DEMAND PROJECTIONS AND ECONOMIC MODELING

FOR

NEW AND RENEWING COMMUNITIES

By

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Economic and development projection and foecasting techniques for new

town development are not an exact science; they generally rely on historic

socio-economic events, coupled with development goals, which are extended

into the future utilizing logical and rational assumptions. In the United

States, numerous techniques and models have been developed in the past

decade which can be applied to new town developent to provide support to

management in policy and decision-making. The efficacy of these techniques

and models is not totally clear; however, it is certain that a rigorous

and analytic approach to new town development planning is desirable and gen-

erally accepted. The purpose of this paper is not to provide a rigorous

treatise on projection and modeling techniques, but a structural delineation

of concepts which are generally applied by practioners. Two categories of

large-scale developments will be discussed: satellite new towns which are

culturally and economically dependent on an existing urban center, and free-

standing new towns (or new cities) which are completely independent of any

existing cities. The algorithmic techniques of these types of large-scale

developments are inherently different.

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PROJECTION APPROACHES FOR SATELLITE NEW TOWNS

Analysts are always searching for new tools which will enable them to address
complex interrelationships of real world variables. Computer models perhaps
best epitomize the current approach to quantitive methodologies in seeking
solutions to intricate problems. The potential advantage of a computer model
over conventional methods derives mainly from the computer's ability to deal
simultaneously with the large number of variables at exceedingly high speed
and accuracy. In the incipient stages of the New Communities Development
program (Title VII of the Housing and Urban Development Act of 1970) in the
United States, the Department of Housing and Urban Development developed, and
presently maintains, the NUCOMS System which is a computer-based set of analytic
models and supporting systems. The overall structure of NUCOMS is composed of four
broad categories of models (regional, sector, community, financial), all of
which are functionally "linked," and is designed to provide separate, as well
as an overall analysis in support of economic, physical and financial plan-
ning and analysis. Each of the models contains numerous submodels which
are integrated to the overall system (See Exhibit A).

THE ADVANCED NUCOMS SYSTEMS

The structure of the NUCOMS system reflects the general analytic approach
analysts have utilized in development studies for a satellite new town.
Analysis is executed through descending geographic levels—each level defined
functionally rather than in terms of a specific area. This "hierarchical
approach" can be analagous to a zoom lens on a camera. First, a general
picture of population and employment is forecast for the entire region.
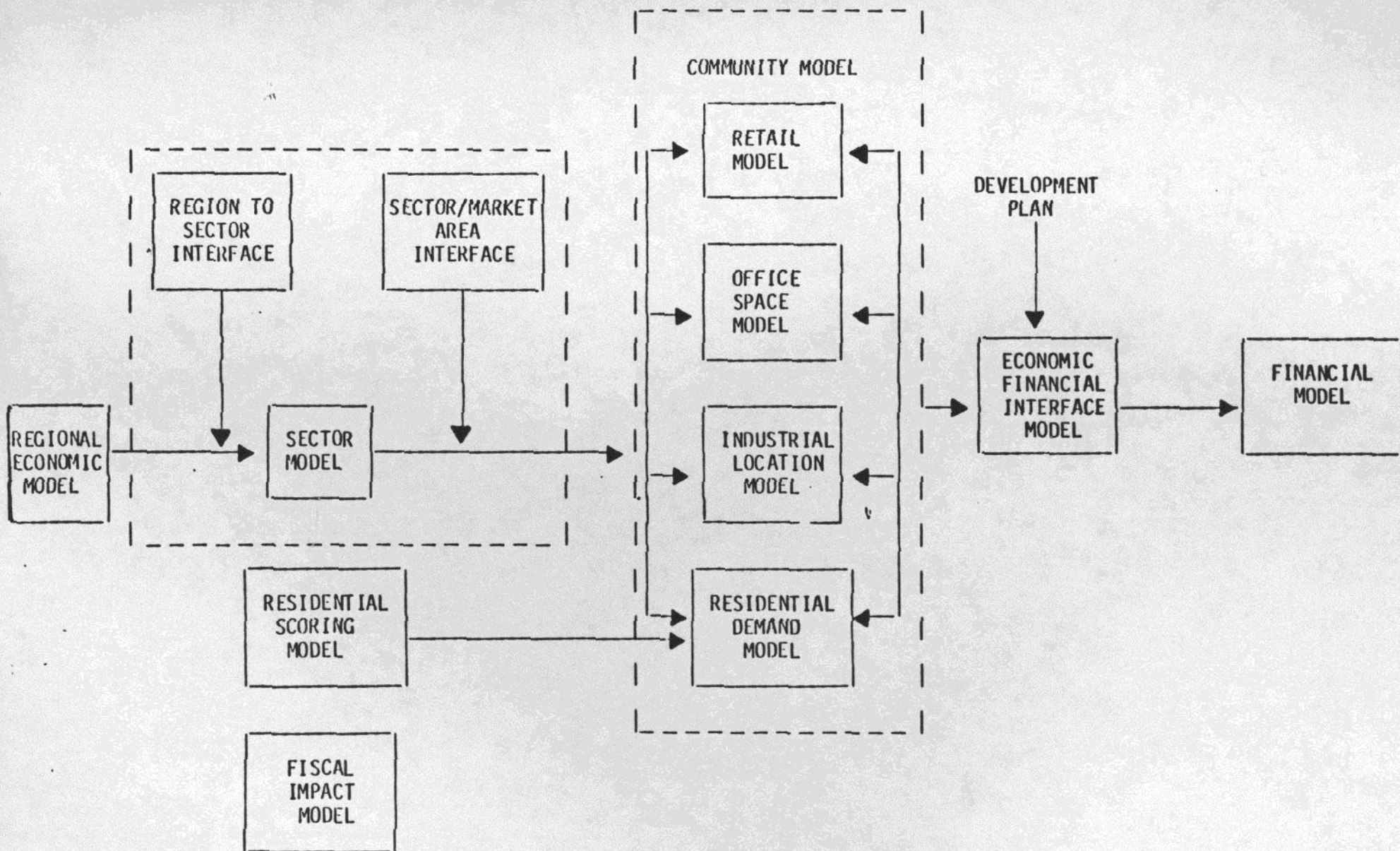
ADVANCED NUCOMS SYSTEM - OVERALL STRUCTURE

