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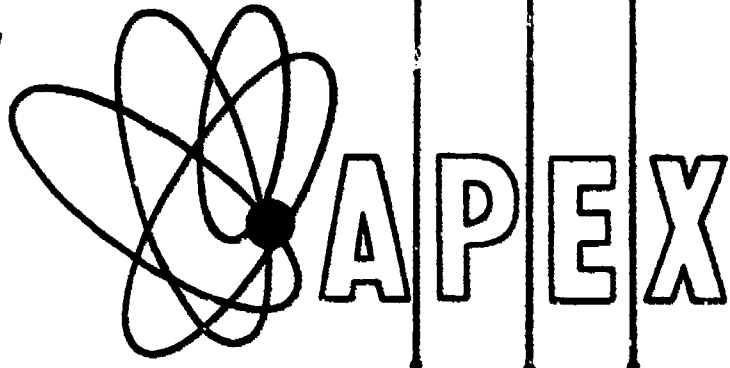
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ABSTRACT

The Game Director's Manual is the first in a set of 21 manuals (AA 001 009-001 029) used in APEX (Air Pollution Exercise), a computerized college and professional level "real world" simulation of a community with urban and rural problems, industrial activities, and air pollution difficulties. The participants, which may range in number from 18 to 75, each assume one of five decision-making roles: city or county politician, city or county planner, developer, industrialist, and air pollution control officer. An APEX game typically takes five sessions (cycles) of about four hours each; however, a minimum of three three-hour cycles is possible. A cycle, which represents a one-year period in the simulated urban environment, is composed of two major phases. The first is the game simulation during which the students participate in their interacting roles making decisions and forming policy. In the second phase decisions emerging out of the game simulation are analyzed by a computerized system of integrated simulation models. This computer analysis indicates changes in the urban area and becomes input into the game simulation of the next cycle. The APEX computer program (not included in manuals) is in Fortran IV and runs on an IBM 1130-2B computer or IBM 360-50 or higher series computer.  
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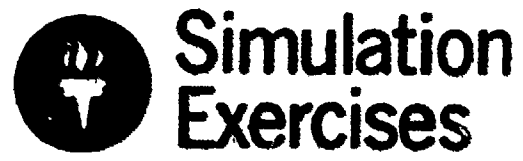
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**Air Pollution Exercise**

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**VOLUME 1**  
**GAME DIRECTOR'S MANUAL**

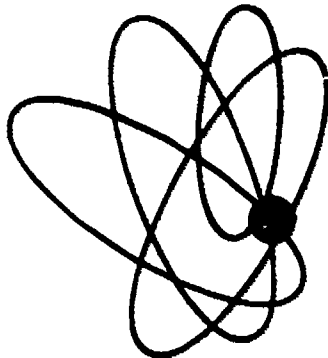
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**ENVIRONMENTAL PROTECTION AGENCY**





**APEX VOLUME 1  
GAME DIRECTORS MANUAL**

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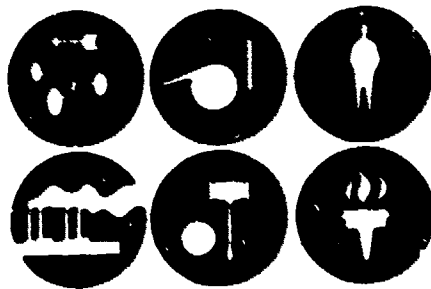
This course is designed for professional persons in the field of air pollution control. The course manual has been prepared specifically for the trainees attending the course, and should not be included in the reading lists of periodicals as generally available.

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**CONDUCTED BY**

**The Office of Manpower Development's  
Institute for Air Pollution Training**

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**ENVIRONMENTAL PROTECTION AGENCY  
Office of Air Programs  
Office of Manpower Development  
Institute for Air Pollution Training  
Research Triangle Park  
North Carolina 27711**

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# APEX • VOLUME 1 GAME DIRECTOR'S MANUAL

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LIST OF MANUALS USED IN THE APEX GAME SIMULATION

- Volume 1: Game Director's Manual
- Volume 2: Computer Operator's Manual
- Volume 3: Air Pollution Control Officer's Manual
- Volume 4: City Politician's Manual
- Volume 5: County Politician's Manual
- Volume 6: Industrialist's Manual: No. 1, Shear Power Company
- Volume 7: Industrialist's Manual: No. 2, People's Pulp Plant
- Volume 8: Industrialist's Manual: No. 3, Rusty's Iron Foundry
- Volume 9: Industrialist's Manual: No. 5, Caesar's Rendering Plant
- Volume 10: Industrialist's Manual: No. 6, Dusty Rhodes Cement Co.
- Volume 11: Developer's Manual: No. 1
- Volume 12: Developer's Manual: No. 2
- Volume 13: Developer's Manual: No. 3
- Volume 14: Developer's Manual: No. 4
- Volume 15: Developer's Manual: No. 5
- Volume 16: Developer's Manual: No. 6
- Volume 17: Developer's Manual: No. 7
- Volume 18: City Planner's Manual
- Volume 19: County Planner's Manual
- Volume 20: Reference Materials
- Volume 21: Legal References: Air Pollution Control Legislation



APEX

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## Air Pollution Exercise

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 **Simulation Exercises**  
conducted by the  
**Institute  
for Air Pollution  
Training**

The responsibility of the Federal Government's Office of Air Programs to provide leadership and assistance to State and local air pollution control agencies in the recruitment and development of qualified personnel is a major theme of the 1970 Clean Air Act. The Office of Air Programs, (OAP) in conjunction with the University of Southern California and the University of Michigan, has created and developed a simulation exercise identified as APEX (Air Pollution Exercise). This exercise establishes a dynamic atmosphere in which the trainees participate in a "real world" simulation involving a community with urban and rural problems, industrial activities, and a variety of air pollution control problems.

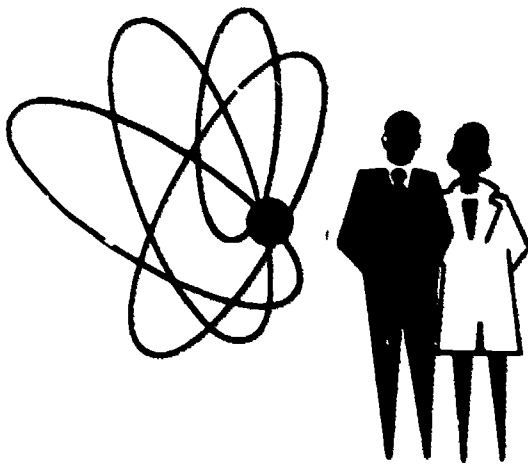
Current and projected uses of APEX have been developed through several of the University Consortia established in conjunction with OAP's Office of Manpower Development.

The use of simulation exercises for the training of air pollution control professionals offers two immediate and vital benefits:

1. A means is provided for a working application of theoretical knowledge; the learner applied information and skills to "real life"

situations. In addition, motivation directed toward additional learning results from participation in seeking solutions to the problems.

2. The focus is provided for solving problems through an interdisciplinary approach, where the interrelationship between "formal" areas of study and application becomes evident.



Students participating in APEX assume the roles of a number of decision makers: city and county politicians, city and county planners, developers, industrialists, air pollution control officers, and concerned citizens. Realistic data are supplied for each role, and the students are required to make decisions that are then analyzed by the computer. Next, the results of the decisions are presented as new situational data representing a year of "actual time." Students participating in these programs — which place special emphasis on air pollution problems — employ a wide range of skills and knowledge in a variety of areas. Additional opportunities for growth are provided through seminars, lectures, texts, and working contact with recognized authorities in a number of professions.

Within the overall format of the simulation exercise, emphasis is placed upon specific areas through the use of special situations, for example, hearings on air pollution standards or legal actions brought against a particular industry.

Additionally, preparations are underway to introduce APEX as a graduate course at OAP's new Technical Center in the fall of 1971 for students from the Triangle Universities Consortium. In addition to its use at the University of Southern California, APEX is now being conducted as a graduate course at the University of Illinois at Urbana and at Harvard University as part of an Environmental Education program for both graduate and undergraduate studies.



## Section 1-1

### Introduction to - APEX

APEX is one of, if not the most complex gaming-simulations of an urban area in use today. Although it was designed to supplement standard teaching methods, APEX is far more than an educational tool. It is a communication channel of a new kind -- capable of providing both the language and the forum for information transfer between persons and groups with different educational and cultural backgrounds as well as different perspectives on urban life.

APEX is composed of two essential components (1) a computerized system made up of a series of well-integrated simulation models (2) linked to a "gamed" environment encompassing a series of interactive roles. The computerized system predicts the changes that occur in several sectors of urban life in response to the decisions made by participants in the "gamed" environment, decisions made by persons outside the "gamed" environment (other actors whose behavior is simulated in the computer), and external pressures on the city (also simulated in the computer).

The county of APEX is run year by year by a set of elite decision makers performing both the mundane and extraordinary functions of their office in the "gamed" environment. Each cycle or year is condensed in time to a three to eight hour session during which the decision makers formulate their yearly policy. The decisions that emerge out of the "competitive-cooperative" environment of the gaming-simulation are used as priming inputs to the computer simulation. The change in the status of the urban area is calculated by the computer and returned to the decision makers as the primary input to the next cycle of action. Included in the change picture generated by the computer are selected social indicators measuring the magnitudes of change in assorted key areas and a newspaper serving as the focal point of local public opinion.

The key decision makers acting in the gamed environment include politicians and planners from a central city and a county, an air pollution control officer from the county, and land developers and industrialists from the private sector. The politicians are responsible for the administration of their respective jurisdictions and for the formulation and implementation of various programs to upgrade the social status of their constituents. The planners serve as aides to the politicians and represent the major long range coordinating force in the community. The air pollution control officer is charged with the task of cleaning and monitoring the air mass above APEX county. The land developers and industrialists have the responsibility of running their particular business concerns within the confines of the county. It is expected that each decision maker will find it to his advantage to coordinate and/or compete with other players in his efforts to promote his strategies. The APEX General Interaction Diagram included here (see page ) indicates possible linkages among players and between players and the simulation.

In general, people have great difficulty understanding the dynamics of a complex system through traditional means. Gaming-simulation offers participants the opportunity to study, work with, and discuss the struc-

ture of such a system and to experiment with intervention strategies designed to change that structure. When used as a teaching device, the strength of a gaming-simulation such as APEX lies in the opportunity afforded participants for involvement in the system. When compared with the passive observation of the system offered by traditional methods, this approach has had great success.

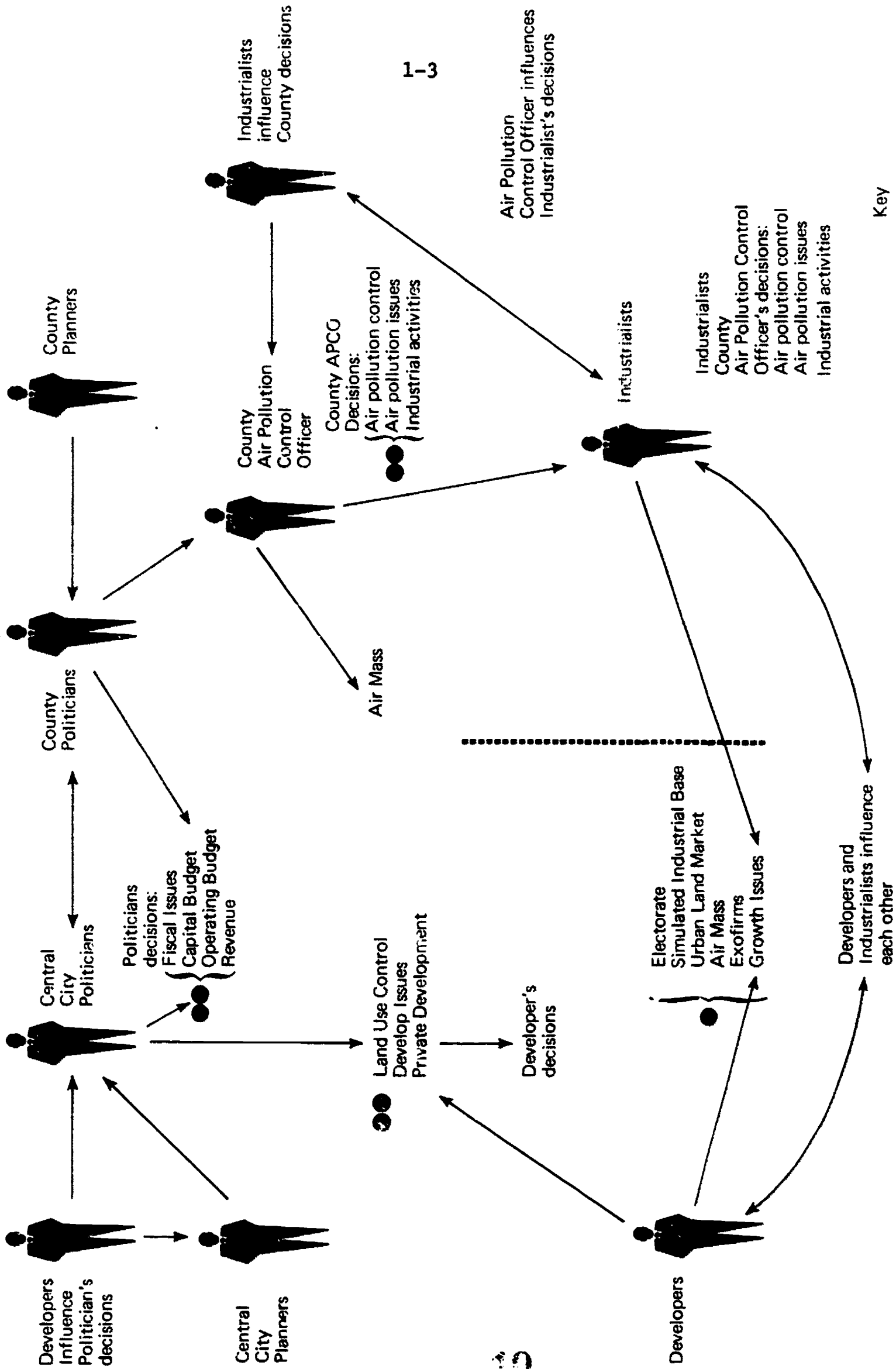
In theory, complex gaming-simulation of the APEX variety is more than a training device or communications facilitator. If the models were more sophisticated the data base more accurate and more complete, a complex gaming-simulation would be a policy testing device for use by practicing urban politicians, planners, APCO's and administrators. Conditional predictions (predictions based on the particular policies and/or decisions submitted to the model) of the ramifications of various decisions can be generated through the use of a complex gaming-simulation -- predictions that may forewarn the model user of unforeseen reactions to policy at several levels of the urban hierarchy ranging from that of the highest level.

The gamed environment is similar to that found in a typical midwestern industrialized town. (In fact, the prototype city is Lansing, Michigan). It has a population approaching 220,000 including several of minority groups sharing racial or ethnic ties. There is a relatively dense central city in the heart of the county, an adjacent suburb and two outlying townships. Most of the industry is located in the central city (as are the minority groups). Major firms include a large auto plant and the state government offices. The suburb houses a major university. The townships are largely agricultural, although urbanizing settlements are dotting the landscapes. There is a major river running through the city serving as the primary drainage system for the county. The climate of APEX is temperate, with summer temperatures averaging about 70 degrees and winter temperatures averaging near 25 degrees. Prevailing winds are westerly, swinging to the southwest in summer and northwest in winter.

