# The Interactive Design/Marketing Model in Determining Highest and Best Use

by James R. DeLisle

The notion of highest and best use has received a substantial degree of attention in recent real estate literature, but no consensus has been reached on how to best identify highest and best use in appraisals.[1] This void creates a dilemma for real estate appraisers. From a philosophical perspective appraisal theory and standards dictate that real estate should be valued according to its highest and best use.[2] From a pragmatic perspective, however, the absence of a standardized technique for establishing highest and best use across the wide range of appraisal assignments frustrates its use. This article will clarify some of the ambiguity surrounding highest and best use analysis and introduce a standardized model that practitioners can use to identify highest and best use efficiently.

1. Harold D. Albritton, "Testing Highest and Best Use," *The Appraisal Journal* (July 1979): 406-411; G. Vincent Barrett, "A Restatement of Highest and Best Use," *The Real Estate Appraiser and Analyst* (November-December 1979): 4-9; Fred P. Bounds, "A Highest and Best Use Approach to Valuation," *The Appraisal Journal* (July 1982): 434; American Inst. of Real Estate Appraisers, *The Appraisal of Real Estate*, 8th ed. (Chicago: American Inst. of Real Estate Appraisers, 1983); Society of Real Estate Appraisers, *An Introduction to Appraising Real Property* (Chicago: Society of Real Estate Appraisers, 1983); American Inst. of Real Estate Appraisers, *The Dictionary of Real Estate Appraisal* (Chicago: American Inst. of Real Estate Appraisers, 1984).

2. Halbert C. Smith and Mark R. Maurais, "Highest and Best Use in the Appraisal Profession," *The Real Estate Appraiser and Analyst* (March-April 1980): 27-37.

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Rather than propose yet another theoretical interpretation of highest and best use, I will begin by exploring the appropriate criteria that it should satisfy in the context of appraisal. The interactive design/marketing (IDM) model that can be used to determine highest and best use cost effectively in appraisals is then presented. To illustrate how it would actually be applied, the model is extended to a case study.

## *EVALUATIVE CRITERIA FOR HIGHEST AND BEST USE*

### Overview

Numerous interpretations of the principle of highest and best use have been proposed.[3] Recent attempts to define the concept have resulted in a variety of new terms such as "most fitting use," "most probable use," and "optimal use."[4] Unfortunately, the addition of these new terms has not resolved the basic question of how real estate use decisions should be evaluated.[5] As a result of this void, practitioners are forced to adopt an implicit notion of the highest and best use, and then experiment with techniques that can help identify such a use for a particular subject property.[6] Although many of the techniques that have been proposed appear valid, their acceptance is precluded by the absence of a consensus on the evaluative criteria against which use decisions should be judged. To clarify the issue of highest and best use, the three basic levels of evaluative criteria against which usage decisions should be judged must be specified. First, establish the geographic level at which evaluations of use decisions should be rendered. Second, specify the appropriate time period over which those evaluations should be made. Third, identify the participants whose perspectives should be reflected in highest and best use analysis.

#### GEOGRAPHIC PERSPECTIVE

Three geographic levels of aggregation could be used to evaluate highest and best use decisions in appraisal. The first level represents the microperspective. At this level the evaluation of land use decisions addresses the physical suitability and legal acceptability of alternative uses for a specific site.[7] The suitability of the site for various uses is based on such physical conditions as its topography, water table, and soil composition. The legality of various use options is deter-

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3. Max J. Derbes, Jr., "Highest and Best Use: What Is It?" *The Appraisal Journal* (April 1981): 166-178; Nicholas J. Ordway and Jack Harris, "The Dynamic Nature of Highest and Best Use," *The Appraisal Journal* (July 1982): 325-334.

4. David Scribner, Jr., "The Key to Value Estimation: Highest and Best Use Or Most Probable Use," *The Real Estate Appraiser* (May-June, 1978): 23-28; Terry V. Grissom, "The Semantics Debate: Highest and Best Use vs. Most Probable Use," *The Appraisal Journal* (January 1983): 45-57.