EXHIBIT A

permits, electrical hook-up connections, and the community's historical performance may be executed. In the end, however, a single capture rate value, which represents the intricate interrelationships of all the "real world variables," in conjunction with the analysts intuition, is determined for future time periods. The capture rate is then multiplied by the regional housing demand to arrive at the community housing demand. Moreover, the community housing demand is further analyzed by estimating the future share of "ownership" housing, s_i, and "rental" housing, m_i. This is usually carried out through trend analysis or a regression analysis. (An example of this process is displayed in Exhibit K and Exhibit L.)

It shold be obvious that the capture rate for the comunity is the critical variable in projecting community housing demand; and, the capture rate variable is extremely difficult to determine. There are no magical formulas, or quantitative scoring models which analysts can rely on. The analysts' knowledge of the region, the community (and its plans, attributes, and developer abilities), and the interrelationships of all the market forces are the ingredients which can best provide reliable projections.

OFFICE SPACE DEMAND

In estimating the community office space demand, the market analyst generally assumes that the regional market growth wil generate the community demand. For analytic purpose, the office market could be segmented into different categories

Next, during successive blowups on smaller geographic areas, additional infor-
mation is introduced to help predict how households, commercial employment,
and industrial formation is distributed throughout the immediate vicinity of
the new community. The NUCOMS system incorporates this hierarchical approach
with its series of interrelated models: Regional and Economic Model, Sector
Model, Community Model. These models are directly interfaced with the Financial
Models, which provide financial and fiscal impact analyses. Below, these
NUCOMS models are discussed briefly.

REGIONAL AND ECONOMIC MODEL:

The Regional and Economic Model provides a future estimate of the popu-
lation of employment and income distribution of the region by inter-
relating such variables as employment, population, labor force parti-
cipation, migration, wage rates by various SIC (Standard Industrial
Classification). ("Region" is generally defined along metropolitan
center distinction, usually the Standard Metropolitan Statistical Area
SMSA). Two methods are provided in the model: A modified shift-share
approach and an economic base approach. The standard shift-share technique
simulates the growth in a metropolitan area in terms of the following three
components: (1) The national growth rate among all industries, (2) the growth
rate among the industries in the specific metropolitan area, and (3) the
difference between the growth rate in the local industries and the growth
for that industry at the national level. The competitive effect, which was
the third component, was modified to become an extrapolation of the past
shift-share

relationship between the metropolitan area and the economic area (generally, the state level). Using historical data, the share of employment growth in the economic area that is captured by the specific metropolitan area is then estimated.