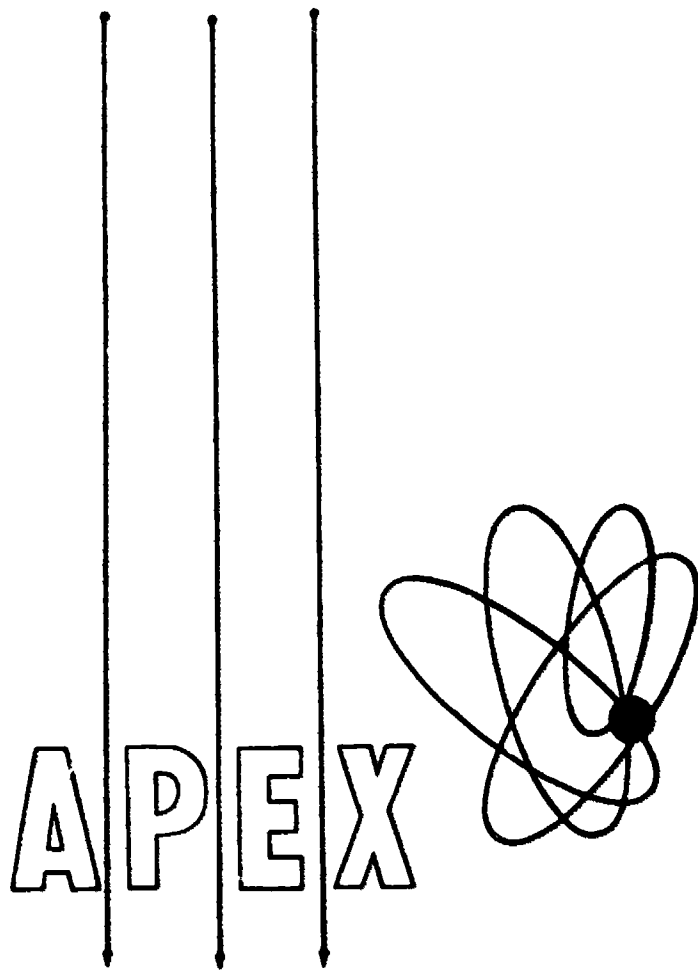
For the purposes of the gaming exercise, APEX county is divided into 29 analysis areas (see the attached map, Section 9). Population, employment and land use will be allocated to the areas and are categorized by types established especially for APEX. These types are described in the glossary included in this manual (Section 2) a glossary designed to aid participants in learning the terminology of urban and environmental management as well as that of the gaming exercise.

**FOR ADDITIONAL INFORMATION:**

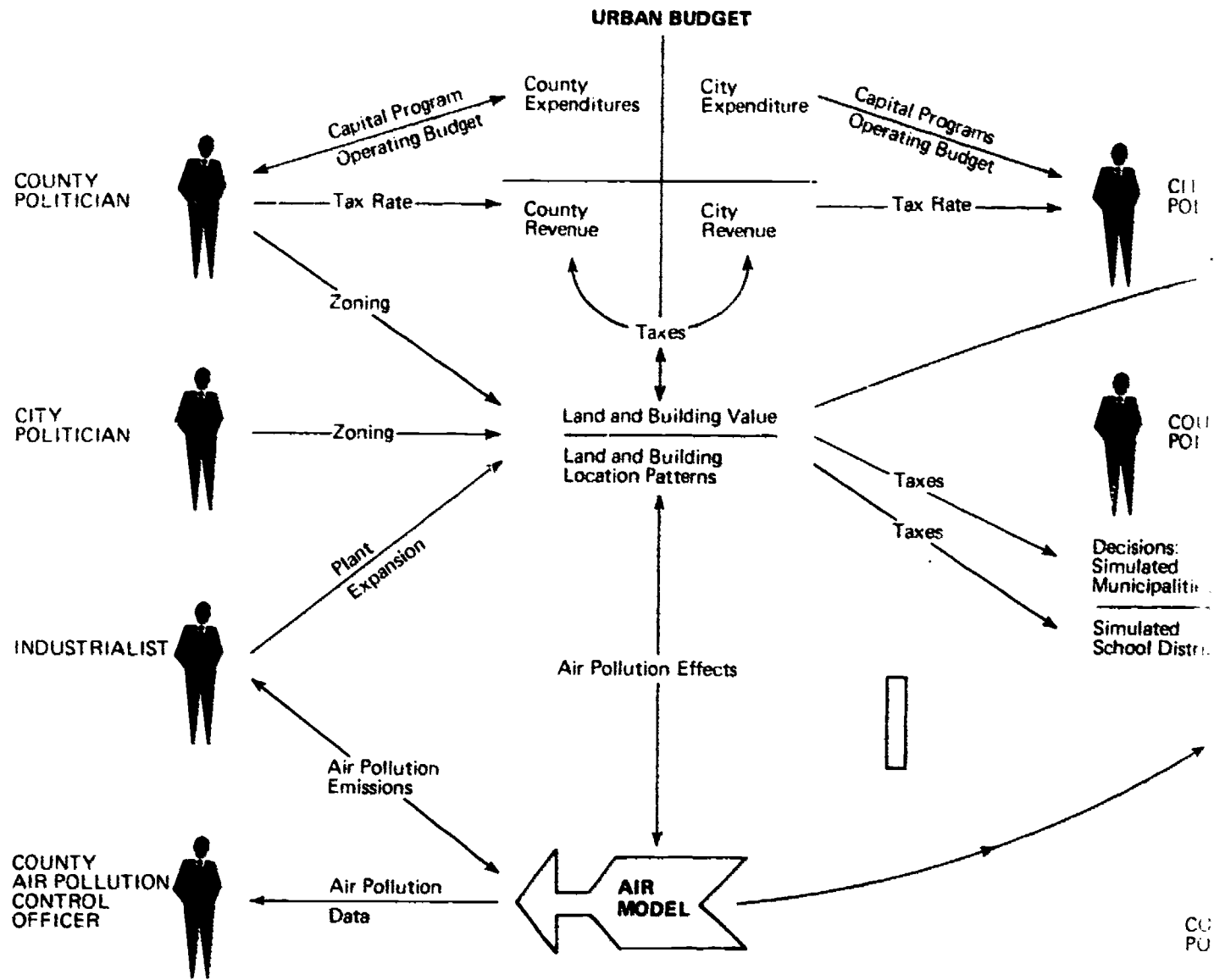
Address inquiries to Chief, Institute for Air Pollution Training  
Environmental Protection Agency  
Research Triangle Park, North Carolina 27711



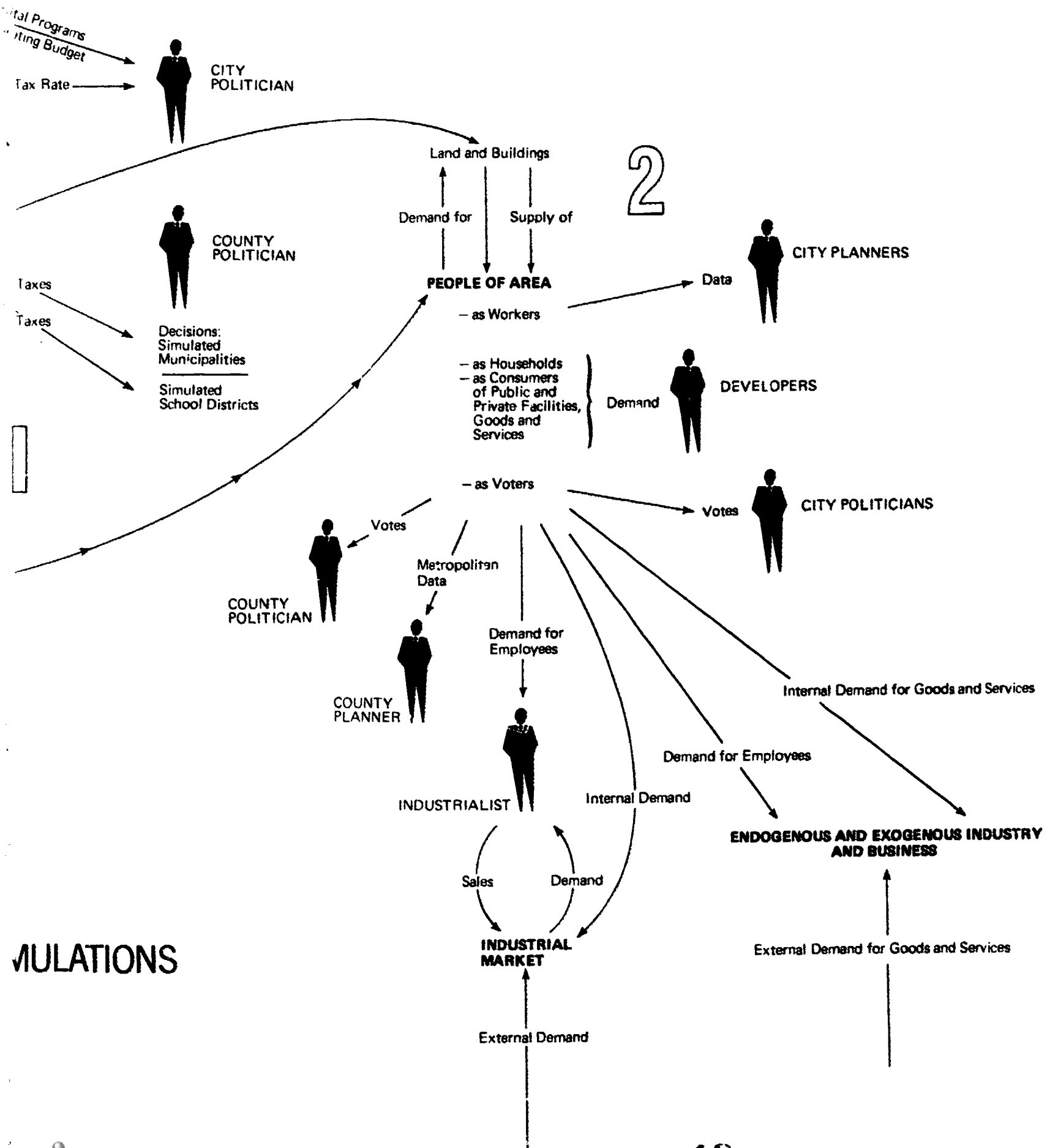
# APEX GENERAL INTERACTION DIAGRAM



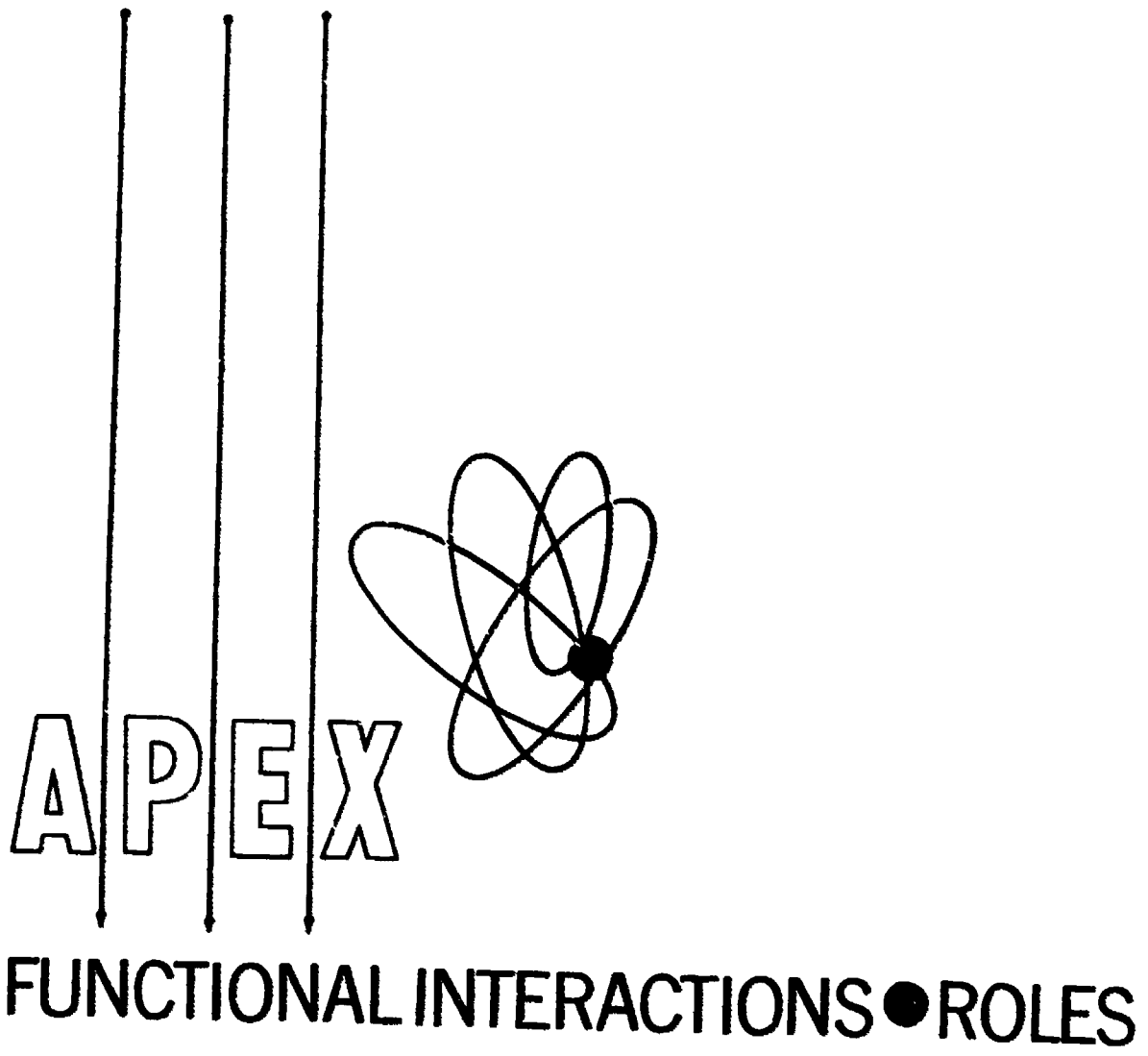
**FUNCTIONAL INTERACTIONS**  
**● SIMULATIONS**