5. James R. Webb, "Highest and Best Use: A Critical Examination," *The Appraisal Journal* (January 1980): 57-63.

6. Robert L. Blake, "The Interim-Income Approach to Value of Improvements No Longer Suited to Highest and Best Use," *The Appraisal Journal* (October 1978): 588-591; Kerry D. Vandell, "Toward Analytically Precise Definitions of Market Value and Highest and Best Use," *The Appraisal Journal* (April 1982): 253-268.

7. James A. Graaskamp, *A Guide to Feasibility Analysis* (Chicago: Society of Real Estate Appraisers, 1970).

mined by constraints embedded in existing private and public land use controls that are specified in deed restrictions or zoning codes.[8]

The second geographic level of aggregation represents the middle-range perspective. At this level highest and best use hinges on the compatibility of the proposed uses of a particular site with its immediate neighborhood or environment. This determination focuses on the actual or perceived compatiblity of the proposed uses with such real characteristics as surrounding land uses, existing improvements, and the intensity of neighborhood development. These physical factors could also be extended to include aesthetics and other perceptual features that might affect the overall image or livability of the neighborhood once the proposed use is added.

The third geographic level of aggregation reflects the macroperspective. At this broad level the acceptability of various uses is determined on the basis of the effects such development would have on the overall urban system in which the subject property is situated. Thus, in determining highest and best use an appraiser considers the impact of the alternative uses on such factors as the efficiency of the urban system, the adequacy of the existing infrastructure, and the livability of the resulting environment.[9]

#### TIME PERIOD

Three major time frames could be acceptable for evaluating highest and best use decisions. On the microlevel the time period is defined as the immediate time span over which the direct involvement of the current participants (that is, developers, investors, and tenants) is expected to continue. The extent of this narrow time frame is determined by how long these parties either contribute to or receive benefits from the project.

On the intermediate level the time frame is extended to encompass the period over which the project foreseeably involves specific parties or "probable users." Alternatively, this time frame encompasses the relevant time span in which expected future uses influence the immediate and secondary use decisions for the site.

On the macrolevel the time frame extends to the total time period over which the resultant improvements are expected to satisfy spatial needs economically. This broad time frame extends from the inception of the immediate land use decision to the rehabilitation, renovation, or demolition decisions that ultimately affect the improvements.

#### PARTICIPANT PERSPECTIVE

The final issue regarding the evaluation of highest and best use decisions focuses on the identity of the participants from whose perspectives the proposed uses

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8. Frank S. So, Israel Stollman, Frank Beal, and David Arnold, eds., *The Practice of Local Government Planning* (Washington, D.C.: International City Management Association, 1979).
9. Richard B. Andrews, *Urban Land Economics and Public Policy* (New York: Free Press, 1971): 31-54, 95-137.

should be evaluated. The scope of relevant participants is classified into three aggregate levels. On the microlevel the participants are constrained to those who have some form of direct, contractual involvement with the immediate real estate use decision for the subject property. In new projects these direct participants include developers, joint venture partners, primary investors, and syndicators. On the intermediate level the specification of the relevant participants is expanded to include the individuals and entities who are expected to have some form of direct, but not necessarily contractual, involvement with the real estate over a finite forecast period. These parties include lenders, underwriters, tenants, and, indirectly, the primary market segments expected for any proposed use. On the macrolevel the relevant participants are further expanded to include the parties who affect or are affected by the project over time. The latter include prospective buyers, future tenants, owners of neighboring sites, and community and local governmental agencies that provide the infrastructure and support services for the use.

### Resolution of the Issues of Aggregation

The philosophical position that the highest and best use decision should reflect in the context of real estate appraisals must be clarified before the appropriate individual levels of aggregation are specified. Two basic positions could be adopted: the normative perspective that looks at the question of what "should be" the use and the positive perspective that looks at the question of what "will be" the use. To a great extent the ambiguity that surrounds current highest and best use literature is explained by the fact that the philosophical perspective differs depending on the type of service that an appraiser performs for a client. Thus, the resolution of this normative-positive dichotomy hinges on what type of service the appraiser is providing. For example, if the appraiser is performing a feasibility or evaluative study, the normative approach can properly be adopted. If the appraiser is conducting the analysis in the context of a traditional appraisal, however, the positive perspective must be maintained to protect the integrity of the appraisal process. This is well founded in appraisal history as attested to by the industry rejection of the Federal Housing Administration's calls for "normative" values in the 1930s and the Veterans Administration's calls for "warranted prices" in the 1940s.[10] As periodically restated by industry sources, the role of an appraiser when preparing an appraisal report is to provide objective third-party projections of probable sale prices rather than directly helping set or otherwise affecting prices. Thus, the analysis of highest and best use must be constrained to the positive domain.