The economic base theory approach assumes that all economic activity can be divided into two components--basic and non-basic. Basic employment is that which is used to produce output for export and the non-basic employment is that which is used for services. Each industry's employment is classified between basic and non-basic and an employment multiplier is computed as the ratio of total employment to total basic employment. Total employment is forecast by determining the level of basic employment and then applying the multiplier.

The Cohort-survival Method is used for population forecasting and the Lorenz curve approch is used for income distribution. Both of these methods are well-established techniques. (The algorithm for the Regional Economic Model System is presented in Exhibit B.)

SECTOR MODEL:

The Sector Model provides projections for employment, population household size, new household construction, and income distribution for geographic sectors defined by the user. (A sector is defined as a subdivision of the region; often, sectors are defined consistent with county boundaries.)
The model uses the regional estimates generated by the Regional Economic

DATA INPUTS

INPUTS REQUIRED AT RUN TIME	INPUTS STORED IN THE MODEL DATA BASE
Base Year Population Estimates	Birth Rates
Base Year Employment Totals	Death Rates
Regional Share Of Economic Area Employment - 1960 1970	Labor Force Participation Rates
Base Year Wage Estimates	Employment Projections by Economic Area
Ratio of Personal to Household Income	Wage Rate Projections
Distribution of Household Income	Household Size Projections
Maximum and Minimum Unemployment Rates	

Top flow row:

Project Market Area Employment Forward One Year → Project Population Forward One Year → Compute "Population Supported" Employment by Combining the Population Forecast with the Labor Force Participation Rate → Adjust Employment Through In Or Out Migration → If Necessary, Either Reduce Employment Forecast Or Add To Unemployment

Bottom flow row:

Multiple Forecast Employment Matrix by the Wage Matrix to Arrive at the Wage Income Matrix → Compress Wage Income Matrix to Total Wages Summary and Factor to Total Personnel Income → Factor Personal Income to Mean House-Hold Income with House-Hold Size → Form a Distribution of Household Income Around the Estimated Mean → Project Housing Starts →

DATA OUTPUTS

Market Area 1970-200

- 2-Digit SIC Employmen Forecast
- Age and Sex Specific Population Forecast
- Birth And Death Rate Forecast
- Labor Force Participa Rate Forecast by Se
- Migration Forecast
- Household Forecast
- Per Capita and Total Personal Income Fore
- Wage Income Forecast 2-Digit SIC
- Forecast of Wages as Percent of Total Per Income
- Forecast Distribution Household Income
- Household and Househo Size Forecast

STRUCTURE OF REGIONAL ECONOMIC MODEL

EXHIBIT B

Model and allocates the growth to the sectors within the region. The general methods for projecting sector employment within the model are: (1) Distributed lag multiple regression model, (2) Straight line employment share intepolation, and (3) Straight line employment interpolation.

The multiple regression technique examines how certain variables relate to the dependent variable, namely employment. Basically, this regression analyzes the extent to which the change in employment share in sector i, of employment category j, for the time interval t, is a function of employment in sector i, of employment category j, in the two prior time intervals, t-1 and t-2.

The straight line employment share interpolation technique calculates employment shares by sector and by employment category for intermediate years not supplied by the user over the simulation period. The user must supply data on the employment shares by sector and by employment category for the first and the last year of simulation. The straight line employment interpolation does the same as above except actual employment projections are used instead of employment share.