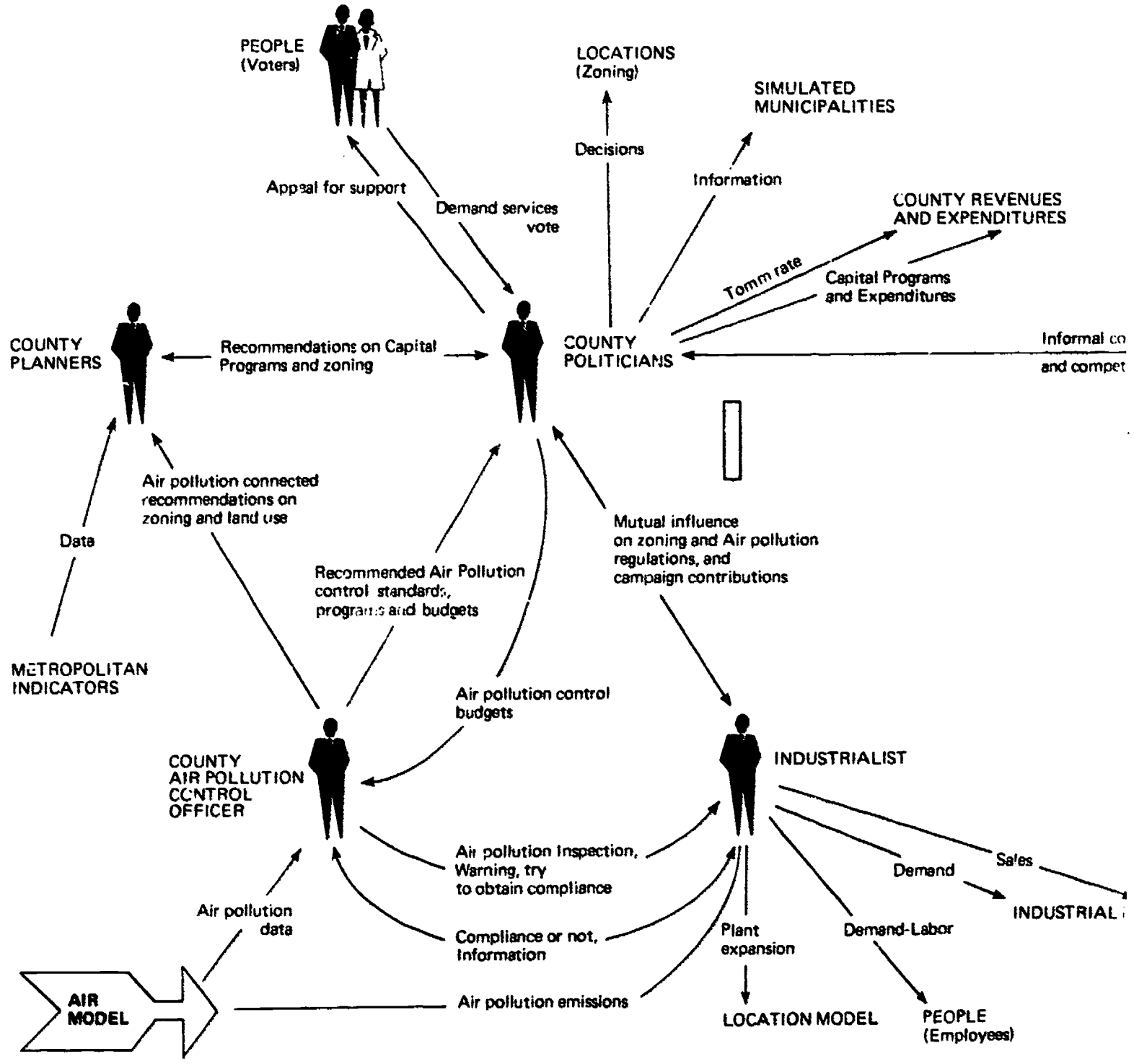


# APEX FUNCTIONAL INTERACTIONS • SIMULATIONS



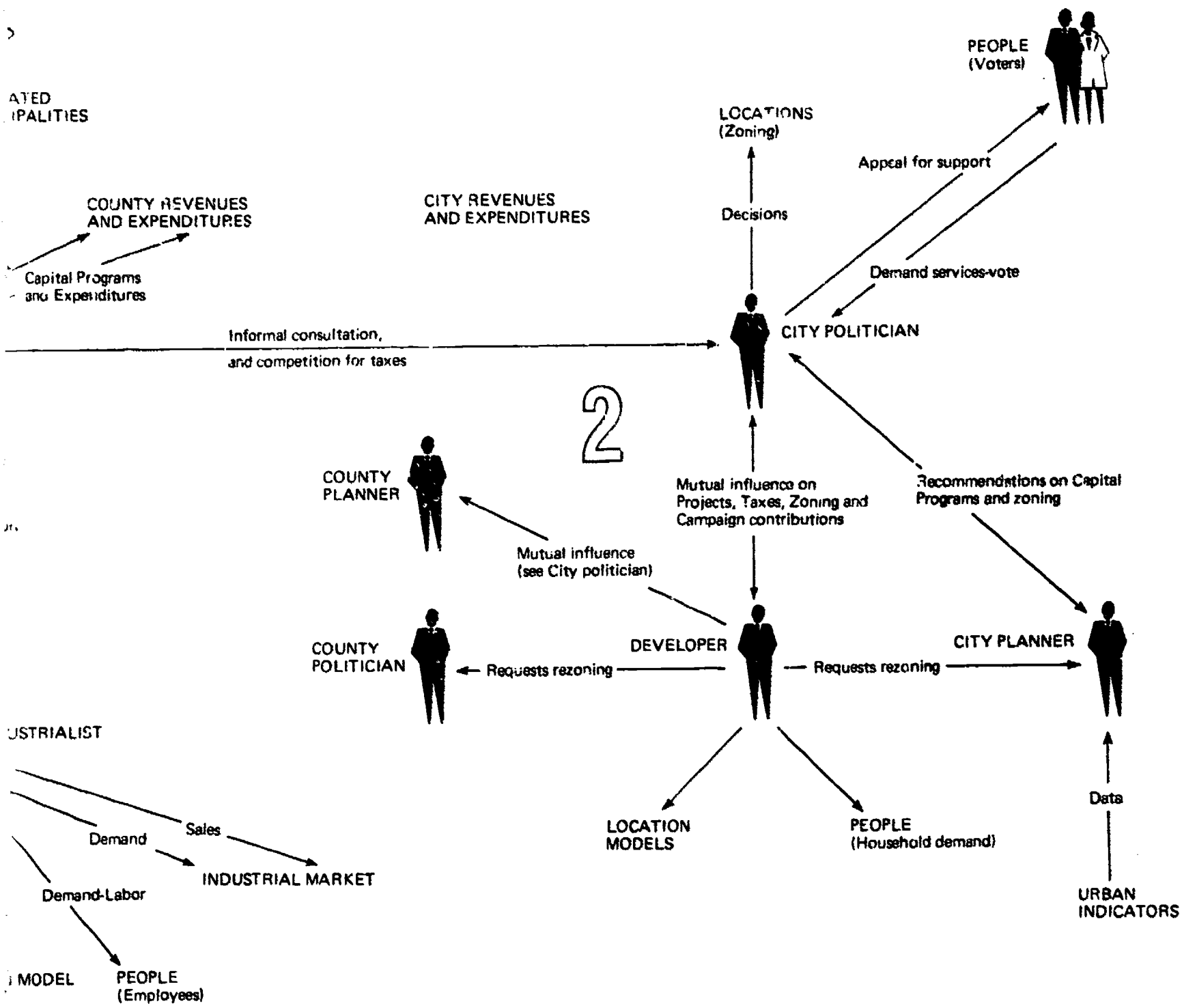
MULATIONS





A





# APEX FUNCTIONAL INTERACTIONS • ROLES



Section 2-1

GLOSSARY AND REFERENCE TERMS

ABATEMENT

Abatement is the reduction of pollutant emissions from a source or sources.

AIR POLLUTION

Air pollution is the presence in the outdoor air of substances which, when present in sufficient quantity or over a period of time, can cause an undesirable effect upon man, property, or the environment.

AIR POLLUTION REGULATIONS

Air pollution regulations are legal constraints on pollutant emissions, production processes, or control systems. State regulations and County regulations are enforceable by legal sanctions, while recommendations are not.

AIR QUALITY

Air quality refers to the pollution concentration characteristics of the atmosphere or ambient air in a given area. It is usually stated in terms of the levels of concentration of specific pollutants, in parts of pollutant per million parts of air. (See CONCENTRATION.)

Air Quality Goals are expressions of desirable maximum pollutant concentrations to be achieved through a pollution control program.

Air Quality Standards are quantitatively-specified maximum levels of pollutant concentrations or dosages, as more precise statements of air quality goals.

ALERT STAGES

Alert Stages refer to critical levels of concentration or dosage signalling potential disastrous pollution effects and requiring emergency abatement and control measures.

ANALYSIS AREA (A.A.)

Analysis areas are used as the primary areal reference units for the data and issues throughout the game. The County is divided into a number of analysis areas, each of which is the approximate size of several census tracts. The analysis areas included in the five jurisdictions are as follows:

Jurisdiction 1 -- Central City: Ward 1 = AA 1 through AA 4  
 Ward 2 = AA 5 through AA 8  
 Ward 3 = AA 9 through AA 13

Jurisdiction 2 -- Suburb: AA 17 through AA 19

Jurisdiction 3 -- Township 1: AA 23 through AA 28

Jurisdiction 4 -- Township 2: AA's 14-16, 20-22, 29

Jurisdiction 5 -- County: AA's 1-29

(See APEX Analysis Area map)

### ANNUAL WAGE

This is the annual cost to the Industrialist of one worker and is an average of the various rates of pay applicable to the different types of workers in the firm. The applicable average wage rate for each firm is reported in the Industrialist's output each cycle under cost factors.

### ASSESSED VALUE

Assessed value is the value assigned to real estate property for purposes of assessing taxes owed to each of the Jurisdictions, County and school districts. Governments are required by law to maintain an assessed value of 50% of market value for property in their jurisdiction, although this requirement is often not met. (E.g. if a residential property is valued on the market at \$20,000, its assessed value is \$10,000.)  
(See STATE EQUALIZED VALUE.)

### BOARD OF DIRECTORS

Each Industrialist acts as a Plant Manager and is responsible to the Board of Directors of his plant for his decisions and actions. The Board has the ultimate decision-making power in Plant affairs and may approve, amend or reject the Manager's fiscal policy proposal. The Board also sets the amount of dividends to be paid to the stockholders.

### BONDING

Bonding is the process of incurring public debt to finance some capital improvement project. It is a device used to extend the incidence of costs over a long period of time, rather than have costs met out of current revenues while the project is under construction. Politicians may issue two kinds of bonds, general obligation bonds and revenue bonds. These differ in three respects: (1) the need for voter concurrence, (2) how they are paid off, and (3) the kinds of projects for which they are appropriate. Before Politicians may float general obligation bonds to finance projects, voters must approve this action in a referendum. There is a State-imposed limit on the indebtedness that a jurisdiction may incur through general obligation bonds. The amount of additional

bonded indebtedness that can be sought is indicated in the Politician's output as "\$ Limit on Next Bond Sought".

(See DEBT RETIREMENT for the process of financing general obligation bonds.)

Revenue bonds are not submitted to a referendum and are appropriate only for particular projects. (Projects for which they may be used are noted in the Project List.) They are paid off through fees collected for the service provided by the facility, rather than by taxes.

### CAPITAL PLANT INDEX (C.P.I.)

The capital plant index is a ratio of the present dollar value of public capital facilities (sewers, water lines, streets, parks and miscellaneous public holdings) to population equivalents. This number reflects the load imposed on facilities by residents, employees and clients, and thus is considered as an indication of the relative level of adequacy of these facilities. Present dollar value is calculated each cycle on the basis of depreciated value of existing facilities plus new facilities. (Facilities depreciate at about 5% of original value per year.)

(See POPULATION EQUIVALENT.)

### CASH CARRYOVER

This is the cash reserve which an Industrialist or Developer carries over to the next cycle after making all his expenditures, including those for capital plant. It represents as-yet uncommitted funds, which the player is free to use in the next cycle.

### CASH TRANSFER

A cash transfer is used for loans or gifts of cash between players when the reason for the exchange is unspecified. Revenues made, or expenditures incurred, through an exchange of cash between either the Government, Industrialist, or Developer, are recorded in the budget section of the output. When applicable, cash transfers are also used to cover the cost of television time and newspaper articles.

### COMBUSTION

Combustion is the process of burning fuel or wastes.

### CONCENTRATION

Concentration is the ratio of pollutants to effluent gases or ambient air, measured in parts per million (ppm) as a volume to volume ratio, or micrograms per cubic meter (UG/cubic meter) as a weight to volume ratio. Data on mean concentration per quarter, concentration on worst day, and number of days above a specified concentration can be obtained by the APCO, through the installation and operation of monitoring stations.

### CONTAMINANT See POLLUTANT

CONTROL EFFICIENCY

Control efficiency refers to the ratio of the amount of a pollutant removed from effluent gases by a control device to the total amount of pollutant without control.

CONTROL SYSTEM

Control system refers to equipment and/or procedures intended to reduce the amount of a pollutant, or pollutants, in effluent gases. Each gamed industrial firm has a limited set of control system options for each production or combustion process.

DEBT RETIREMENT (Debt Service)

Debt retirement, or debt service, is a term used to describe the process of paying off long-term general obligation bonds sold by public agencies. Debt retirement is a budget category of the Politician which includes expenditures for both principal and interest on general obligation bonds. Financing of these expenditures may be with either normal millage or debt retirement millage.

DEMOLITION COSTS (Clearance Costs)

A demolition cost of 5% of the assessed value of developed property must be paid when developed land is rezoned.

DENSITY

In residential areas, density is the term used to express the number of dwelling units per acre of land. In APEX a different density is associated with each of the five residential development types, with the lowest density found in land use category R-1 and the highest in category M-2.

The table on the following page expresses housing density in housing units per acre, and in acres per housing unit.

DEPRECIATION ALLOWANCE

Each cycle, the total value of capital facilities, (building and equipment) depreciate. A tax credit of 5% of the capital value facilities is allowed the industrialist to compensate for this depreciation. The amount is deducted before Federal and State income taxes are paid. The industrialist may claim any part of his maximum allowance; any portion of the allowance not taken will accumulate. The maximum depreciation allowance is listed under cost factors in the industrialist's output.

HOUSING DENSITY

AA	R-1		R-2		R-3		M-1		M-2	
	Units per Acre	Acres per Unit	Units per Acre	Acres per Unit	Units per Acre	Acres per Unit	Units per Acre	Acres per Unit	Units per Acre	Acres per Unit
1	1.4	.71	3.5	.29	5.6	.178	11.2	.089	21.0	.047
2	2.4	.41	6.0	.16	9.6	.104	19.2	.052	36.0	.027
3	2.0	.5	5.0	.20	8.0	.125	16.0	.062	30.0	.033
4	2.8	.35	7.0	.14	11.2	.089	22.4	.046	42.0	.023
5	2.1	.47	5.3	.18	8.4	.119	16.8	.059	31.5	.031
6	1.6	.62	4.0	.25	6.4	.156	12.8	.078	24.0	.041
7	2.5	.4	6.3	.15	10.0	.10	20.0	.050	37.5	.026
8	3.0	.33	7.5	.13	12.0	.083	24.0	.041	45.0	.022
9	1.2	.83	3.0	.33	4.8	.208	9.6	.104	18.0	.055
10	2.5	.4	6.3	.158	10.0	.10	20.0	.050	37.5	.026
11	1.0	1.	2.5	.4	4.0	.25	8.0	.125	15.0	.066
12	1.0	1.	2.5	.4	4.0	.25	8.0	.125	15.0	.066
13	1.0	1.	2.5	.4	4.0	.25	8.0	.125	15.0	.066
14	.5	2.	1.3	.76	2.0	.5	4.0	.25	7.5	.013
15	.6	1.66	1.5	.66	2.4	.41	4.3	.208	9.0	.011
16	.8	1.25	2.0	.5	3.2	.31	6.4	.156	12.0	.083
17	1.2	.83	3.0	.33	4.8	.208	9.6	.104	18.0	.055
18	2.3	.43	5.8	.172	9.2	.108	18.4	.054	34.5	.028
19	3.0	.33	7.5	.13	12.0	.083	24.0	.041	45.0	.022
20	.8	1.25	2.0	.5	3.2	.31	6.4	.156	12.0	.083
21	.5	2.	1.3	.76	2.0	.5	4.0	.25	7.5	.013
22	.4	2.5	1.0	1.	1.6	.62	3.2	.31	6.0	.16
23	.7	1.42	1.8	.55	2.8	.35	5.6	.178	10.5	.095
24	.3	3.33	.8	1.25	1.2	.83	2.4	.41	4.5	.022
25	.4	2.5	1.0	1.0	1.6	.62	3.2	.31	6.0	.16
26	.3	3.33	.8	1.25	1.2	.83	2.4	.41	4.5	.022
27	.6	1.66	1.5	.66	2.4	.41	4.8	.208	9.0	.011
28	.3	3.33	.8	1.25	1.2	.83	2.4	.41	4.5	.022
29	.5	2.	1.3	.76	2.0	.5	4.0	.25	7.5	.013



DEVELOPMENT TYPES AND COSTSA. Residential

In APEX there are various levels of cost and density associated with different qualities and sizes of housing which may be built by Developers. These costs are for structures, exclusive of land and site improvements.