Once the commitment to the positive domain of appraisal analysis is accepted, the evaluative criteria can be specified. In general, the microlevels of aggregation for each of the issues—geographic, temporal, and perspective—best reflect the

10. James R. DeLisle, "Toward a Formal Statement of Residential Real Estate Appraisal Theory: A Behavioral Approach," Ph.D. dissertation, University of Wisconsin, Madison, 1981.

positive domain of traditional highest and best use analysis while the macrolevel factors tend to represent the normative domain of "most fitting use."[11] This divergence helps explain the conflicts surrounding the discussion of highest and best use. In general, microlevel criteria reflect the interests of producers and consumers in the private sector, while planners and forecasters are interested in the macrolevel criteria. Since highest and best use analysis in appraisal is directed at establishing probable sales prices set by the private sector, the decision reflects the microperspective. This does not suggest that there is a unique solution to the highest and best use question, since the ultimate decision results from market behavior that cannot be reduced to a distinct mathematical model. However, appraisers can note behavioral tendencies and suggest how these tendencies affect the most probable use.[12]

The commitment to the positive domain of highest and best use analysis provides a consistent basis for grouping the criteria across the three issues. For example, from the geographic perspective highest and best use decisions should reflect the microlevel. Since existing contraints on usage are not fixed, however, appraisers should not accept them as binding. Rather, appraisers should evaluate how the market will set these constraints. This is done by considering the probability that the most likely users will be able to obtain changes in zoning or other restrictions. To the extent that surrounding uses may influence behavioral decisions on land use, the middle-range geographic perspective should also be considered.

The time period surrounding highest and best use analysis should extend beyond the short-term level to the intermediate level. This expansion is necessary to capture the pricing effects that may result from the market's tendency to discount expected future sales prices in setting current prices. Similarly, the scope must be expanded from the microlevel to the intermediate level regarding those participants whose perspectives should be considered. This expansion is necessary to capture the pricing effects that the attitudes and policies of indirect participants—lenders, limited partners, secondary investors, and tenants—have on anticipated net income, or the effects of after-tax value of benefits on probable resale prices.

Since land usage cannot be reduced to a deterministic process, appraisers should consider the probabilities of alternative highest and best use decisions. To help practitioners satisfy this theoretical requirement in a cost-effective manner, there is a need for a more efficient model for evaluating alternative use decisions. Such a model will also enable appraisers to expand the scope of their services when

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11. Richard U. Ratcliff, *Valuation for Real Estate Decisions* (Santa Cruz: Democrat Press, 1972); Grissom, "The Semantics Debate," 45-57.

12. James R. DeLisle, "Residential Appraisal: A Behavioral Approach to Energy Efficiency," *The Appraisal Journal* (January 1984): 41-47.

conducting feasibility analyses or otherwise advising clients on land use.[13] The balance of this article introduces the interactive design/marketing model that can be used to increase the efficiency and reliability of highest and best use analysis in both valuation and evaluation studies. Although the model presented has been automated in the form of a spreadsheet template for processing on microcomputers, the focus of the discussion is confined to manual calculations to demonstrate that the IDM model can be easily used to solve complex highest and best use problems.[14]