The Sector Model includes three options for forecasting population: (1) work-residence reconciliation, (2) self-calbrating using commuting curve, (3) trend method and using basic constant growth and functions. The work-residence reconciliation method is used to account for the fact that workers often do not reside in the same sector where they work. By applying the required work-residence matrix to the employment data, the reconciliation factor can be generated. This reconciliation factor is used to adjust the sector employment forecasts and the sector population estimates.
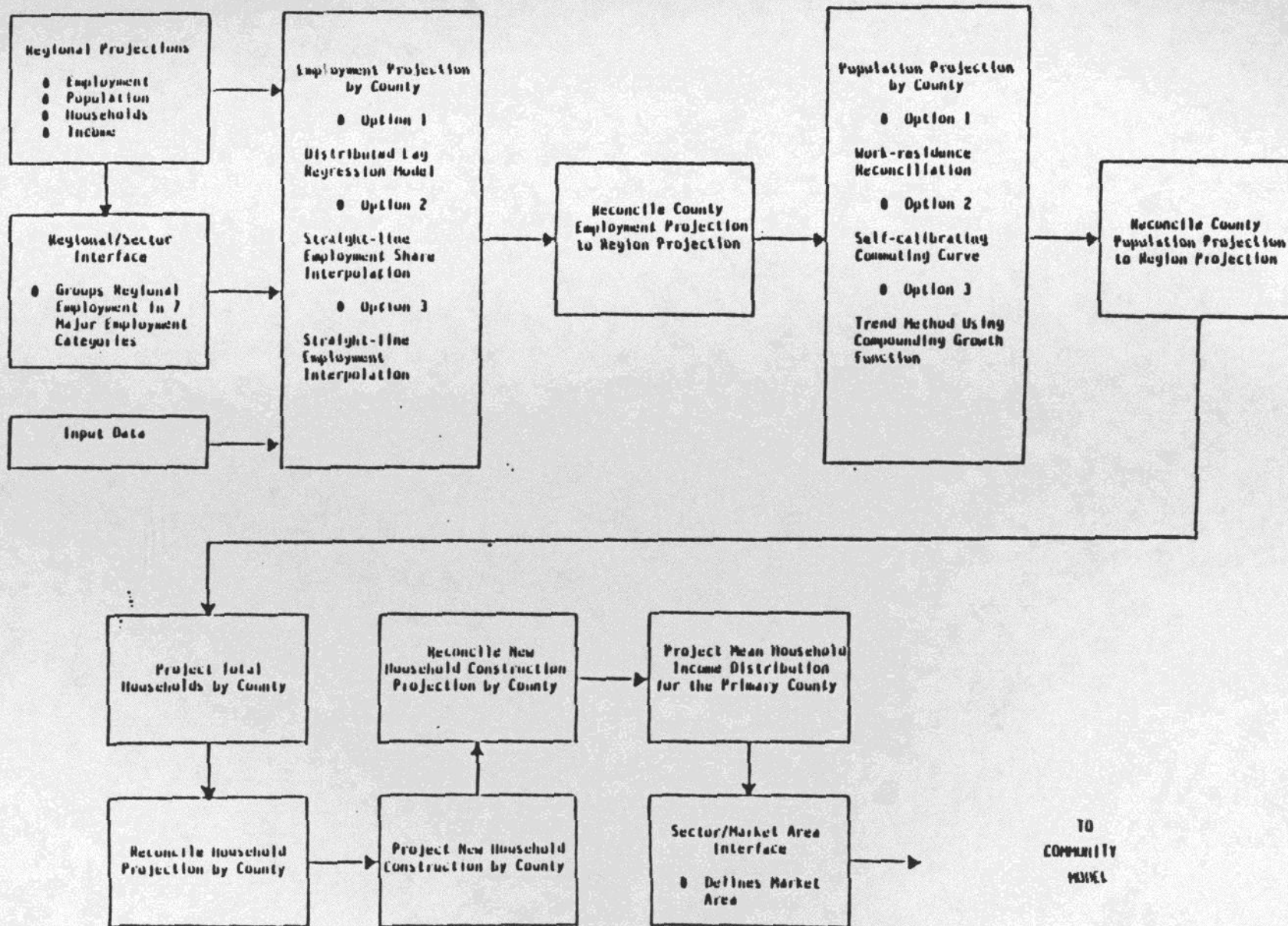
The self-calibrating option computes work-residence coefficients based on the
accessibility between sectors. A frequency distribution for commuting time is
computed and a commuting curve is derived. From this, a potential commuter
ratio is calculated which is used with an inputed household stability factor in
an equation to project sector employment. Trend method uses the basic compound
growth formula to forecast sector population. This method assumes a constant
annual rate of growth and generates its forecasts independent of employment
projections.