Single Family

Three different development-cost levels are applicable to APEX single-family housing units, ranging from the highest construction cost of \$40,000 (designated as R-1) to the lowest cost housing, built at \$15,000 per unit (designated as R-3). Any one of these types may be built on land which, when vacant, is zoned R.

Multiple Family

Units of two different cost levels, M-1 and M-2, are available for construction of multi-family housing in APEX. The highest cost per unit, for M-1, is \$30,000 and the lowest, for M-2, is \$12,000. Either of these types may be constructed on vacant land zoned M.

Residential Development Costs per Unit

R-1	R-2	R-3	M-1	M-2
\$40,000	\$22,500	\$15,000	\$30,000	\$12,000

B. Commercial

Two types of commercial land use are allowable in APEX. These relate to local neighborhood shopping facilities and to regionally-oriented commercial and service facilities. Both may be built only on zoning category C land. Each is developed on a cost-per-acre basis, as follows:

Commercial Development Costs by Type

CL	CR
\$100,000	\$125,000

C. Industrial

Endogenous industrial development permitted Developers in APEX is on a per-acre basis, the cost being \$100,000 per acre. Zoning category I land may be developed into this land use.

(See ZONING CATEGORY.)

DOSAGE

The specified time duration of an air pollutant's critical concentration level in a particular location, or for a particular person, material, etc., is known as dosage.

EFFLUENT

Effluents are the total gaseous emissions from production and combustion processes and activities, including air pollutants and non-noxious material.

ELITE OPINION POLL (E.O.P.)

The Elite Opinion Poll calls for a vote of all game players on certain major policy issues in the community. These issues appear as headlines in the M.E.T.R.O.-APEX News, which ask for either a deciding or advisory vote. The results of the Poll affect public officials' chances of re-election, as well as the probabilities of passage of general referenda and specific bond issue and special millage requests.

EMISSIONS

Emissions are pollutants in effluent or exhaust gases which are released into the air.

EMISSION FACTORS

Emission factors are estimates which can be used to approximate the rate of emissions of specific pollutants from generalized sources.

EMISSION MEASUREMENT

Air pollution emissions are measured in pounds per hour for particulates, sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), and hydrocarbons (HC); in Ringelmann number for smoke; and in Stinkelmann number for odor. The emissions measured are of specific pollutants from specific sources.

EMISSION RATE

Emission rate refers to the amount of pollutant emitted per unit of time. Maximum allowable emissions will be specified in pounds per hour if they refer to emission rates.

EMISSIONS SOURCE

An emission source is the origin of some specific air pollutants. In the game there are several gamed point sources, about thirty non-gamed point sources, plus motor vehicles and space heating as line and area sources, respectively.



## EXOFIRM (EXOGENOUS FIRM)

An Exofirm is an industry or bureaucratic firm that depends primarily upon markets outside the local area for its growth and vitality. These firms are usually classified as Exofirms on the basis of their being net importers of dollars and net exporters of products or services to these outside markets. Jobs created by Exofirm growth spur additional growth of households and jobs oriented to the local market. (Exofirms are also often referred to as basic firms).

In APEX, Exofirms locate in zoning categories I and O.

Periodically, the newspaper will note the opportunity for Developers to invest, in a speculative way, in the entry of new Exofirms into the metropolitan area, with a variable probability of success attached to such investments. Occasionally, these Exofirms require rezoning of land and/or installation of special capital improvements. Requirements for such special public action and requests for private investment will be noted in the newspaper announcement of the firm's interest in locating in the area.

## FUEL RATE

The amount of fuel consumed by each industry per unit of time is specified in tons/hours for coal, in barrels (bbl)/hour for oil, in thousand cubic feet (MCF)/hour for natural gas, and in megawatts (MW) for electricity.

## FUEL TYPE

The fuel type possibilities include: low-grade coal (Lo-Coal), high-grade coal (Hi-Coal), low-grade oil (Lo-Oil), high-grade oil (Hi-Oil), natural gas, and electricity. The fuel option for each plant is listed in the Industrialist's output. The fuel grade refers inversely to the air pollution potential of the burning fuel, i.e., Lo-Grade has high pollution potential, and Hi-Grade fuels have low pollution potential.

## HOUSEHOLD TYPES

The five household types used in APEX are characterizations of families belonging to fairly homogeneous socio-economic groups. These characterizations reflect life style, political involvement and voting habits, general consumption behavior and preference for public goods. There is substantial overlap of income levels for all status groupings; hence income, alone, is a weak indicator for characterizing households.

Household Type 1 -- is upper class and upper-middle class combined. Occupations of the heads of households are: professionals, technical workers, managers, officials, and proprietors. One-half of the family income levels are in excess of \$15,000 and the other half are in the \$10,000-\$15,000 range. Value of housing is in excess of \$20,000, and if they rent, rentals are over \$150 per month. This is the group which is most concentrated in residential location. Education of the head of the household is at least college graduate, often with post-graduate study. Pressure group membership for this household type is found in the Chamber of Commerce and Good Government League.

Household Type II -- is the typical middle-class household in which the head's occupation is clerical, sales, or kindred types. Income of the family is primarily in the \$7,000-\$10,000 range. Education of the head of the household is some college or at least high school graduation. Housing value is primarily in the \$15,000-\$25,000 range, and gross rentals would usually be from \$100 to \$149 per month, though they may be somewhat lower. Pressure group affiliations for this type are with the Good Government League on the one hand, and with the ultra-conservatives on the other.

Household Type III -- the most numerous and widely-distributed of the five types is characterized by a mixed membership of very low income white collar workers, skilled craftsmen, and foremen, though the latter two predominate. In the outlying areas, farmers fall into this category. Family income is primarily in the \$5,000-\$9,000 range. The head of household's education is typically high school graduation. Housing value is usually in the \$12,000-\$20,000 range and rentals are from \$80-\$125 per month. Members of this group are apt to belong to the unions and/or the ultra-conservative pressure group.

Household Type IV -- is composed of semi-skilled workers, industry operatives and non-household service workers, such as waiters, barbers and parking-lot attendants. Family income is in the lower portion of the \$4,000-\$7,000 range. Housing values range from \$10,000 to \$14,000 with gross rentals being \$70 to \$90 per month. Education of the head of the household is usually 9 to 11 years. Pressure group membership for this household type is found in the unions and among the civil rights groups.

Household Type V -- is the lowest stratum of society, and heads of households are laborers or household service workers. The vast majority of the area's unemployed are of this type and roughly half of all members are elderly and retired. Family income is less than \$5,000 annually and the value of housing is less than \$10,000, with rentals primarily \$50-\$75 per month. Heads of households have usually not been educated beyond the eighth grade. Membership in pressure groups is found in the unions and civil rights groups.

Political involvement of the five household types declines from type I (the highest) to type V, the latter being generally apathetic. Likewise, concern with government operation and provision of public services is highest in type I households and declines steadily through type V families.

The five household types will tend to demand housing of the five residential development types according to the following percentages:

Household type I -- 50% will choose R-1; 30%, R-2, and 20%, M-1.  
Household type II -- 20% will choose housing in each of the five development types.

Household type III -- 10% prefer R-1; 30% prefer R-2; 20% choose R-3; 25% take M-1, and 15%, M-2.

Household type IV -- 20% will choose R-2; 40%, R-3; 10%, M-1, and 30%, M-2.

Household type V -- 40% will be in R-3; 60% in M-2.

IMPROVEMENT COSTS

Improvement costs are fees to prepare raw land for development, including subdivision costs, sewer and water connections, drainage and engineering. Developers are required to pay improvement costs on all land on which they build structures. For residential property, improvement costs are on a per unit basis as follows:

R-1	R-2	R-3	M-1	M-2
\$1,000	\$800	\$700	\$600	\$400

For commercial and local industrial land uses, improvement costs are on a per acre basis; for each the fee is \$5,000 per acre.

These fees are automatically applied to all land on which the Developer builds.

INTEREST RATE

The cost of borrowing money will vary for the Industrialists and Developers according to both their credit rating and the length of the loan, i.e., how many years will be taken to repay it. Applicable interest rates are as follows:

Years to Repay	Credit Rating		
	A-1	A-2	A-3
1-2	4%	6%	8%
3-5	6%	8%	12%
6-10	8%	12%	16%
11-20	12%	16%	20%

The cost of borrowing money for governmental agencies -- the interest rate on bonds -- will vary according to the credit rating of the jurisdiction, and will differ between general obligation and revenue bonds. Since revenue bonds are not backed by governmental taxing power they are riskier and therefore carry higher interest rates than general obligation bonds. As a jurisdiction's credit rating falls from A-1 to A-3, the interest rate on general obligation bonds will increase from 4.5% to 6%.

ISSUE

Issue is used to refer to a problem situation presented to players in the APEX News. Following each issue are two to four alternatives from which one must be selected. (See ELITE OPINION POLL.)

JURISDICTION

Jurisdiction refers to one of the political units in APEX.  
Abbreviations used in the game are:

- CC - Central City (Jurisdiction 1)
- S - Suburb (Jurisdiction 2)
- UT 1 - Township 1 (Jurisdiction 3 or Western Township)
- UT 2 - Township 2 (Jurisdiction 4 or Eastern Township)
- Co - County (Jurisdiction 5)

(See ANALYSIS AREA.)

LAND USE

Land use refers to the types of structures built upon particular pieces of land.

(See DEVELOPMENT TYPE and ZONING CATEGORY.)

MAXIMUM PRODUCTION CAPACITY

This is the maximum number of units which can be produced by a gamed industry in a cycle, given the plant and equipment in existence during that cycle. Maximum capacity may be increased by making capital expenditures for building and equipment. New productive capacity becomes available only in the cycle following that in which money is budgeted for plant expansion.

MILLAGE

Millage is the tax rate, in mills, which is applied to State equalized property value to generate property tax revenue. One mill is equal to a \$1 charge on each \$1000 of value, or one tenth of one percent of the State equalized value. There are three types of millage:

- A. Normal Operating Millage is determined by local Politicians and is applied to standard operating costs of government by State and local law -- the local limit can never be higher than the limit set by the State.
- B. Special Millage, which is not subject to State and local limits, can be used for financing special programs. It must be voted on in a referendum.
- C. Debt Retirement Millage is not subject to the state and local limits but it can be used for retiring capital project bonds. This millage requires a favorable vote in a referendum.

Total millage is the sum of operating millage, any special millages and the debt retirement millages which may be in effect during the year.

MONITORING STATION

A monitoring station is a piece of equipment placed at a given location for measurement of air quality. An air quality monitoring station of one of five types may be installed and operated in any analysis area. The pollutants measured by each type of monitoring station are:

- Type 1: Particulates
- Type 2: Particulates and SO<sub>2</sub>
- Type 3: Particulates, SO<sub>2</sub>, and CO
- Type 4: Particulates, SO<sub>2</sub>, CO, and NO<sub>x</sub>
- Type 5: Particulates, SO<sub>2</sub>, CO, NO<sub>x</sub>, and Hydrocarbons

PARTICULATES

Particulates are solid particle air pollutants, which may be suspended in the air or may settle out, depending on the size of the particles, wind speed, and other factors.

PLANT INSPECTION

A plant inspection is an "on-site" examination of production and pollution control equipment, processes and procedures. Plant inspections ordered by the APCO will provide him with information on the production processes; production capacity; fuel and process rates; control systems; smoke code (Ringelmann number); and odor code (Stinkelmann number) for each process of a specific gamed or non-gamed emission source.

PLANT MANAGER

The player in the role of Industrialist is acting as a Plant Manager. (See BOARD OF DIRECTORS.)

POPULATION EQUIVALENT

The population equivalent is a means of converting (a) residents, and (b) employees and clients of industries and commercial facilities into a standard measure of the demand placed on such public capital facilities as sewers, streets, and water supply. The population equivalent of an area (analysis area or jurisdiction) is computed as follows:

$$P.E. = [\text{Total households}] + [.8 \times \text{all employees of commerce and industry}]$$

For use of population equivalents in APEX, see CAPITAL PLANT INDEX.

PRESSURE GROUP

There are five pressure groups represented in APEX which take stands on public policy issues and can influence voter behavior. The more extreme the position assumed by the pressure groups, either pro or con, (as indicated by a scale of +4 to -4), the greater will be the voter turnout for referenda and elections. Each pressure group derives its constituency from members of two or more household types. (See HOUSEHOLD TYPES)



1. Civil Rights Groups -- find their leadership in the elite liberal and in ghetto activists. The majority of their followers come from lower social strata. These groups represent both Negroes and Mexican-Americans. The orientation of the groups is primarily toward what they consider bread-and-butter issues, such as fair employment, and toward actions which focus on the neighborhoods in which they live. Thus, the Civil Rights groups tend to be active in specific cases, but their influence is moderate.
2. Good Government League -- is overwhelmingly middle-class, composed primarily of professional people, a heavy percentage of them women. This group is interested in a wide range of issues, in which they exert moderate influence, and is oriented toward governmental efficiency and toward community growth and image.
3. Chamber of Commerce -- draws many members from the business community and some from professional groups such as law, engineering, and medicine. This group exerts the highest degree of power of all pressure groups and is oriented primarily toward community image and "boosterism". However, when an issue tends to split the business community, this group is likely to take no position.
4. Unions -- are more conservative locally than nationally and exhibit some divergency between craft unions and industrial unions, the former being more conservative. The unions exert moderate influence on a range of issues somewhat less broad than those of interest to the Good Government League. The conservatism of the unions is especially apparent in the opposition of some of its constituency to public spending for social welfare.
5. Ultra-Conservatives -- draw membership from people who are isolated from most community affairs. Although members have average incomes, the education level of most is lower than the community average. These groups become involved in public issues only sporadically, taking extreme and noisy positions when they feel personally affected by proposed public actions.

#### PROCESS RATE

Process rate refers to the amount of materials processed by an Industrialist per unit time. The measure is specified in tons, pounds, barrels, per minute, hour, etc.

#### PRODUCTION LEVEL

This is probably the key item determined by an Industrialist each cycle. It is the number of units of a product his plant will produce in that cycle. The Industrialist is free to set his production at any level he chooses, as long as the figure he sets does not exceed his maximum production capacity.

#### PRODUCTION PROCESS

A production process is a definable part of the overall production system

of a given firm. Each gamed industrial firm may have up to eight production processes, while each non-gamed industrial firm is assumed to have only one process.