## *THE INTERACTIVE DESIGN/MARKETING MODEL*

The interactive design/marketing (IDM) model is a multistage land use decision model. In the highest and best use analysis sections of an appraisal, the model can be used to test existing uses against several optional uses. This type of application should help appraisers overcome the natural tendency to accept the status quo as the de facto highest and best use. Alternatively, the model can be used to quantify, cost out, and then determine the relative probability of the raw land's development for various uses. There are four basic stages in the model (see figure 1). In the first stage an appraiser defines the nature and scope of the highest and best use portion of the appraisal assignment. Although existing uses and land use constraints may be accepted as givens, exploration of the probability of their elimination or modification by the market should be included in the problem statement. In the second stage the range of alternative uses that are plausible for the site are identified. To take advantage of the greater efficiency of the model, these uses should cover the spectrum of alternative uses. In the third stage the amount, quality, and costs of production of the plausible uses are derived. In the fourth stage the revenue requirements for the respective uses are determined. These revenue requirements are then tested against actual market rents to filter out the options that do not appear to be marketable and economically viable. The remaining uses are then accepted as candidates for highest and best use. If more than one use remains, an appraiser can scrutinize them through after-tax modeling to select the most probable use.[15]

### STAGE I: IDENTIFICATION OF ALTERNATIVE USES

The IDM model is best introduced by applying it to a specific case. Assume that an appraiser is appraising a five-acre, commercially zoned parcel located on the fringe of a suburban commercial area. An appraiser could validly apply three types of filters in determining the highest and best use of the subject property:

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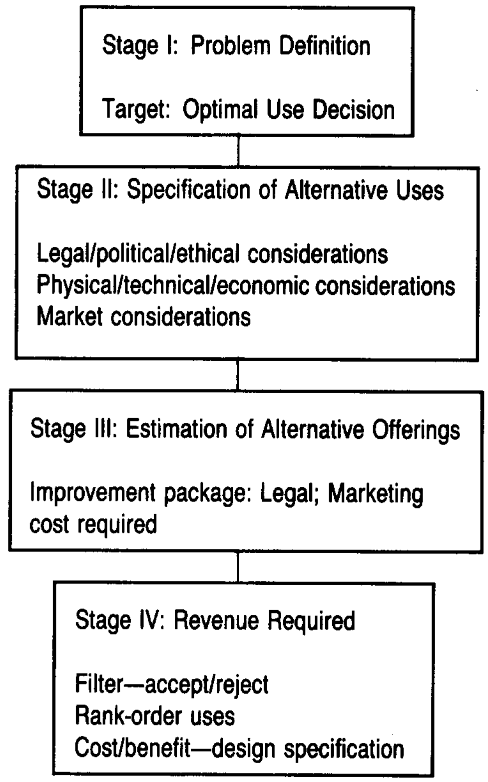
13. American Inst. of Real Estate Appraisers, "Evaluation," *The Appraisal Journal* (October 1983): 546-568; Joseph D. Albert and Thomas D. Pearson, "Marketing Professional Appraisal Services," *The Appraisal Journal* (April 1983): 225-233; Carroll E. Pennell II, "The Role of the Professional Appraiser in the 1980s," *The Appraisal Journal* (April 1981): 205-213.

14. James R. DeLisle, *Interactive Planning/Development Models* (Edina, Minn.: Control Data Worldtech, 1984).

15. Austin J. Jaffe and C. F. Sirmans, *Real Estate Investment Decision Making* (Englewood Cliffs, N.J.: Prentice-Hall, 1984).

FIGURE 1

The Interactive Design/Marketing Model




legal and political restrictions on what is permitted on the site, physical and economic considerations affecting the suitability of the site for various uses, and market conditions of relative supply and demand affecting the marketability of various uses. In the IDM model, these factors are reduced to effective levels to ensure that they do not unduly constrain the exploration and evaluation of alternative market offerings.

In this case assume that an appraiser has considered the relevant factors and has identified four plausible developments for the five-acre site: a three-story office building, a one-story retail project, a two-story walk-up apartment building, and a five-story apartment project. In this market the median gross market rental per square foot is $6.00 for office space, $4.50 for retail space, and $350 per month for a two-bedroom apartment with a rent differential of 20% per bedroom. The two-story, walk-up apartments appeal to a relatively young, mobile clientele and feature a one-to-two mix of one-bedroom and two-bedroom units. The five-story, elevator structure is targeted for a more mature market and includes a two-to-one mix of two-bedroom and three-bedroom units. In the market the average size of one-bedroom apartments is 600 square feet, compared to 800 square feet for two-bedroom units and 900 square feet for three-bedroom units.

