	COD
13 Durham - 37 Sales	1.044	.897	1.192	.624	1.643	1.052	20.47
14 York - 58 Sales	1.013	.967	1.041	.456	1.789	1.034	15.07
15 Halton-Peel - 287 Sales	1.005	.984	1.034	.529	1.846	1.029	14.51
Overall - 382 Sales	**1.010**	**.994**	**1.023**	**.456**	**1.846**	**1.032**	**15.22**

The model produced good equity among all major property characteristics – building area, site area, time, age, location and value.

A hybrid model, specified and calibrated using non-linear regression (NLR) allows for both additive and percentage adjustments within the same model. It also allows the analyst to have complete control of model specification and provides a land and building breakdown even if only improved sales are used in the analysis.

An NLR model was developed for the improved sales for comparison with the additive model results above. The model used a single weighted floor area variable, which combined all building, obsolescence, basement and mezzanine areas into one variable.

AREAWTOT = AREA_TOT- AREA_OBS + .95*BSMTAREA + .90*MEZ_AREA.

As with the additive model, the floor rate is adjusted for construction quality and municipal locale using a series of binary variables and percentage adjustments.

Depreciation was measured using percent good and applied as a multiplier against the floor rate.

PERGOODPCTGOOD = (1 - AGE/100)**1.364.**

The model produced a coefficient of 1.364 for the exponent PCTGOOD. Thus a property that is 20 years old would have a multiplier of .7375 ((1 – .20)**1.364) applied against the floor area rate to adjust for the effects of depreciation on value. The model also features site area rates for each neighbourhood, or combination, with a common economy of scale factor of .62728. The coefficient for time again indicates inflation at a rate of 0.5% per month over the sales period.

The R-square for the model is 90.111% based on 378 sales. Four sales over $1 million from Durham Region were filtered because they were skewing site area rates for their respective neighbourhoods. This influence was mitigated in the additive model through the inclusion of a generic site area variable for all properties.

Table 5 below provides the ratio study statistics. The hybrid model again produced good equity amongst all major property characteristics.

Table 5: Sales Ratio Study Statistics for Improved Properties - Hybrid Model

		95% CI for Median					
Municipality	Median	Lower	Upper	Minimum	Maximum	PRD	COD
13 Durham - 33 Sales	1.031	.923	1.110	.642	1.645	1.032	17.33
14 York - 58 Sales	1.000	.955	1.040	.572	1.692	1.037	15.67
15 Halton-Peel - 287 Sales	.998	.971	1.024	.488	1.797	1.022	15.25
Overall - 378 Sales	**1.000**	**.980**	**1.017**	**.488**	**1.797**	**1.025**	**15.54**

A comparison of Tables 4 and 5 indicate similar CODs for the overall model. The hybrid model performed considerably better in Durham but the additive model does produce a slightly better COD for York and Halton-Peel.

Model Specification and Calibration - Vacant Land and Improved Properties

Separate analyses for vacant land and improved properties indicated two key differences between the two property types – namely the influence of time and the factors used to capture economies of scale with respect to site area. To accommodate these differences the model specification for the combined model featured separate time adjustments for vacant land and improved properties as well as separate site area variables with separate exponents to capture the different economy-of-scale relationships.

The model, listed in Figure 2, calibrated different base rates for both vacant and improved properties in each neighbourhood, as well as separate economy-of-scale adjustments for vacant and improved parcels.

Figure 2: Model Output – Combined Hybrid Model

```
Nonlinear Regression Summary Statistics     Dependent Variable SALE_AMT

  Source                DF   Sum of Squares  Mean Square

  Regression             59   9.922540E+14   1.681786E+13
  Residual              696   3.598166E+13  51697790289.2
  Uncorrected Total     755   1.028236E+15

  (Corrected Total)     754   4.207273E+14

  R squared = 1 - Residual SS / Corrected SS =     .91448

                                                Asymptotic 95 %
                               Asymptotic     Confidence Interval
  Parameter   Estimate         Std. Error     Lower          Upper

  FLOOR      39.778035029   2.472390124 34.923798024 44.632272034
  QU1          .946235701    .074658477   .799652871  1.092818531
  QU3         1.590945682    .141517146  1.313093996  1.868797369
  PCTGOOD     1.529504324    .266569635  1.006127300  2.052881348
```