#### QUASI-PUBLIC LAND

This is land owned by tax-exempt organizations such as churches and fraternal organizations. Such land includes church buildings and schools, cemeteries and such miscellaneous buildings as Elks lodges.

#### REFERENDUM

A referendum is a vote of the (simulated) population of a jurisdiction on some issue presented to the people by the Politician. Most usually referenda are called to approve (or reject) a general obligation bond issue or a request for special millage, although they may be called to approve some legislative matter, such as open housing.

#### REZONING APPLICATION FEE

The rezoning application fee is a charge of \$100, which is assessed for each rezoning request submitted by a Developer or Industrialist. It is included in that player's financial statement for the next cycle.

#### RINGELMANN NUMBER

The Ringelmann Number is a code for measuring the blackness of smoke plumes and is equivalent to the opacity. Ringelmann Numbers and opacities are used for specifying allowable smoke emissions (Ringelmann for black and opacity for other colors). #0 = zero opacity, #1 = 20%, #2 = 40%, #3 = 60%, #4 = 80%, #5 = 100%. In APEX, all smoke readings are reported as Ringelmann Numbers.

#### STATE EQUALIZED VALUE

State equalization is a process designed to even out differences in assessment practices among political jurisdictions. The state equalization factor applied to each jurisdiction's assessed value will thus be different. The state equalized value for a jurisdiction, reached by applying the factor to local assessed value, is the base on which millage is levied to generate property tax revenues.

#### STINKELMANN NUMBER

The Stinkelmann Number is a code (developed in APEX) for measuring odor emissions, and for specifying maximum allowable odor emissions. Numbers range from 0-5, covering least to worst odor levels, respectively.

#### TAX RATE

See MILLAGE.

UNIT COSTS

The costs to the Industrialist of operating his plant are calculated, for each production component, except labor, on the basis of the amount and cost of each component required to produce one unit of the product. These unit costs apply to fuel, administrative overhead, inventory, and raw materials.

Fuel Cost applies to the fuel required to produce each Industrialist's product and will be different for each fuel type.

General Administrative Costs include all overhead expenditures, other than salaries, involved in production.

Inventory Carrying Costs must be paid to store product inventory from one cycle to the next. This cost excludes property taxes on inventory.

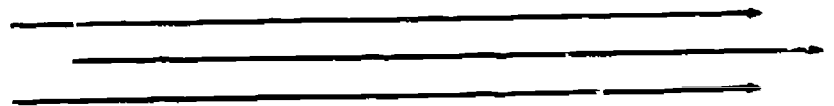
Materials Costs include all raw materials required to produce the product, except fuel.

The unit costs for each of these components which are applicable for a particular Industrialist for the next year are included in that player's output.

UNIT SALES PRICE

This is the price, which an Industrialist sets each cycle, at which he will sell a unit of his product. Each Industrialist has complete control over price, although the number of units he actually sells will be dependent on the relationship of his price to supply-demand conditions in the general market, and to the current average industry-wide price (reported for the last three years in the Industrialist's output).

6

ZONING CATEGORY

Zoning categories apply only to vacant land for APEX. Each of the six zoning categories may be developed into one or more types of land use:



ZONING CATEGORY

Zoning categories apply only to vacant land for APEX. Each of the six zoning categories may be developed into one or more types of land use:

<u>FROM</u>	<u>TO</u>
<u>Zoning Category</u>	<u>Developed Land Use Type(s)</u>
(1) R - Single-family residential	(1) R-1 (low density, high cost) (2) R-2 (medium density, medium cost) (3) R-3 (high density, low cost)
(2) M - Multiple-family residential	(4) M-1 (low density, low cost) (5) M-2 (medium density, low cost)
(3) C - Commercial	(6) CL (Commercial-Local) (7) CR (Commercial-Regional)
(4) I - Industrial	(8) I (endogenous industry) (9) I (exogenous industry)
(5) O - Bureaucratic	(10) O (exogenous bureaucratic)
(6) A - Agricultural	(11) A (active farming)

## Section 3-1

### Responsibilities of the Game Director

The successful application of APEX is heavily dependent on a skillful presentation by the game director and his assistants. Not all audiences respond to gaming-simulation in the same way nor do all audiences enjoy -- or even expect -- the same type of rewards. Therefore, the game director and his team must exercise control over the run to insure that the needs of the participants are met effectively. This chapter of the operator's kit describes the responsibilities of the operator and his team in launching a run of APEX.

#### The Operating Team

Before describing the sequence of activities under the control of the game director, it is necessary to describe the desired set of skills for a team running APEX. Under certain conditions, it is possible for a single game operator to run the game (however, he will no doubt yearn for roller skates and some extra arms). The functions that must be performed by a single operator or a team include the initial presentation of the game, the administering of assistance to the various role players, the pseudo-role playing of key characters not otherwise represented in the simulation, the computer processing, and the handling of critique and review. Under ideal circumstances, the general presentation falls under the control of a single individual (the game operator), the assisting of players during the game is handled by five separate people (the role advisors), the computer processing is the responsibility of yet another member of the team (the technical advisor), and any or all of the staff can function in a pseudo-role playing capacity.

Doubling up on tasks is most easily accomplished by combining the tasks of the general game director with those of one role advisor and assigning responsibility for the computer processing to another (or the same) role advisor. Beyond that, more than one role may be served by a single advisor; for example, the planners and the politician might be advised by a single individual. Whatever the assignment of specific tasks, each team must be capable of managing the run, advising each of the five roles and processing the decisions through the computer.

#### Activities of the Game Director

1. **Pre-Game Activities.** A certain amount of pre-game preparation can go a long way toward insuring a smooth and effective run. The game operator must be sure that an IBM 1130 or appropriate 360 series computer is readily accessible. Multiple ply paper or other means of supplying duplicate copies of printout should be available as well as computer cards.

Arrangements for space and furniture should be made prior to the run. Experience thus far indicates that the physical conditions of the game are among the more crucial variables under the control of the operator for insuring a successful run. Additional discussion of these logistics appears in Section 4.

If the audience is coming from out of town or from a great distance, arrangements for food and shelter should be carefully worked out in advance. These arrangements may seem trivial or unimportant, but considerable energies can be diverted from a run if participants are concerned with personal needs. If food is to be provided during the run, arrangements should be made ahead of time. (It is usually desirable to have a coffee pot "burbling" through a run.)

The game operator should pick his advisors in advance and guarantee their continued presence and ability to perform their tasks. A pre-game meeting of advisors is often useful to establish objectives for the particular run and plan appropriate intervention strategies.

Finally, introductory materials should be distributed to participants well in advance of the introduction. If the game is being demonstrated, one would not expect that participants will read all of the pregame materials or, if they do, one should not expect a great deal of learning via this technique. However, under normal operating conditions complaints about inadequate preparation seem to crop up whether the introduction takes 5 minutes or 5 hours; the advance distribution of materials should help minimize these.

2. Opening Remarks. The game director must make an opening presentation to the players. Obviously, this will vary in style with the audience and with the personality of the director. Here again, experience provides us with some useful clues. A short opening seems to accomplish everything that a long one does with the exception of boring the players. Thirty well spent minutes describing the nature of gaming-simulation, the background of the simulated city and a cursory introduction to each of the roles is usually adequate. The information needed to prepare such a statement is contained in various sections of this manual.

3. Role Advising. After the introduction, it is useful to give all the players in a particular role extensive background in this role. This is usually done by breaking the audience into groups and assigning a role advisor to each group. The mode of role advising is also a personalized thing and should vary with the audience. Clearly, novices to air pollution need a different type of introduction than air pollution specialists.

As a general guideline, the role advisor should probably give a brief description of the nature of the role in the "real world". Subsequently, that description can be abstracted to the APEX situation; that is, the scope of the role in the game can be defined. Once the role is understood (even if that understanding is only partial), the advisor can explain to the players the specifics of the worksheets and the details of the output. Finally, the role advisor can, if need be, suggest strategies and objectives to the players, trying to give them a perspective and context with which to begin.

At the conclusion of this introduction (which often takes about an hour), most new players are totally confused and overloaded with information. This is neither undersirable or avoidable. Most learning is accompanied with some frustration and discomfort. Fortunately, the play of the

game tends to overcome the frustration in one or two cycles; therefore, the exercise ends on a more pleasing and more confident note.

4. The Play -- Routine. During the actual play of the game, members of the operating team serve as consultants to the players. Many of the issues and discussions that arise during a normal run of the game are not documented sufficiently in the program and/or the support literature to allow players to engage in more than an initial attempt to resolve the problems. Because time for researching such problems is often not available, the operating team must supply the missing information as best as it may be able, concentrating on conditions which are felt to apply in most situations. The operating team must supply the needed input as the situation arises. It might prove useful for a game director to record those requests that arise repeatedly, research the problems alluded to in those requests, and prepare responses in anticipation of additional requests for the same information in subsequent runs. Whatever the source of the information, it is imperative that the full operating team be informed of its content. On the mechanical side of the operation, the advisors and the game director must make sure that worksheets are distributed correctly and filled out properly. The distribution of the computer printout also falls to the operating team. General room maintenance, the posting of summary information, direction to the resource materials, etc., also occupy the operating team during a run.

Perhaps the most important function for the operating team is the periodic critique. A great many activities go on simultaneously during a run of APEX and, often, all the players are unaware of the overall pattern of events as they unfold. The game director must be sensitive to the needs of his audience for occasional discussion of this larger context. Furthermore, a large part of the learning experience for the participants is the discussion of their strategies, attitudes and perceptions -- playing is not the only beneficial educational activity.

5. The Play -- Extraordinary. Quite often situations arise that call for the unusual. The game is only the skeleton of a complex urban structure and often the operating team is called upon to temporarily supplement that skeleton by assuming the role of persons not otherwise represented. The game director and his crew should be sensitive to the players' need for such support and should be ready to respond. Particular types of intervention are described in greater depth in Section 6.

Sometimes these unusual situations do not arise, but for purposes of explication, demonstration, or even entertainment, their appearance could be facilitated. Here the game director and his team should be creative and improvise to construct an unusual event. For example, the operator might choose to jar the system with a pollution crisis, new industry, large grant of money or threats from the ghetto. It is this creative aspect of operating the game that generates the most fun and excitement for the players and the staff, in addition to providing the richest learning and/or communication environment. Whether the intervention is a response to player's needs or initiated by the operating team, it is imperative that all members of the operating team be aware of the boundaries and dimensions



of the strategy. Some standard modifications or interventions are described in chapters 6 and 8.

6. Post-Game Activities. After each cycle, the operator and his crew must prepare for and execute the computer processing component of the game. Of greatest importance is the validation of the decisions. In appropriate situations, the role advisors can actually fill out the worksheets with the players -- in this instance, they should be correct. More often, the players will fill out the worksheets. These should be checked carefully for consistency and completeness by the role advisors before the players leave the premises. Such careful checking saves enormous wear and tear on the staff during the computer processing. The role advisors should transfer the decisions as reported on the worksheets to the keypunch coding forms carefully and accurately.

The computer processing itself is described in detail in Volume 2 of this kit and, therefore, will not be discussed here. However, it is the game director's responsibility to see that the computer processing is done correctly.

7. Critique. To reinforce the comments in the section dealing with routine, situations will no doubt arise that are of extreme value from an educational or communications standpoint. At these times, the game director may choose to stop the role playing and discuss the unusual events. Although much learning is derived from the play of the game, occasional review of the proceedings crystallizes key issues and allows all players to derive benefit from a particular event.

At the conclusion of a run it is imperative that players discuss their perceptions of what went on to reinforce and clarify knowledge gained earlier. Therefore, the game director should lead a critique of the play at the game conclusion. One strategy is to announce that there will be one more cycle than the number actually played. This minimizes end of game strategy on the part of the players. The time reserved for the extra cycle can then be spent in critique.

Critiques will vary with the run and should draw attention to those experiences most related to the goals of the group.

#### Comments on Timing

The game director is responsible for the timing of a given run. Most often in the past, each cycle took about four hours (though a full eight hour day has routinely been spent on a single cycle) and most runs cover about five cycles. Although the constraints on the audience often dictate the time for a run, the operator should insist on at least three cycles of play and cycle time of at least three hours. If such time can not be spent on a run, APEX is probably the wrong gaming-simulation for the audience.

Within a cycle, the game director controls the timing. Typically, cycles are marked with periods of intense interaction or surprising calm.

These variations are not unusual and should not concern the operator. Occasionally, the operator may choose to end the calm with some form of intervention, as for example the illustration of some key point or concept.

The director is responsible for seeing that decision forms are completed by some appointed hour. Here prodding by the director and his crew is needed to push the players into decisions. This is a part of the simulation -- most key decisions in urban areas are made with incomplete information and insufficient time. It is particularly important to assist those players who are having difficulty in coping with the pressures and complexities of their role in the early cycles. Failure by a single role player to make a coherent set of decisions is harmful to the overall run but, more important, is disastrous for the player -- often leading to his "copping out". This is a point where the potential for learning exists for the student. He can, with the proper assistance, begin to put the causes of real world success and failure in perspective. Through this new insight he can add to the game and the experience of the other players.

### ● CHECKLIST OF ACTIVITIES FOR GAME DIRECTOR

#### I. Pre-game activities

- A. Finalize computer arrangements
  - 1. Reserve adequate time (3 hours on a minimally configured IBM 1130)
  - 2. Check supplies of paper (200 pages per cycle), and cards
  - 3. Check out primary and back-up disks
- B. Make all food and lodging arrangements
- C. Hold a strategy meeting with full operating crew
  - 1. Decide on time schedule (number and length of cycles, critique schedule)
  - 2. Prepare STEP exercises to be used, if any
  - 3. Make role assignments (who should play what role)
  - 4. Assign non-gamed roles (news media, government agent, judge, etc.)
  - 5. Agree on rules or background notes for the upcoming session
    - a. What constitutes a public hearing?
    - b. By what legislation is the APCD created and established?
    - c. Who approves APCO budget?
    - d. How does one close down a simulated industry?
    - e. What is the charge for newspaper headlines?
    - f. How often will elections be held?
    - g. Who votes on what EOP issues?
    - h. . . . etc.
- D. Send out preliminary materials if possible (general description, manuals)
- E. Pregame computer checkout
  - 1. Set initial conditions
  - 2. Run project lists, if necessary
  - 3. Run Cycle 0 newspaper, if necessary
  - 4. Run Cycle 1 printout with appropriate number of copies.
- F. Set up game room with all necessary materials

1. Arrange the furniture (See chapter 3 for options)
  2. Distribute role manuals (if not previously done)
  3. Distribute worksheet decision forms
  4. Distribute name tags
  5. Prepare picture atlas, reference albums, other reference materials
  6. Distribute supplies (pencils, paper, newsprint pad, magic marker, thumb tacks, tape, chalk, etc.)
  7. Post maps, general summary tables, issue background materials, EOP tally sheet, summary of preceding cycle's issue outcomes
  8. Set up a calculator or adding machine
- G. Set up video tape equipment, if appropriate

Game activities - Cycle 2 (first played cycle)

- A. Opening Introductory Speech (thirty minutes)
- B. Role advising

Game Activities - Other Cycles

- A. Distribute most recent output and newspaper
- B. General Play (critiques as needed)

Post-Game Activities - Each Cycle

- A. Code worksheet decisions
- B. Punch cards
- C. Run the program

## Section 4-1

### Logistics

#### Timing

The last chapter included a brief section dealing with the timing of a run. Specifically, it was stated that each run of the game should consist of at least three cycles (simulated years), the optimum number being five. Each cycle should span at least a three hour period, although an eight hour cycle is within reason. Within these guidelines, the style of play can be varied considerably by using different schedules for the play.