### STAGE II: SPECIFICATION OF ALTERNATIVE USES

The relaxation of zoning and other external limitations in an appraisal problem supported by the IDM model may appear to increase unduly the scope of the analysis. However, the greater efficiency afforded by the reliance on a pre-tax pricing model over more sophisticated after-tax cash flow models more than offsets this expansion. The use of a pre-tax model in highest and best use analysis for appraisals is justified by several considerations. First, the effects of tax shelters are not robust; they vary from user to user. While not acceptable per se, this phenomenon precludes the derivation of unique after-tax solutions to appraisal, development, or land use control decisions. Second, tax benefits are highly elastic, that is, they can be and have been almost instantaneously created or wiped out by changes in federal and state legislation.[16] Since real estate usage decisions have long-term consequences, such unpredictable changes create a volatile, speculative environment that is beyond the positive scope of an appraisal. Third, market changes in property taxes, expenses, and property appreciation that affect future net income flows tend to be robust, and have a similar affect on a wide range of commercial uses. Although assumptions on these variables can affect after-tax cash flow solutions for a particular project, they will generally not affect the relative rank ordering of uses. Finally, the IDM model is designed for use in filtering decisions; it is not intended as a technique for fine-tuning creative financing packages. The model is intended to break down the number of options that an appraiser processes through more demanding cash flow modeling, thus simplifying the analytical task without compromising the precision of the ultimate solution. Given these limitations, reliance on after-tax modeling for filtering analysis needlessly complicates the process. Because of the high costs and time requirements, this approach continues to prevent appraisers from exploring the full range of alternatives.

### STAGE III: ESTIMATION OF ALTERNATIVE OFFERINGS

A series of mathematical equations can be used to define the composition of the ultimate offerings for each of the four general uses. Two steps are necessary to define the nature of each use. First, to establish the upper range of the optimal physical packages, the maximum quantity of physical improvements that can be placed on the sites and still satisfy marketing and zoning requirements must be derived. Second, to determine the capital requirements of each of these improvement packages, the outlay required for each project must be calculated. In the IDM model, the equations that are presented to perform these analyses are set

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16. Deloitte, Haskins & Sells, *The Tax Provisions of the Deficit Reduction Act of 1984* (New York: Deloitte, Haskins & Sells, 1984); *1984 Federal Tax Handbook* (Englewood Cliffs, N.J.: Prentice-Hall, 1984).

up to use data that should be readily available to an appraiser. The use of the equations is further simplified by their applicability to a wide range of alternative land uses.

In the IDM model the calculation of the improvement packages involves a two-stage process. First, the maximum size of the building that can be placed on a subject property is derived for each alternative use. Second, to establish the number of functional units that must be constructed, the surface area of the subject property is allocated among improvements, parking, and open space. The following equation can be used to establish the maximum building envelopes.

$$MSTRsf = \frac{(GSsf)(1 - RSr)}{(1/Nsb) + (PI)(SFPS)}$$

where

$MSTRsf$ = maximum sq. ft. structure
$GSsf$ = gross sq. ft. site
$RSr$ = reserved site ratio (nonimproved area)
$Nsb$ = number stories in building
$PI$ = parking index (units/unit of building)
$SFPS$ = sq. ft. per stall (parking)

Table 1 presents the calculations for the maximum building envelopes for each of the four uses. The differential reserved site allocations, building heights, and parking requirements materially affect the maximum building envelopes for each alternative. In specifying the value for each of the key variables, the appraiser must consider simultaneously the nature of the use and its target market.[17] Since zoning does not have to be accepted as a given in highest and best use analysis in the IDM model, the solutions should be tested against zoning restrictions after the market-oriented solutions are generated. Alternatively, the reserved site ratio can be set at a level that encompasses both lot coverage and setback requirements.[18] However, in many cases the deviation from the acceptance of zoning as a binding constraint will not affect use intensity since the market's parking requirements will typically exceed those included in zoning criteria. Table 2 illustrates that parking requirements are the most severe of the intensity constraints. If the lot coverage or floor area ratios exceed the probable level of the zoning constraints, the equations can be overridden. If this occurs the excess space can then be allocated to additional parking or open space.