The Sector Model projects household size as well as new household construction
(housing starts) for each sector. The extrapolation equations used for
household size estimation assume that differences between sectors are retained
(constant) while growth within the sector is directly proportional to regional
growth.

A reconciliation process for each projection occurs throughout the Sector
Model. The sector projections are checked against the regional projections
and the sum over the sectors is forced to equal the regional projections.
This is to ensure that consistent estimates are transferred to the rest of the
NUCOMS system. (The algorithm for the Sector Model is presented in Exhibit C.

COMMUNITY MODEL
The basic design structure of both the Regional and Economic Model and the
Sector Model is generally based on traditional analytic methods. (The two
exception are the sector population projection techniques of work-residence
reconciliation and that self-calibrating option using commuting curve.)

Regional Projections

- Employment
- Population
- Households
- Income

Regional/Sector Interface

- Groups Regional Employment in 7 Major Employment Categories

Input Data

Employment Projection by County

- Option 1

  Distributed Lag Regression Model

- Option 2

  Straight-line Employment Share Interpolation

- Option 3

  Straight-line Employment Interpolation

Reconcile County Employment Projection to Region Projection

Population Projection by County

- Option 1

  Work-residence Reconciliation

- Option 2

  Self-calibrating Commuting Curve

- Option 3

  Trend Method Using Compounding Growth Function

Reconcile County Population Projection to Region Projection

Project Total Households by County

Reconcile Household Projection by County

Reconcile New Household Construction Projection by County

Project New Household Construction by County

Project Mean Household Income Distribution for the Primary County

Sector/Market Area Interface

- Defines Market Area

TO COMMUNITY MODEL

However, the Community Model, which analyzes the last level in the hierarchal approach, is not an approach which is commonly utilized by practicing consultants, market analysts, and real estate appraisers. This may be due, in part, to non-availability of computer programs specifically tailored to large-scale developments; moreover, practioners are generally sensitive to techniques which require lengthy computations.

The purpose of the Community Model is to determine the portion of the regional and sector growth captured by the new community; thus, the Model is inherently linked to the Regional and Sector Models. There are four separate submodels with the community model: Residential Model, Industrial Demand Model, Office Space Demand Model, and Retail Demand Model. In addition, a separate Residential Scoring Model exists to support the Residential Demand Model. A brief discussion of these models is provided below.

RESIDENTIAL DEMAMD MODEL:

The Residential Demand Model calculates the capture rate for a new community based on the housing starts in the market area and the residential attractiveness "scores" determined by the Residential Scoring Model. The Residential Demand Model is based on an analysis of 12 test case new communities throughout the U.S. Based on the analysis of available data on these communities and published literature on the subject of new communities and residential preference and choice, the major factors affecting residential location were identified, classified and evaluated. A scoring system exists within this model to asses quantitative residential attractiveness scores and the capture rates for the specific new community under evaluation.

The residential capture rate is calculated using the results of the analytical research and is applied to the market area growth to determine the residential demand. Demand due to on-site employment (industrial, retail and office space) is added to detemine total demand for housing. This is then converted into housing demand by income class. (See Exhibit D)

Industrial Demand Model

The Industrial Demand Model projects the industrial employment and development prospects of the new community and then converts those projections to land requirements. This is a particularly important part of the total new community forecasting program in view of the fact that a significant internal employment base is the key element in defining a successful new community.

The Industrial Demand Model performs two basic function. First, it forecasts the amount of industrial employment to be attracted to the new community by estimating the amount of employment by major industry grouping that will be seeking to locate within the new community during the forecast period. This includes: (a) new growth in employment, less that portion occurring at existing facilities, and (b) employment in establishemts moving from one location to another within the sector.