VL1401	.974659936	.172264128	.636440294	1.312879579
VL1403	.581591744	.118527163	.348878090	.814305398
VL1404	.946540965	.128353119	.694535243	1.198546687
VL1405	.836743061	.141938509	.558064080	1.115422042
VL1406	.587109677	.236182273	.123394538	1.050824817
VL1407	.967065872	.342583472	.294444933	1.639686812
VL1408	.294179871	.125675131	.047432053	.540927690
VL1409	.546545243	.243915016	.067647804	1.025442682
VL1502	.749851881	.281799602	.196572670	1.303131091
VL1503	.583126540	.205381075	.179885803	.986367276
VL1504	.555225727	.129040985	.301869463	.808581991
VL1505	.839843375	.275688518	.298562534	1.381124215
VL1507	.784215579	.128119850	.532667851	1.035763306
VL150809	1.155407070	.203197534	.756453451	1.554360689
VL1511	.879316876	.084193326	.714013530	1.044620222
VL1512	.712377923	.073428824	.568209366	.856546481
VL1513	.605077755	.097301995	.414037134	.796118375
VL151416	.760952123	.077420559	.608946282	.912957965
VL1517	.882782810	.121887359	.643471821	1.122093800
VL151820	1.078498971	.421037264	.251843562	1.905154379
VL1519	.724218532	.206252366	.319267123	1.129169942
DURHAM	.962243912	.101123918	.763699411	1.160788413
YORK	1.141437027	.136271405	.873884714	1.408989341
STYFACT	1.002386237	.046689579	.910716933	1.094055541
N130102	230704.99275	26950.806786	177790.36476	283619.62073
N1304	201094.20614	54318.171740	94447.088925	307741.32335
N1401	525580.48585	90560.536438	347775.89790	703385.07380
N1403	568393.81400	108826.62751	354725.98005	782061.64795
N1404	693839.01524	88909.815516	519275.41685	868402.61363
N1405	663650.91715	98105.681709	471032.35505	856269.47925
N1406	303297.50637	69143.747010	167542.17706	439052.83568
N1407	284201.00914	90159.136813	107184.52048	461217.49779
N1408	330085.62725	66830.209729	198872.64673	461298.60777
N1409	337714.50483	140262.20930	62326.733181	613102.27647
N1501	121545.66680	57356.485836	8933.1897605	234158.14384
N1502	199776.65204	68871.203585	64556.428563	334996.87551
N1503	257314.13617	36889.967380	184885.17641	329743.09593
N1504	350041.47944	43895.112070	263858.77093	436224.18795
N1505	280841.45410	55631.907207	171614.97724	390067.93096
N1507	316849.87613	38924.483765	240426.39115	393273.36112
N1508	304027.23926	48754.090912	208304.51735	399749.96117
N1509	223700.38934	85244.550011	56333.093542	391067.68514
N1510	496932.24147	56651.502020	385703.91433	608160.56862
N1511	482937.49185	40568.331733	403286.51151	562588.47219
N1512	522664.22443	43545.390349	437168.15194	608160.29692
N1513	627783.62270	56997.617771	515875.73942	739691.50599
N1514	535152.45276	39144.357324	458297.27281	612007.63271
N1516	482265.58996	52059.058630	380053.96631	584477.21362
N1517	313703.43979	38142.466594	238815.35031	388591.52926
N151820	205675.97868	70657.009846	66949.542031	344402.41534
N1519	401456.11933	91402.816186	221997.81764	580914.42102
LSIZXPI	.632313414	.031429219	.570605968	.694020860
LSIZXPV	.826269614	.017284076	.792334434	.860204793
TIMEVL	1.011140955	.001637640	1.007925649	1.014356261
TIMEIMP	1.005395274	.001199333	1.003040531	1.007750018

Model Equation

```
ESP = 1.011140955**MONTHVL*1.005395274**MONTHIM
 *[(230704**(NB1301 + NB1302) + 210000**NB1303 + 201094**NB1304
   + 30000**(NB1305 + NB1306 + NB1307) + 525580**NB1401 + 568393**NB1403
   + 693839**NB1404 + 663650**NB1405 + 303297**NB1406 + 284201**NB1407
   + 330085**NB1408 + 337714**NB1409 + 121545**NB1501 + 199776**NB1502
   + 257314**NB1503 + 350041**NB1504 + 280841**NB1505 + 316849**NB1507
   + 304027**NB1508 + 223700**NB1509 + 496932**NB1510 + 482937**NB1511
   + 522664**NB1512 + 627783**NB1513 + 535152**NB1514 + 482265**NB1516
   + 313703**NB1517 + 205675**(NB1518+NB1520) + 401456**NB1519)
   * 0.70**VL1303 * 0.70**VL1304 * 2.25**VL1305 * 2.90**VL1307 * 0.97466**VL1401
   * 0.58159**VL1403 * 0.94654**VL1404 * 0.83674**VL1405 * 0.58711**VL1406
   * 0.96707**VL1407 * 0.29418**VL1408 * 0.54654**VL1409 * 0.74985**VL1502
   * 0.58313**VL1503 * 0.55523**VL1504 * 0.83984**VL1505 * 0.78422**VL1507
   * 1.15541**(VL1508+VL1509) * 0.87932**VL1511 * 0.71238**VL1512 * 0.60508**VL1513
   * 0.76095**(VL1514+VL1516) * 0.88278**VL1517 * 1.07850**(VL1518+VL1520)
   * 0.72422**VL1519
   * (VACANT*SITEAREA**.826269614+IMPROV*SITEAREA**.632313414)
+ (39.78*AREAWTOT*0.94624**QUAL1*1.59095**QUAL3*PERGOOD**1.52950
    * 0.96224**DURHAM*1.14144**YORK*1.0024**STY2 + 8.00*OFFAREA)]
+ YARDCOST + ADDCOST.
```

Using neighbourhood 1401 as an example, the equation to calculate the base rate (BR) would be as follows:

$$BR=N1401^{NB1401} * VL1401^{(VACANT*NB1401)} *(VACANT*SITEAREA^{LSIZXPV}+IMPROV*SITEAREA^{LSIZXPI})$$

The coefficients for N1401 and VL1401 were $525,580 and .9747 respectively. Thus the base rate for vacant land would be $512,283. The economy-of-scale factors calibrated for vacant land and improved properties were .8267 and .6323 respectively. These factors are consistent with others calibrated in previous analyses.