17. James R. DeLisle, "Market Segmentation: Implications for Residential Appraisal," *The Real Estate Appraiser and Analyst*, forthcoming.

18. To use this approach the appraiser takes the gross site area and nets out the setbacks. By dividing the result by the gross area, an effective ratio can be calculated. The results of this calculation are the more binding of this ratio or the lot coverage ratio would be set as the reserve site ratio.

TABLE 1

Nature of Use Analysis

| | Inputs | | | |
|---|---|---|---|---|
| | Option 1 | Option 2 | Option 3 | Option 4 |
| Variable | Office | Retail | 2-story Apt. | 5-story Apt. |
| Gross site area | 217,800 | 217,800 | 217,800 | 217,800 |
| Reserve site ratio | 0.1 | 0.08 | 0.2 | 0.12 |
| Number of floors | 3 | 1 | 2 | 5 |
| Parking: | | | | |
| Index | 500 | 200 | 600 | 800 |
| Sq. ft./stall | 400 | 400 | 400 | 400 |
| Number of stories | 1 | 1 | 1 | 1 |
| Max. sq. ft. bldg. | 172,959 | 66,792 | 149,349 | 273,806 |

TABLE 2

Site Allocation

| | Output | | | |
|---|---|---|---|---|
| | Office | Retail | 2-story Apt. | 5-story Apt. |
| Building (sq. ft.) | 57,653 | 66,792 | 74,674 | 54,761 |
| Parking | 138,367 | 133,584 | 99,566 | 136,903 |
| Open space | 17,296 | 5,343 | 29,870 | 32,857 |
| Ratios - calculated | | | | |
| Lot coverage | 0.26 | 0.31 | 0.34 | 0.25 |
| Floor area ratio | 0.79 | 0.31 | 0.69 | 1.26 |
| Parking stalls | 346 | 334 | 249 | 342 |

Once the maximum improvement packages for the alternative uses are derived, the next step in the IDM model is to calculate the total replacement costs required *(TRCr)* to produce them. Table 3 presents the unit costs that would be fed into the model for each of the four uses. Depending on the desired level of precision, an appraiser could employ a great deal of detail in cost estimating. In this case the cost estimates are limited to five major functional elements: structures, land improvements, land, legal and organizational expenses, and other carrying charges.

TABLE 3

Construction Costs

| | Inputs | | | |
|---|---|---|---|---|
| | Office | Retail | 2-story Apt. | 5-story Apt. |
| Cost per sq. ft. | | | | |
| Building | $ 22.50 | $ 18.00 | $ 27.00 | $ 36.00 |
| Landscaping | 1.50 | 1.50 | 1.50 | 1.50 |
| Parking | 2.50 | 2.50 | 2.50 | 2.50 |
| Total land cost | 200,000 | 200,000 | 200,000 | 200,000 |
| Other costs | 10,000 | 10,000 | 10,000 | 10,000 |
| Overhead percent | 10 | 10 | 10 | 10 |
| Legal & organizational | 20,000 | 20,000 | 20,000 | 20,000 |
| Construction interest | | | | |
| Interest rate | 0.180 | 0.180 | 0.180 | 0.180 |
| Months to build | 18 | 8 | 12 | 16 |

Once the unit costs are specified for each item, the capital requirements can be derived by multiplying the number of each type of unit by its unit cost. These costs are then added to establish the ''hard cost'' portion of the *TRCr* to justify the project.

To complement the hard costs the indirect or soft costs that include financing fees, construction interest, and other carrying charges must be calculated. Unlike hard costs these items are typically not based on unit pricing but are specified as a percentage of the total improvement costs. To calculate these dependent costs an indirect method must be applied. Assuming that the appraiser can specify the soft costs in terms of some fixed percentage of the total costs, the amount that they will ultimately constitute can be calculated through an algebraic equation.[19] Table 4 presents the total costs for the proposed projects. The category labeled Other Costs includes financing fees and carrying costs.