The most obvious constraint on the scheduling of a run is the availability of the participants. The more subtle constraint is the goal and aim of the participants in playing the game. Play can range between the intensive -- two cycles per day for two or more days -- and the extensive -- one cycle per week for five or more weeks. Short intensive sessions may allow only cursory treatment of certain problems and can be exhausting for players and the operating team if not carefully scheduled. Nevertheless, such sessions are usually quite spirited, provide a good exposure to the game and its models, and require a relatively short time commitment from the audience. In contrast, longer extensive sessions are conducive to deeper exploration of the issues and problems presented by the game; allow for in depth probing of the strategies of the players and the nature of the processes in the simulation, and take on a more leisurely pace for both player and operating team. However, such sessions are often characterized by waning interest on the part of participants because of the long delay between cycles, and they also require that the audience be available for several weeks.

The experience with the exercise thus far indicates that one cycle per day for five days is the most preferred scheduling arrangement. The balance between the difficulty of maintaining momentum and the need for in depth exploration of the nuances of the simulation is best kept within this range. Clearly, if the needs of the audience are best met by a detailed study of the system with a great deal of attention given to the raft of possible supplementary activities, the cycles should run longer and be spread out over time. However, if the audience needs only a cursory look at the system, shorter cycles over less real time are adequate.

An additional hindrance to rapid cycling is the interim period that must be reserved for computer processing. With the minimally configured IBM 1130 computer (8K core, 1132 printer and 1442 card reader), processing takes about three hours, including time for key punching. For the IBM 360-50 and higher series computers, processing may be as short as one hour. An attempt to conduct multiple cycles in a single day must take into account the processing time involved. The STEP exercises (see Section 8) are often conducted for the participants while the processing is taking place. However, in runs over a longer period of time, the STEP exercises can be inserted at the discretion of the operating team (see Figure 1: Game Flow Chart).



A sample schedule is:

WEDNESDAY

3:00 - 5:00 Introduction to APEX

THURSDAY

8:30 - 12:30 Cycle 2  
1:30 - 4:30 STEP (staff processing)  
4:30 - Return output

FRIDAY

8:30 - 12:30 Cycle 3  
1:30 - 4:30 STEP (staff processing)  
4:30 - Return output

MONDAY

8:30 - 12:30 Cycle 4  
1:30 - 4:30 STEP (staff processing)  
4:30 - Return output

TUESDAY

8:30 - 12:30 Cycle 5  
1:30 - 4:30 STEP (staff processing)  
4:30 - Return output

Room Arrangements

The physical layout of the room is an important determinant of the probability of success for a given run. The room must be large enough to accommodate the players easily and comfortably. (A four hour period spent in an uncomfortable, cramped, smoke-filled room is a strong deterrent to an enthusiastic second four hours). The room should have blackboards or an area for a portable blackboard. The furniture should be portable and relatively comfortable. Tables should be large enough to allow a reasonable amount of spreading out of materials by the players. The room should have adequate free wall space for the display references.

If more than one room is available for a given run, the flexibility of the room arrangements increases dramatically. Adjoining rooms can be used for public hearings, secret meetings, board meetings, etc. If video tape equipment is available, an adjoining room can be used as a TV studio.

The interaction pattern that emerges during the game is usually highly dependent on the placement of players within the room. Proximity breeds coalition. Individuals usually contact other players in those roles located near their own position first. Players in the center of activity often are involved in most of the interaction. Therefore, room arrangement can isolate

or emphasize a particular role. Several suggested room layouts are illustrated in the following diagrams.

Display Materials

Several kinds of support materials for the players should be posted in clear sight. In general, it is good practice to place most materials in reasonable proximity to the role most likely to use them. This philosophy was reflected in the sample room arrangements.

Player support materials include 1) Land Use Map, 2) Summary Tables (printout from the computer), 3) Elit. Opinion Poll Tally Sheet, 4) One copy of the newspaper, 5) Other maps as available. Optional items include a rezoning record and a summary of the preceding cycle's decisions on issues. A suggested format for the Elite Opinion Poll Tally Sheet is presented here.

Role Assignments

The APEX gaming-simulation can be used effectively by as few as 18 or as many as 75 players. The role assignments can be made in any one of several ways. Persons can be assigned roles by random draw. A first come first serve philosophy can be applied. Persons can be asked for preference and assigned to maximize the number of persons in their first or second choice. Finally, arbitrary assignment can be made by the game director. The rationale of this latter approach is up to the game director. Whatever system is used, it is important not to let pre-existing "cliques" band together during the run. In the past, roles have been assigned: to match real world avocation to gamed role; to place people in the least (rather than most) familiar role; and to match persons to the role in which they might learn the most, given their backgrounds.

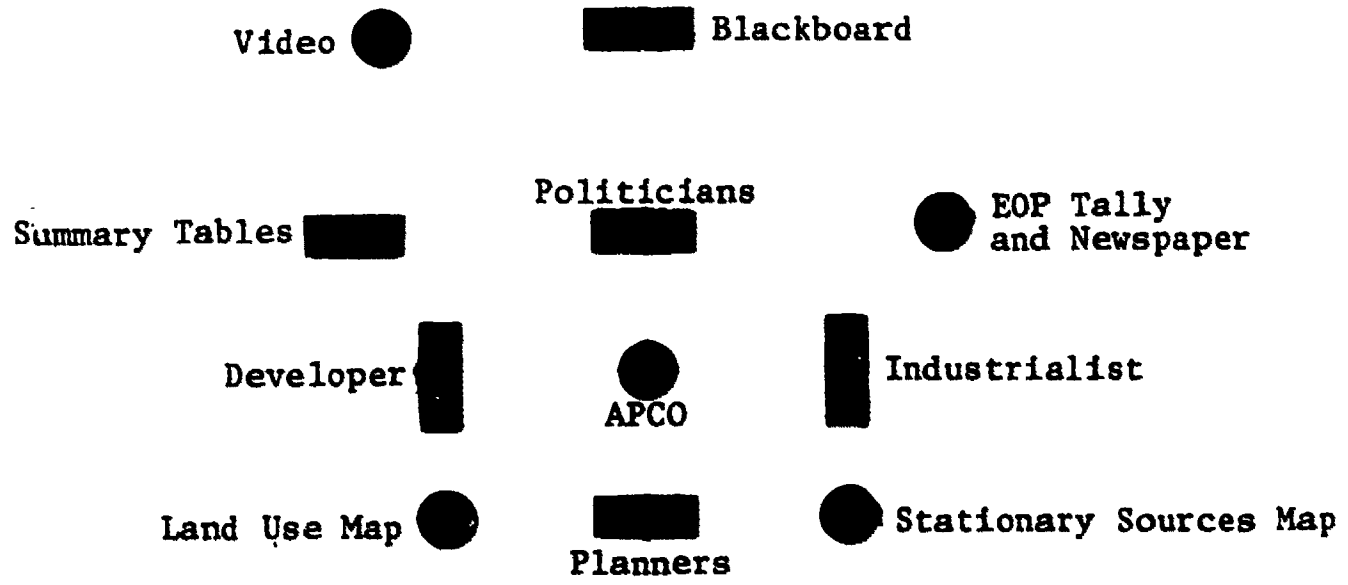
The number of persons assigned to each role is a function of the total number of players. There should usually be more County Politicians than City Politicians and more Industrialists than Air Pollution Control Officers. The following chart summarizes suggested role assignments for groups of different sizes.

Size of Group	Politicians			Planners			Developer Indust.						Jour.*
	Central	City Co.	APCO	City	Co.	Regional*	1	2	3	5	6		
17	3	3	3	1	1		1	1	1	1			
25	3	5	3	1	1		1	2	2	2	2		
32	3	5	5	1	1		1	2	2	2	2	1	
49	3	5	5	1	1	3	2	3	3	3	3	3	
65	5	5	7	3	3	3	3	3	3	3	3	3	
77	7	7	7	5	5	5	3	3	3	3	3	5	

\*optional roles without manuals or output of their own.

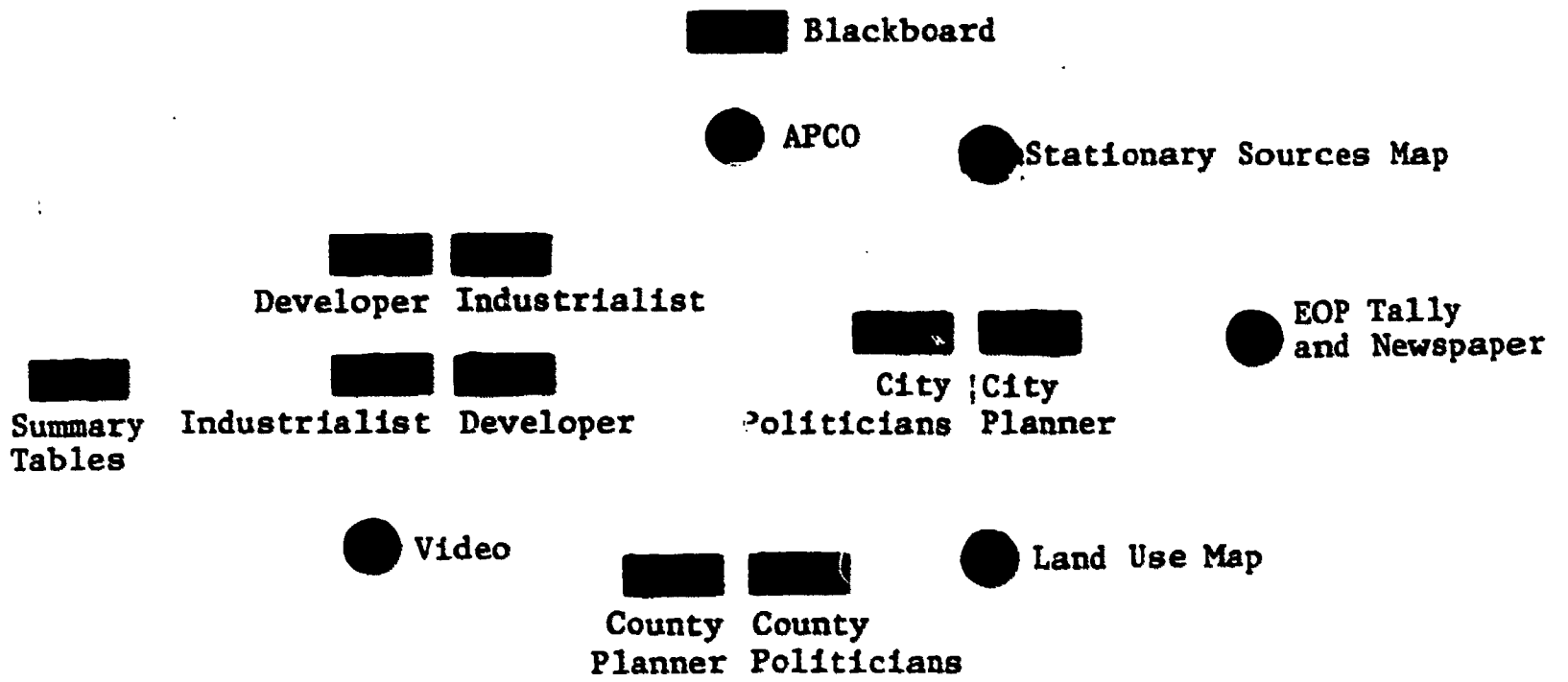
### Video Tape Equipment

The use of video tape equipment can add greatly to the quality of the game. Most users will not have access to such equipment; however, if it can be arranged to have it available, it is well worth it. The video taping of STEP exercises, news broadcasts and editorials and campaign speeches adds a new dimension to the activity of the game.



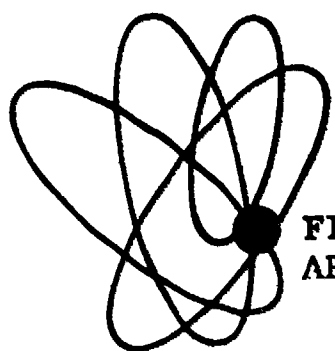
● Emphasis on a Single Role

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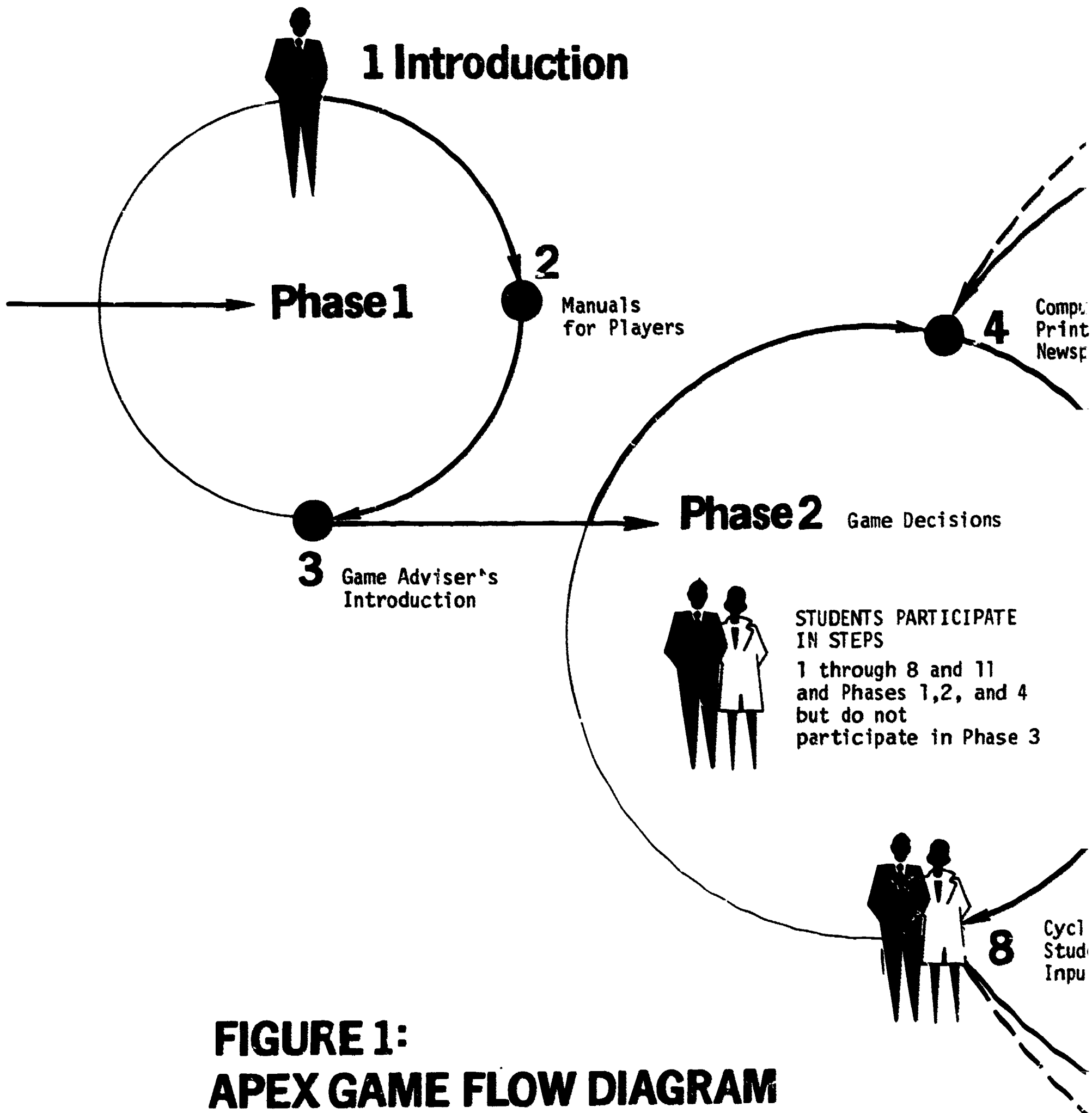