The time coefficients for both improved and vacant properties again indicate inflation in the marketplace over the sales period. Both coefficients produce rates of change similar to those calibrated in previous models. The model produced an R-square of 91.448% using 755 sales. The four improved sales filtered from the improved hybrid model were again filtered from the combined analysis. Three vacant land sales from Halton were also filtered from the model. Again, these sales were skewing the land analysis in certain neighbourhoods. This did not occur in the multiplicative model due to the use of the natural logarithm, which gives equal weight to all sales and is thus less influenced by extreme sales during the analysis. Table 6 lists the ratio study results for the overall market area, vacant land and improved parcels.

Table 6: Sales Ratio Study Statistics by Property Type - Combined Model

Property Type	Median	95% CI for Median Lower	95% CI for Median Upper	Minimum	Maximum	PRD	COD
Improved Properties - 378 Sales	1.001	.977	1.024	.473	1.798	1.023	15.50
Vacant Land - 377 Sales	1.034	1.009	1.058	.493	1.870	1.050	17.66
Overall - 755 Sales	**1.018**	**1.002**	**1.032**	**.473**	**1.870**	**1.038**	**16.65**

A review of Table 6 shows that the median and COD for the overall model and each property type meet international ratio study standards for level of appraisal and uniformity respectively. Furthermore, the statistics produced similar overall results when compared to the separate analyses. This is an indication that the vacant and improved properties can be analysed using a single valuation model with minimal loss in appraisal uniformity. The model also produced good equity among all major property characteristics.

Comparative Analysis – Model Application

A subject property was selected to compare and contrast the application of each model, including the cost approach value. The subject property characteristics are listed in Figure 3 below.

Figure 3

Subject Property Characterstics

Roll Number	180102002208503
Property Address	1125 SQUIRES BEACH RD
Sale Date	200107
Sale Amount	$2,140,000
Locational Neighbourhood	1301 Pickering
Lot Size (in acres)	3.00
Total Floor Area (in square feet)	46012
Total Basement Area	0
Total Mezzanine Area	2124
Finished Office Area	4155
Obsolescence Area	0
Weighted Quality Class	2
Weighted Year Built	1988
Weighted Height (in feet)	19.00

The results of each analysis were applied to the subject property and a land and building breakdown calculated where applicable (Table 7). Notice that the combined hybrid model produces separate land values as if vacant and improved. This is because the model includes a binary variable for vacant vs. improved sales in each neighbourhood (where applicable), as well as separate economy-of-scale adjustments for vacant and improved properties. In this case, the vacant land value is higher than the improved land value, likely indicating limitations of the purchaser to utilize the land as desired. The ACS cost model of course assumes equal vacant and improved land values.

Table 7: Value Comparison by Analysis Model[a]

Subject Property	Value Component	ACS Cost Model	Vacant Land Model	Improved Additive Model	Improved Hybrid Model	Combined Hybrid Model
1125	Building Value	$2,342,306	$0	$0	$1,639,331	$1,571,511
Squires	Land Value - Improved	$644,433	$0	$0	$387,482	$463,357
Beach	Market Adjustment Factor	-$210,260	$0	$0	$0	$0
Road	**Total Property Value**	**$2,776,479**	**$606,718**	**$2,161,910**	**$2,026,813**	**$2,034,868**
	Land Value - as if Vacant	$644,433	$606,718	$0	$0	$575,034

a. Additive Model and Hybrid Model for Improved Properties do not provide a vacant land value because vacant land sales were not included in the analysis.

While the improved additive, improved hybrid, and combined hybrid models produce similar total value; the breakdown between land and buildings is different (the additive model of course makes no breakdown). Because it includes both vacant and improved sales in calibration, the combined hybrid model is likely more accurate in this regard. The cost model is out of line with the values estimated by the direct sales comparison models.

Conclusions

The results of this research provide empirical evidence that vacant land and small industrial properties can be valued under the sales comparison approach through the use of MRA. Each of the models developed meet international ratio study standards as outlined by the IAAO. Furthermore, the research also demonstrates that vacant industrial land and small industrial properties can be valued in a single analysis using a hybrid model calibrated through the use of non-linear regression.

References

Gloudemans, R.J. 2002. Confidence Intervals for the COD: Limitations and Solutions. *Journal of Property Tax Assessment & Administration* 8(2): 23-27.

International Association of Assessing Officers (IAAO). 1999. *Standard on Ratio Studies*. Chicago: IAAO.