### STAGE IV: GROSS INCOME REQUIREMENTS

The fourth stage of the IDM model consists of the derivation of revenue levels necessary to support the indicated improvements. Table 5 presents the inputs that must be stated for each use to generate these income requirements. Once the key

19. This calculation is based on a weighted cost of capital, applying the mortgage coefficient and the required pre-tax cash-on-cash equity rate of return.

assumptions have been made, the following equation can be used to calculate the gross income required to cover the operating expenses of the project and provide the required returns to capital.

$$GIr = \frac{TRC \times WCC}{NIR}$$

where

$GIr$ = gross income required
$TRC$ = total replacement cost
$WCC$ = weighted cost of capital
$NIR$ = net income ratio

and

$$WCC = (LV)\ (Mc) + (1-LV)\ (EC)$$

where

$LV$ = loan-to-value ratio
$Mc$ = mortgage coefficient
$Ec$ = equity cash-on-cash return

and

$$NIR = 1-VACr - EXPr - PTAXr$$

where

$VACr$ = vacancy ratio
$EXPr$ = expense ratio
$PTAXr$ = property tax ratio

Table 6 presents the results of the gross income requirement *(GIr)* calculations for each of the four uses. The table also presents the allocation of gross income into the basic components. These figures are calculated by multiplying the required revenue levels times the relative percentage distributions. An appraiser can use this breakdown to determine if the operating assumptions are reasonable.

To make the *GIr* more meaningful, they should be expressed in terms of the indicated rental structure necessary to generate them. When there is only one source of revenue, the rental structure can be derived in a direct calculation. The required annual revenue levels per square foot include $5.75 for office space, $5.45 for retail space, $7.28 for walk-up apartments, and $8.98 for five-story elevator apartments. In evaluating the uses an appraiser compares these required rents to the current market levels. However, commercial rental space is typically quoted in terms of annual square footage costs while apartments are quoted in terms of monthly unit rentals. To evaluate the relative marketability of the apartments, the required gross income must first be converted to the rental structure for the various apartments.

TABLE 4

Project Summary

| | Output | | | |
|---|---|---|---|---|
| | Office | Retail | 2-story Apt. | 5-story Apt. |
| Total construction | $4,263,435 | $1,544,231 | $4,326,130 | $10,248,548 |
| Total land | 200,000 | 200,000 | 200,000 | 200,000 |
| Total other costs | 467,661 | 191,796 | 485,059 | 1,102,503 |
| Total replacement cost | $4,931,096 | $1,936,027 | $5,011,189 | $11,551,051 |

TABLE 5

Carrying and Operating

| | Inputs | | | |
|---|---|---|---|---|
| | Office | Retail | 2-story Apt. | 5-story Apt. |
| Permanent financing | | | | |
| Loan-to-value ratio | 0.80 | 0.80 | 0.80 | 0.80 |
| Interest rate | 0.16 | 0.16 | 0.16 | 0.16 |
| Term in years | 30 | 30 | 30 | 30 |
| Payments per year | 12 | 12 | 12 | 12 |
| Equity return | | | | |
| Pre-tax rate | 0.06 | 0.06 | 0.06 | 0.06 |
| Expense ratios | | | | |
| Vacancy ratio | 0.05 | 0.05 | 0.05 | 0.05 |
| Expense ratio | 0.15 | 0.10 | 0.20 | 0.18 |
| Property tax ratio | 0.10 | 0.10 | 0.10 | 0.10 |

TABLE 6

Gross Income Requirements

| | | | | |
|---|---|---|---|---|
| Gross income required | $993,945 | $364,223 | $1,087,788 | $2,432,559 |
| Rent/sq. ft. per year | 5.75 | 5.45 | 7.28 | 8.88 |
| Rent/sq. ft. per month | 0.48 | 0.45 | 0.61 | 0.74 |

TABLE 7

Allocation of Income

| | | | | |
|---|---|---|---|---|
| Vacancy allowance | $ 49,697 | $ 18,211 | $ 54,389 | $ 121,628 |
| Operating expenses | 149,092 | 36,422 | 217,558 | 437,861 |
| Property taxes | 99,394 | 36,422 | 108,779 | 243,256 |
| Debt payments | 636,588 | 249,935 | 646,928 | 1,491,202 |
| Equity cash flows | 59,173 | 23,232 | 60,134 | 138,613 |
| Total allocated | $993,945 | $364,223 | $1,087,788 | $2,432,559 |