● No Special Emphasis

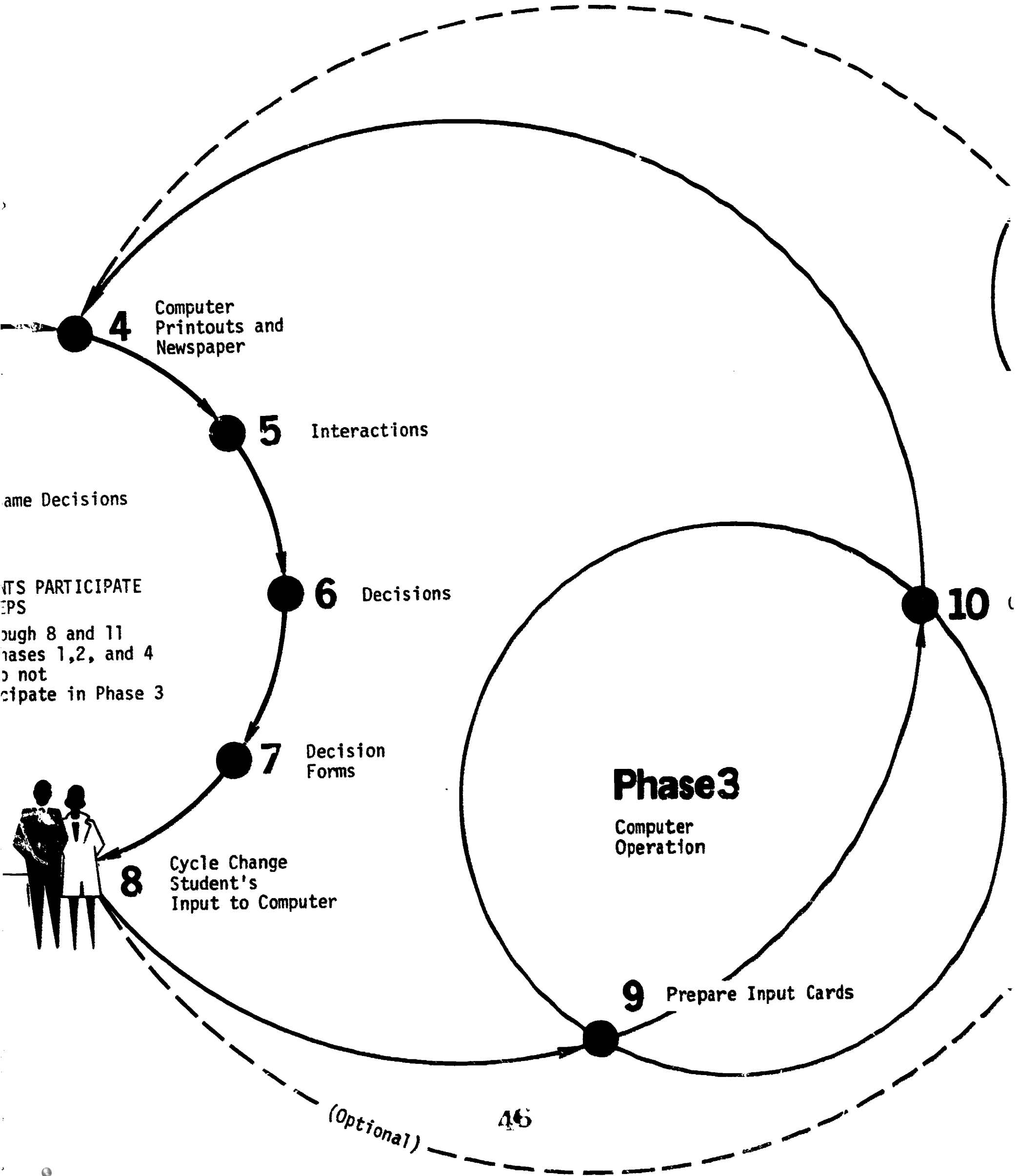
These are two of many arrangements that emphasize various aspects of the game.



**FIGURE 1:  
APEX GAME FLOW DIAGRAM**







ame Decisions

ENTS PARTICIPATE  
EPS

ough 8 and 11  
hases 1,2, and 4  
o not  
cipate in Phase 3



### Phase 3

Computer  
Operation

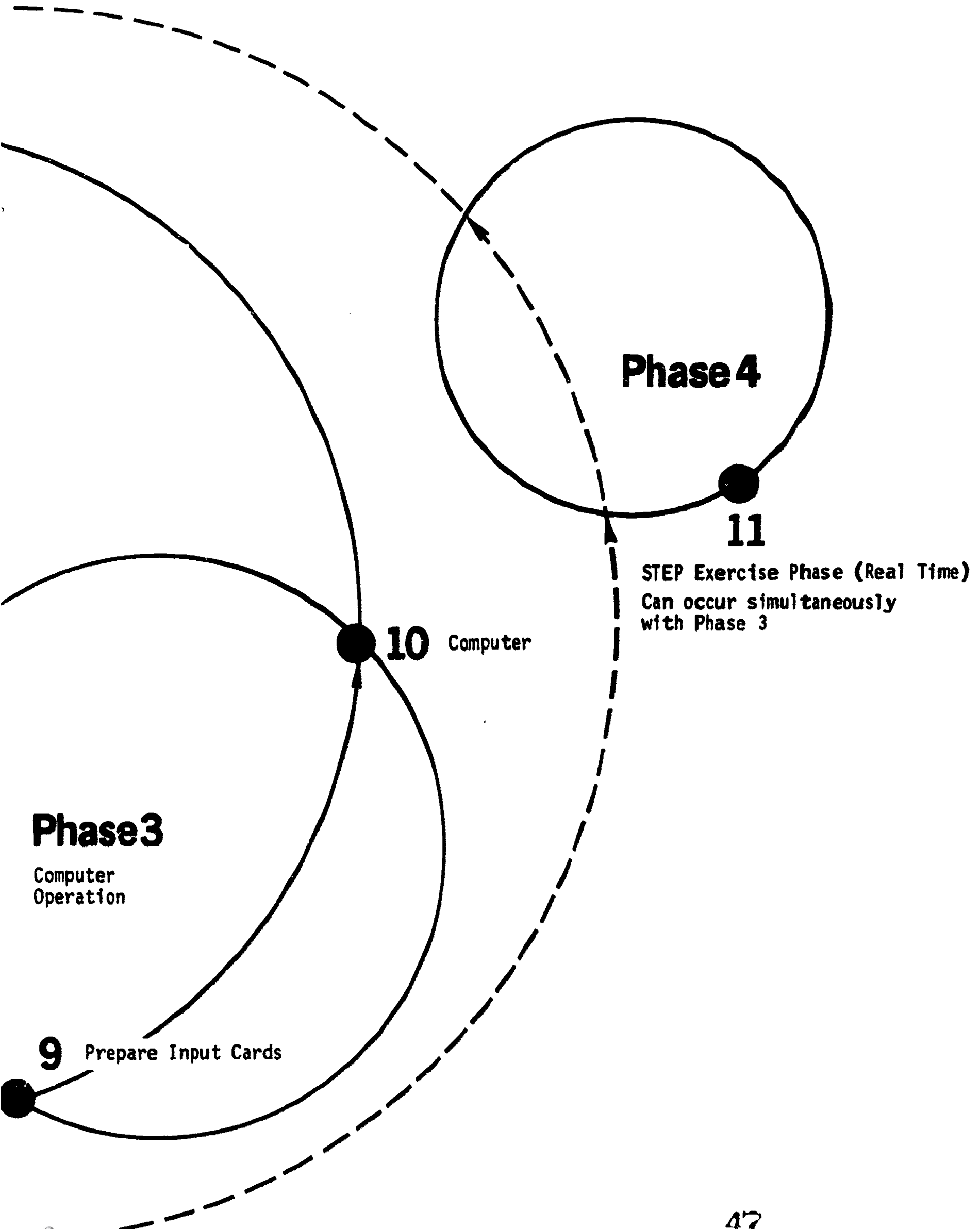


FIGURE 1:  
APEX GAME FLOW DIAGRAM

PHASE 1

The student interacts with the staff to obtain the basic information needed to tie the reality of a decision to the simulation stored in the Computer.

PHASE 2

This is the student - student interaction phase. Students compete for time, money, and other benefits in a compressed time frame. Although the point at which the cycle (year) changes is arbitrary, past experience has shown point 8 to be a convenient cycle change point.

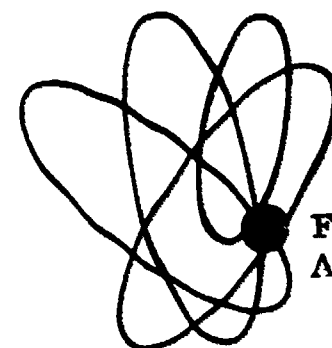


FIGURE  
APEX G

PHASE 3

Here the student's decisions are analyzed by the Computer models. This phase is usually handled by the staff while the students are otherwise engaged (See STEPS - PHASE 4).

PHASE 4

This is an optional phase of the program. However, it can be rewarding because it forces the students to pursue an issue in a real time frame, in contrast to the condensed time frame of the game. The results of the STEP (Supplemental Training Exercise Program) may become a constraint on decisions made in the next cycle.

Section 5-1

DESCRIPTION OF COMPUTER MODELS

A detailed description of the computerized component of APEX is beyond the scope of a kit of this type. At best, a sense of the nature of the basic simulations making up the system can be conveyed in this document.

In anticipation of the types of questions that often come from a group unfamiliar with simulation, it is useful to preface the highly specialized descriptions of particular simulations with a few more general remarks. Simulation is the technique used by computer specialists to harness the speed and power of an electronic computer for the purpose of reproducing sequences of events and decisions that comprise basic change processes in real-world situations. Simulations are normally based on theories of "how the world works" and, as such, are nothing more than abstractions of basic natural and social processes. The computerized form of abstraction in APEX condenses time and reduces the complexity of essential processes to almost manageable proportions.

In this exposition, it is useful to categorize simulations according to the degree of sophistication of the underlying theory. (The terms used to name the categories are often used in other ways in different contexts. Hopefully, this will not confuse the reader or limit his use of the terms in other contexts.) Models are simulations predicated on well formulated logically consistent theories of actual, real-world processes. Algorithms are less sophisticated, make-shift procedures that produce the proper set of outputs but, possibly, with a less than fair representation of the underlying process. Clearly, this distinction is a matter of degree and, because the state of knowledge with respect to urban systems is so poor, many models prove to be nothing more than useful algorithms when subjected to close review.

It is also useful to identify two distinct types of simulation -- social and environmental system simulation. Simulations of social systems are based on theories of human behavior. These can be subdivided further into micro and macro simulations. In urban or economic theory jargon, simulation of individual behavior and/or decision making is micro-simulation. Macro-simulation is applied in situations calling for prediction of aggregate behavior patterns. In contrast to social simulation, environmental simulation is directed at describing the workings of natural or physical systems, particularly as those systems respond to stress from the social sector. A classification of the types of models in APEX can be drawn up from these notions; see Table I.

	Social	Environmental
Model	Micro Macro	
Algorithm	Micro Macro	

For the most part, micro-simulations are a part of the gamed component of APEX. The computerized simulations described in the remainder of this section are largely macro-simulations of aggregate behavior patterns

or environmental simulations.

1. The T.O.M.M. Model. At the heart of the urban-spatial location process in APEX is the Time Oriented Metropolitan Model (T.O.M.M.). T.O.M.M. is used to generate the demand for urban space, both residential and commercial. A modification of the Lowry model, introducing the notion of marginal rather than total change in urban areas and the concept of household types, T.O.M.M. assumes that the initial configuration of basic industry is the primary driving force in determining the shape of the city. The number of households in the city reflects the ratio of households to employees of cities in the size range of Lansing, Michigan. Households are allocated in space so that the number of households in a given area is proportional to the potential of that area for households, where the potential of a particular area is a measure of the employment opportunities in all other areas weighted by their accessibility to that area. The availability of land also affects the allocation of households; areas with large quantities of vacant land zoned for residential use draw households. Types of households within areas are determined so as to reflect the initial distribution in space of the various household types as well as the capital expenditure pattern on schools and local infrastructure.

The number of employees in each commercial employment category (local industrial as well as regional and local commercial) is a direct function of the numbers of households, by type, in the city. Commercial employment is apportioned in space so that each analysis area is supplied with adequate service. Specifically, each area is assigned employment in each category proportional to the market demand (the sum of household and basic employment in all other areas divided by the accessibility from those areas to the given area) generated in that area.

The demand for urban residential space is determined in SELL (see the next paragraph) as a function of the number of households demanding space. The demand for commercial space is determined by assigning a quantity of land per employee in each area.

2. The SELL Algorithm. Given the demand for space generated by the T.O.M.M. model, the SELL algorithm introduces the effect of the supply side of the market. SELL matches the demand to the supply generated by game developers. Because the supply created by decisions made in a run of the game is but a limited part of the total needed, the balance of the supply must be accounted for. Thus, the assumption is made that if space exists in an area where demand exceeds game-generated supply, the excess demand is met by the market. The SELL algorithm "cascades" demand from the most desired area to adjacent areas in the event that neither gamed nor market supply in the given area is sufficient to meet the demand in that area. Once the final demand in the area is determined, the space occupied by the housing units is calculated. SELL also adjusts the prices and values of land by calculating marginal adjustments according to the relative size of demand for space in an area compared to the overall demand.



3. The GROW Algorithm. The GROW algorithm is little more than a linear extrapolation of growth in the basic industrial sector. Subject to modification by incoming exofirms (new firms) or operator intervention, the growth of the basic sector in all areas is calculated as a straight percentage set according to the type of industry found in the area. Growth in gamed industry is added into the growth calculated by other means.

4. The Voter Response Model (VRM). Because a sophisticated statement of the local electoral process is glaringly absent in political science literature, the APEX formulation will be credited with the title "model", as no alternative concept has been presented and validated in the literature. One basic hypothesis underlying the model is that the rate of turnout has a critical effect on the election outcome because the composition of the voting public changes markedly as turnout rate changes. Thus, two components make up the VRM -- turnout calculations and the subsequent determination of issue outcome.

The turnout for an election is calculated as a deviation from one of two norms, the norm in major election years (candidate election as well as issue election) or the norm in non-major election years. The deviation is a function of the quantity of dollars included in issues on the ballot, the quantity of campaign expenditures stirring up interest, and a random effect. The average turnout rate thus calculated is broken down by household type so that the higher the average turnout, the greater the proportion of lower class voters.

Given the turnout, the VRM determines the outcome of specific bond or millage issues. The support for a given issue is calculated by computing the deviation from typical average support rates. These rates vary by household type as well as issue type (basic or non-basic). The lower class households are generally assumed to be less supportive of higher taxes. The deviation from the typical rates is a function of the dollar size of the issue, the elite opinion poll on that issue, the campaign contributions for and against the particular millage or bond, the overall unemployment rate for the community (a proxy for general community satisfaction), and a random effect. The resulting support rates, by household type, are applied to the turnout rates by type with the final result taken as positive if the sum of the supporting voters across all types is greater than half of the total number of people voting.