The second primary model function is to determine the proportion of the employment seeking a new location that will be attracted to the new community. The model is based on the following assumptions: (a) The ability to attract employment will be partly detemined by the amount of industrial land available in the new community relative to the total amount available in the sector; (b) The capture rate will be partly determined by the number of actively competing industrial developments within the sector; (c) the capacity of the developer of the new community relative to that of the other
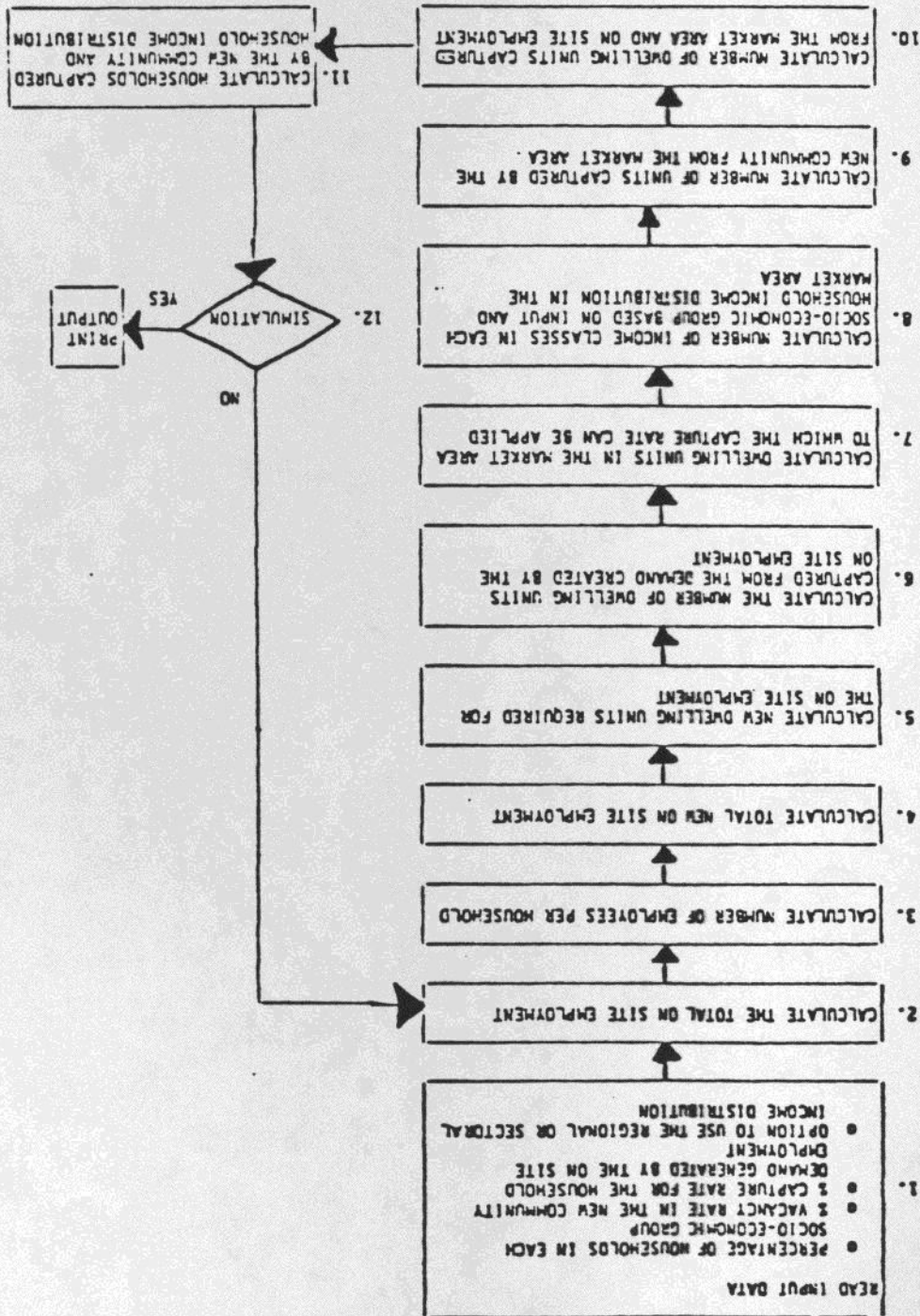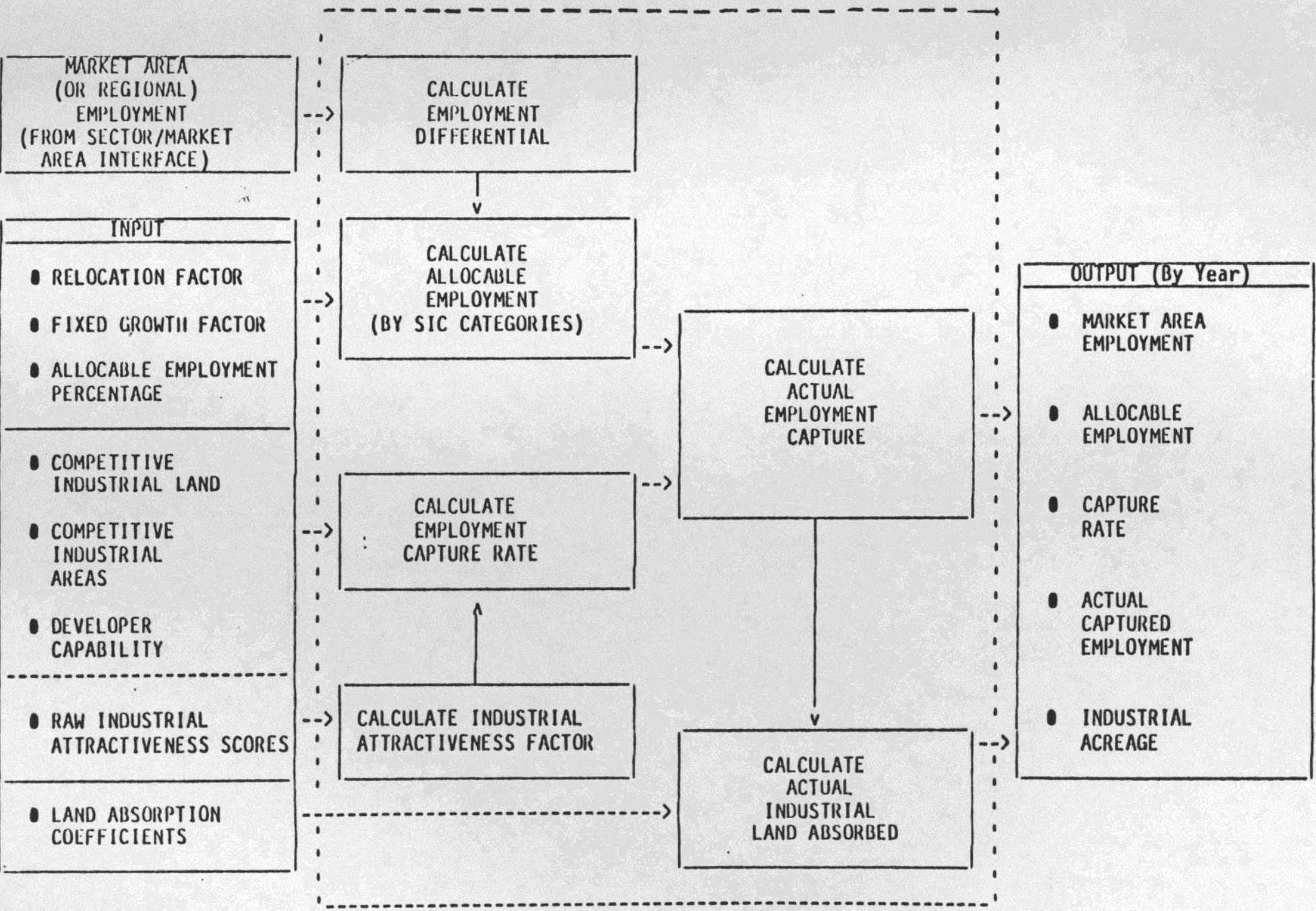
developers operating in the region will affect the capture rate; and (d)
the locational advantages and the quality of the sites offered in the new
community in comparison wth competing offerings will partly determine the
share of employment attracted. Given the forecast of industrial employment
to be attracted,the model converts employment to land area requirements
to land area requirements. This is accomplished by the use of land
absorption coefficients (LACs) which express the quanity of land required
per employee by type of activity. (See Exhibit E)