In order to establish the rent structure for the residential projects, the rental units need to be converted to some common base. Preliminary market research suggests that there is a 20% difference between one-bedroom and two-bedroom units, and between two-bedroom and three-bedroom units. Based on this ratio the number of factored revenue units in the proposed structures can be calculated. Table 7 presents the calculation of the rental structures for the two apartment projects. In the two-story walk-up the maximum building size calculated in stage III will support 68 one-bedroom units at 600 gross square feet and 136 two-bedroom units at 800 gross square feet. Since the two-bedroom units rent for 20% more than one-bedroom units, the 136 units convert to 163.2 factored units. When added to the 68 one-bedroom units, the total is 231.2 factored revenue units. Dividing the *GIr* of $1,087,788 by the 231.2 factored revenue units and converting the figure to a monthly level, the base revenue rent is set at $392. Since this rent applies to the one-bedroom units, the two-bedroom rent of $470 ($392 × 1.2) can be easily calculated. In a similar manner the rental structure can be determined for the five-story building. In that case there was a two-to-one mix of two-bedroom over three-bedroom units at 800 and 900 gross square feet per type. Using these numbers the maximum building area of 273,806 square feet converts to 330 total units. Adjusting the three-bedroom units by the 20% rental premium and adding in the 220 two-bedroom units, 452 factored revenue units are calculated for this use. Dividing the required revenue of $2,432,559 by this figure and adjusting the results to a monthly basis provides a base revenue unit requirement of $448. Because this figure represents the two-bedroom rent, the 20% adjustment yields a three-bedroom rental requirement of $538 per month.

## *GENERATION OF IDM OUTPUTS*

In the case where the IDM model is applied to evaluate alternatives, the output can be the relative ranking of the proposals. The four uses have required rental levels that range from a low of $5.45 per square foot to a high of $8.88. The required rental levels for the apartments range from a low of $392 per month for the one-bedroom units to a high of $538 per month for three-bedroom units. These preliminary figures provide inputs that can be fine-tuned by applying after-tax cash flow analysis or standard Ellwood formulas. However, since the enhancements provided by these techniques tend to be directional across each option, the final ranking will typically not change. The required annual revenue levels per square foot include $5.75 for the office space, $5.45 for the retail space, $392 and $470 for the one-and-two-bedroom walk-up apartments, and $448 and $538 for the two-bedroom and three-bedroom units in the five-story elevator apartments. Once these required revenue structures are constructed, the four uses can be tested against the effective market demand. The median gross square foot market rentals are $6.00 for office space, $4.50 for retail space, and $350 per month for two-bedroom apartments with a rent differential of 20% per bedroom. Given these comparative levels the office project is ranked first, followed by the two-story walk-up apartment. Unless the retail space and high-rise apartments open up new markets, they could be eliminated outright. Once the ranking of uses has been completed, sensitivity analysis can be used to refine these estimates to determine if the required rental for the apartments can be reduced a sufficient degree to make them marketable. This is accomplished by reducing unit sizes, component costs, or operating expenses. In the immediate case the results of the IDM analysis suggest that the optimal use is the office project. To test this conclusion on an after-tax basis, the first two uses are scrutinized through more comprehensive analysis using primary research and more sophisticated after-tax modeling.

## *CONCLUSIONS*

The relative simplicity of the mathematical calculations presented in this article reveals that the interactive design/marketing model can be used by appraisers to enhance simultaneously the efficiency and optimality of highest and best use analysis. To justify such an expanded interpretation of the land use decision, an appraiser must accept the importance of maintaining objectivity in appraisals. Assuming the need for objectivity and the validity of a pre-tax screening model, the basic IDM model can be used to broaden the scope of highest and best use analysis in real estate appraisal. By using the model to test alternative development scenarios through sensitivity analysis, appraisers can better identify most probable uses in feasibility studies. Similarly, the interactive nature of the model supports trade-off analysis of a variety of subtle but potentially significant design decisions.