OFFICE SPACE DEMAND MODEL

The primary role of the Office Space Model is two-fold. First, the model
projects levels of anticipated office space requirements within the new
community which represents the capture of office market potential from
three separate functional and geographic classes: (a) Local Office Market--
those functions which serve local communities and areas of under 150,000
population; (b) Middle Office Market--those functions which serve either
an entire meropolitan area or some segment thereof larger than a local
community. Such functions will normally serve a market area population in
excess of 150,000 persone; (c) Regional and Headquarters Market-those functions
which, at least in part export services beyond the metropolitan area. Their
area of services may be a portion of a state, a region of the country, the
entire nation, or may be international in scope.

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┌─────────────────────┐         ┌─────────────────────┐
│  MARKET AREA        │  --->   │     CALCULATE        │
│  (OR REGIONAL)      │         │    EMPLOYMENT        │
│  EMPLOYMENT         │         │   DIFFERENTIAL       │
│  (FROM SECTOR/MARKET│         └─────────────────────┘
│  AREA INTERFACE)    │                  │
└─────────────────────┘                  v
┌─────────────────────┐         ┌─────────────────────┐
│        INPUT        │         │     CALCULATE        │
│                     │         │    ALLOCABLE         │
│ ● RELOCATION FACTOR │  --->   │   EMPLOYMENT         │
│                     │         │  (BY SIC CATEGORIES) │
│ ● FIXED GROWTH FACTOR│        └─────────────────────┘
│                     │
│ ● ALLOCABLE EMPLOYMENT│
│   PERCENTAGE        │
│                     │
│ ● COMPETITIVE       │
│   INDUSTRIAL LAND   │
│                     │
│ ● COMPETITIVE       │         ┌─────────────────────┐
│   INDUSTRIAL        │  --->   │     CALCULATE        │
│   AREAS             │         │   EMPLOYMENT         │
│                     │         │   CAPTURE RATE       │
│ ● DEVELOPER         │         └─────────────────────┘
│   CAPABILITY        │
│ - - - - - - - - - - │
│ ● RAW INDUSTRIAL    │  --->   CALCULATE INDUSTRIAL
│   ATTRACTIVENESS SCORES│      ATTRACTIVENESS FACTOR
│                     │
│ ● LAND ABSORPTION   │
│   COEFFICIENTS      │
└─────────────────────┘
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MARKET AREA (OR REGIONAL) EMPLOYMENT (FROM SECTOR/MARKET AREA INTERFACE)

INPUT
● RELOCATION FACTOR
● FIXED GROWTH FACTOR
● ALLOCABLE EMPLOYMENT PERCENTAGE
● COMPETITIVE INDUSTRIAL LAND
● COMPETITIVE INDUSTRIAL AREAS
● DEVELOPER CAPABILITY
● RAW INDUSTRIAL ATTRACTIVENESS SCORES
● LAND ABSORPTION COEFFICIENTS

CALCULATE EMPLOYMENT DIFFERENTIAL

CALCULATE ALLOCABLE EMPLOYMENT (BY SIC CATEGORIES)

CALCULATE EMPLOYMENT CAPTURE RATE

CALCULATE INDUSTRIAL ATTRACTIVENESS FACTOR

CALCULATE ACTUAL EMPLOYMENT CAPTURE

CALCULATE ACTUAL INDUSTRIAL LAND ABSORBED

OUTPUT (By Year)
● MARKET AREA EMPLOYMENT
● ALLOCABLE EMPLOYMENT
● CAPTURE RATE
● ACTUAL CAPTURED EMPLOYMENT
● INDUSTRIAL ACREAGE

INDUSTRIAL DEMAND MODEL LOGIC FLOW

Secondly, the model is used to provide estimates of the total level of derived secondary industry serving and population-serving office based employment. (See Exhibit F)

Retail Demand Model

The primary purpose of the Retail Demand Model is to provide a thorough analytic tool to assess the types and magnitudes of incrementally new retail activty which can be supported by the new community within the context of larger market area. The model also serves to examine the impact upon existing retail facilities in the commercial infrastructure with regard to the changed sales levels and distribution. In addition to evaluating the economic viability of retail centers, the model can be used to examine how well certain population concentrations within the effective market area will be served by various mixes of retail activity.

Basically, the Retail Demand Model allows the user to assess the expected sales turnover and capture rates for the new community retail facilities for fourteen durables/shoppers' goods merchandise lines and six convenience goods lines. These expected turnover levels and capture rates are bounded by an upper physical capacity-related bound. The upper bound represents a reasonable estimate of the maximum turnover a facility of the specified square footage can support at a high level of physical utilization or facility "saturation." Beyond this limit or bound operational difficulties typified by stockouts, reduced customer service, etc. can be anticipated. The lower bound represents a minimum level of trade activity below which the marginal investment in the enterprise is questionable or "dominated" by some alternative economic opportunity.