5. The Candidate Election Model (CEM). The CEM is less than a perfect simulation of the local candidate election process. Because the time constraints in gaming are so severe (one year is condensed into a few hours), the model must be tailored to meet several constraining specifications and, therefore, can not capture the full dynamic of local election campaigns. However, the abstraction of the process does include elements of a campaign and, if used with imagination, can induce small-scale party and/or organization politics.

There are four components to the CEM -- the "party support", the campaign, the performance of the incumbent and random effect. The party support mechanism is an operator option. In the normal election process of



the game, the vote by the elite of the community (the participants in the game) simulates their public stand for or against the incumbent. The player's votes account for 60% of the outcome of the election; however, when no elite vote is held the "party support" is split equally between the candidates. If the game director chooses, the "party support" may be weighted to simulate community voting patterns that exist in the "real world".

The campaign component compares the relative positions of the candidates with the pressure groups and household types active in the electoral district. The candidate spends accrued campaign funds stressing his positions on the numerous newspaper issues. Scores are compiled for each candidate by comparing the issue outcomes, the pressure group and household type positions, and player's position, with weighting done according to the dollar expenditures on the numerous issues.

The incumbent performance component evaluates the status of the jurisdiction with respect to taxation rates, deficits or surpluses, capital plant program and operating expenditure pattern. The incumbent is rewarded according to his jurisdiction's successes or failures in these areas. Finally, a random factor is applied to the result.

In the event that no gamed player comes forth to challenge an incumbent, the CEM will supply, at the discretion of the operator, a simulated opponent with a well-defined political outlook. The simulated opponent takes stands on issues and allocates money stressing those positions in a fashion analogous to the gamed opponent.

6. The Air Model. The Air Model is made up of two distinct components. The first calculates the total emissions generated in each analysis area and the second converts those emission readings to air quality measurements via a diffusion model predicated on the Gaussian diffusion equation as modified by Turner<sup>3</sup>.

The emission rate in each analysis area is the sum of all emissions from industrial point sources, automobile exhausts (line sources) and space heating. Industrial contamination is the sum of all emissions from gamed and simulated industries operating in the region. Automotive emissions are, for want of a better means of calculation, proportional to the employment potential of the various areas; employment potential is assumed to be a reasonable proxy for quantity of activity in an area. The total emission rate is a linear projection of the number of auto-miles traveled in the city (each year there is a fixed increase) multiplied by the average emission rate per auto-mile. Space heating emissions reflect the number and composition of households in each area -- lower class households live in home with "less-clean" heating systems.

The diffusion component is based on a standard form of the Gaussian Diffusion equation. It is assumed that there are only 29 point sources (the centroids of the analysis areas) and a maximum of 29 monitoring

stations (again, each analysis area). The emissions from each source are diffused across the city seasonally so as to capture the differences in weather conditions occurring at different times of the year.

7. The Newspaper Algorithm. Issues in the newspaper are generated from several sources. Selected issues are pre-set to appear in particular cycles. The state, national and a small sampling of local issues are of this type.

Many issues are part of a linked chain of issues. The decision made by the responsible player in resolving a given issue is used to trigger a response issue in the next-cycle newspaper. Sets of linked issues carry certain problems from the status of a mere annoyance to a status of one of several possible disasters. Players' actions select the disaster or, in the case of expert decision making, the favorable outcome by forcing the linkages through a complex "decision tree".

Other newspaper issues are triggered by action or non-action in the game arena. Jurisdictions falling below pre-set arbitrary standards in their operating budget expenditures are cited in the newspaper. Similarly, analysis areas with a low level of capital investment per capita and/or unusually high levels of air pollution are identified in newspaper headlines.

Finally, announcements of exofirms are pre-set by cycle for publication in the newspaper. Issues associated with the operations of selected industrial firms are also printed in the business page.

## Section 6-1

### OPTIONS FOR THE GAME DIRECTOR

The computer program of the APEX game is a rigorous, exacting, large, and sometimes cumbersome vehicle. Often it is a constraint on the activities of the game -- players regularly want to experiment with decisions or strategies that can not be accommodated by the simulation. However, the program is far more flexible than one would believe at first glance and, therefore, the game is quite flexible too. Under certain conditions, the constraints of the rigorous computer can be bent.

For the purposes of this kit, we distinguish three ways of modifying the game to add to its richness and depth. By manipulating the program and/or supplementing the game by pseudo-role playing, the game director can alter the normal game pattern considerably. Second, by creating new roles for the participants, the game director can enlarge the normal game role structure. Finally, additional training exercises that supplement the normal play of the game can be inserted by the operator to add new issues and problems to the game or cover selected subjects in greater depth. These supplementary exercises are called STEPS, Supplementary Training Exercise Programs, and are discussed in the next chapter. The remainder of this chapter will take up the built-in methods for massaging the program, operator pseudo-roles and supplementary gamed roles.

#### Console Options

The IBM 1130 version of the APEX program is highly interactive with the operator -- a running conversation goes on between the operator and the computer console. On the IBM 360, the same options are preserved but they are activated via card input at the start of each cycle or through utility programs that support the master program. The descriptions of the various options presented here are non-technical -- the concept or idea underlying each option is described. The technical details are included in the computer operator volume of the kit -- either the IBM 360 or IBM 1130 edition. The options for altering the parameters of the game are presented here in the approximate order of appearance on the IBM 1130 console.

(1) Change the contents of the raw data files. A very dangerous, yet very fruitful program manipulation is the modification of the raw data in the files. WARNING -- The changing of data files may prove hazardous to your health. Because of the highly interrelated use of certain data entries within the program, changes in that data often result in untoward ramifications in unexpected places in the program.

The technical apparatus for changing data files is not overly difficult to use. Deciding what to change is the far more challenging aspect of the file modification option. For example, a decision to change residential units in a given analysis area from one type to another might seem like a fairly innocuous alteration. Some developer might strategize to upgrade existing units rather than to demolish and rebuild; therefore, such a change might be in order as there is no pre-set method for upgrading housing in the game. However, after the

change is completed, many related variables such as density or selling price would still reflect the original land use distribution. Thus, the data would have some inconsistencies which could produce strange results such as an overly high selling price for that type of residential unit, the supply of which was increased by the file modification.

Several more common file changes are described here as examples of this option.

(a) Change the State Taxation Limit. There is no way to alter the state taxation limit except by modifying file 4, record 2, words 10-18. In appropriate situations, the operator, acting in behalf of the state, might raise or lower that limit.

(b) Change the Team Number on a Copied Disk. When copying the first of the two IBM 1130 disks, the team number on the old disk will be recorded on the new one. It is necessary to differentiate the copies of disk "1" so that each will pass distinct team numbers to the master copy of disk "2". (Each disk "2" can link to five disk "1"s.) Thus, a change in file 36, record 1, word 38 is not only possible but mandatory.

An endless array of possible file modifications could be presented here. However, manipulation of files should usually be avoided rather than encouraged unless the change has proven harmless in past trials.

(2) Control of Growth Rate. The prime driving force behind the growth in the community is industrial development measured by the change in the number of jobs available in the county. Two options are available for manipulating the rate and/or direction of growth. The first is the forced input of exofirms (new industries expressing a desire to enter the community) and the second is the out and out addition or subtraction of employees in selected analysis areas in the county.

Each cycle, the newspaper lists industries wishing to enter the county. Ordinarily conditions for entry are set pertaining to capital investment and/or rezoning on the part of the politician and investment by the land developers. In its simplest form, the exofirm option enables the operator to force the admission of a new industry in the analysis area of its choice overriding the desires of the game players. Thus, the growth in the community can be stimulated by operator intervention. In its more complicated form, the exofirm option enables the operator to force the admission of a new industry in the analysis area of the operator's choice. In this instance, not only the rate of growth but the direction is influenced by game director action.

The outright addition or subtraction of employees in any analysis area also affects the magnitude and direction of growth in the community. The rationale for exercising this option is given in Section 6 and the mechanics can be found in Volume 2; therefore, no further discussion is included here.



(3) Addition of Background Pollution. In general, a pollution source in a community is one of three types; point source (industrial and space heating sources), line sources (roadways), or background pollution (contaminants already in the air mass as it crosses the area). Unless otherwise specified by the operator, the background pollution is zero. The operator can induce crises in pollution levels by exercising his option to add background pollution.

(4) Changing the Newspaper. Occasionally, the operator may choose to alter the composition of the newspaper for the purpose of focusing attention on issues not included in the standard edition. This type of yellow journalism can be practiced by exercising one or more of several options. In the event that any set of issues -- national, metropolitan, or jurisdictional, are inappropriate at a given time, they can be suppressed. If the operator so chooses, the normal set of issues for a given cycle can be suppressed in favor of those stock issues preferred by the game director. In this instance, the operator merely enters the numbers corresponding to those issues deemed appropriate, thereby specifying the list of issues for the newspaper. To support this option, a utility program that lists all of the issues is included as part of the program package. It is described in the computer operator's volume of this kit.

More often, the operator will alter the composition of the newspaper by adding headlines to be printed along with the normal news items. These are not full issues in that no alternatives are printed and records of the decisions made in response to the problems presented are not kept. However, this technique of supplementing the news is quite useful for crystallizing issues and/or introducing new problems.

#### Options Exercised Through Card Input or Other Means

In addition to those options exercised at the console on the IBM 1130, additional modifications of the standard game format can be made by the game director. Most of these are achieved through additions in the standard card input stream read by the program at the start of execution.

(1) Operator's cash transfer. One of the key flows in the game is the flow of cash. At times, the operator might find it desirable to infuse cash into the game for one reason or another. For example, the operator may choose to loan money to a developer or industrialist for a particular type of development. An operator cash transfer option is included on the operator key punch form shown in Volume 27. By using this option, the game director can "create" money by transferring cash into the accounts of the various players.

(2) Toying with the Candidate Election Process. The periodic re-election of city and county officials provides the game director with ample opportunity to change the course of the game. In its standard form, an election consists of a campaign by the candidates composed of decisions on how to spend campaign funds stressing various issues and campaign speeches to the gamed players, a hand vote by the game players, entry of these decisions and the results of the hand vote to the program, and,

lastly, a run of the candidate election model. The operator can alter the standard form in a variety of ways.

Usually, an election is held every other year or cycle. If the operator chooses to give the current administration additional time to enact a program, the election can be held every three or four years or as often as the operator chooses. Similarly, if the operator chooses to oust an administration before two years have passed, an election can be held after only one cycle.

For any given election, the operator can exercise several options to influence the mode of proceeding through the election process. The operator can choose to have an active campaign pairing gamed players in head to head contests or a passive campaign matching gamed players and simulated opponents. The former is the more exciting, the more time-consuming, and the more chaotic. If the option of matching gamed and simulated opponents is selected, the game director must decide on the character of the simulated opponent. The range is from the far left to far right. The explanation of the election input procedure in Volume II includes a more precise description of the simulated opponents. (We will let the reader define far left and far right for himself.)

The energies of the players devoted to campaigning can be somewhat controlled by the operator. Preparation of speeches, time spent giving and listening to speeches and the method of presentation are subject to the control of the operator. By varying the time that candidates are announced, the game director can limit or exaggerate the influence of the election over the normal play of the game. Early declaration of candidacy (for example, the start of the election cycle) allows players to campaign as a part of their normal activities, but late declaration (after decisions are submitted but before computer processing) limits attention to the election to extra-game activity.

Finally, sixty percent of the vote in a given candidate election is under the control of the operator, as previously described. Caution should be observed, since the students usually become very involved in the election process. The question of "why was I defeated?" may prove embarrassing.

(3) Adding New Projects or Programs. Unlike the preceding options, the modification of the project or the program list is done prior to running the standard cycle in the computer. A utility program for the 1130 (MAKO6) or the 360 (FILEPRNT) is provided by the program to allow the operator to create and remove projects or programs from their respective lists. The technical description of this utility is included in the Computer Operator's Manual.

This option is available to enable the operator to accommodate player demands for additional programs or projects. Frequently, during the course of play, the Politicians or Planners develop strategies for which there are no pre-set projects or special programs. Occasionally, the existing definition of a project or program is unsatisfactory (for example, the cost may be too high or too low). In either case, a new project or program, or



the deletion and revision of an old project, can meet the player's need.

(4) Special Grant Awards. The only representative for the Federal and State governments in APEX is the game director. In one instance the director must play the role of the Federal Government by serving as a grants officer of the Federal air pollution agency. During the game, the APCO submits requests for Federal funds to the game director who then serves as Federal negotiator in setting the terms of the contract with the county and the APCO. Negotiations are likely to cover the amounts of the grant, the expenditure pattern of the grant and the nature of the county commitment to match Federal monies. Funds are granted just for the cycle in which funds are to be used; however, the broad outline of a three year program should precede the granting of the first year's funds. That is, grants are awarded the APCO for three year periods, with the specifics of each year's portion renegotiated annually with the game director.

The game director may also represent other agencies within the Federal government structure. Cities often contract with the Departments of Housing and Urban Development, Health, Education and Welfare, Transportation, etc., for certain projects. The game director of his operating team can set the form of the proposal, define the context of the project and negotiate the financial terms of the grant. Thus, in much the same way that the Federal government directs local jurisdictions towards certain problems by controlling cash flows, the game director can alter the course of a game and force selected issues on the participants. The mechanisms for making the cash awards associated with grants arising in this fashion are the special grants which are coded on the appropriate worksheets.

(5) Serving as Judge. Quite often, the game director will be called upon to represent the judicial branch of the government. Primarily, this legal pseudo-role will deal with cases in air pollution control or zoning; however, other issues may require the rulings of the court. Fines can be carried out by forcing cash transfers from the guilty party to the government. (If possible, skilled observers such as faculty should usually serve as judge in lieu of the game director.)

As an example of a law case, an Industrialist may contest the APCO's charge that he violated emission standards. A court might have to hear the evidence and pass judgment, including the assessment of fines and court costs. Volume 21 of the kit is devoted to air pollution legal reference material to provide the operator with the necessary expertise to effectively carry out this pseudo-role.

(6) Representing the Public. Two hundred thousand screaming extras are not usually kept in the wings to represent public opinion during the run of APEX. Sometimes, however, certain events in the game should logically trigger some form of citizen response not included in the newspaper or manifest in the community social indicator. The game director can choose to use all of his power (cash transfers, yellow journalism, etc.) to back up a pseudo-role play action as a representative of an irate citizen or special interest group.

### Supplementary Gamed Roles

With large numbers of players, the opportunity and need to represent other actors in the urban system suggest the creation of supplementary gamed roles. The pseudo-roles of the operator described in the preceding section (judge, citizen representative, etc.) can be turned over to a gamed player if the situation allows for such multiple role play by participants. In addition to these additional roles, three roles have been successively appended to the basic structure of the game, a Newspaperman's role, a Regional Planner's role, and a Public Health Planner's role.

(1) The Newspaperman's Role. By utilizing the option of putting additional headlines in the newspaper, the game director can create a newspaperman's role by assigning one or more players the task of preparing extra headlines for the journal. Thus, the newspaperman becomes a central communication link in the game.

There are three major activities in the newspaperman's agenda. He may solicit and review major press releases submitted by other players. He sets the editorial tone of the newspaper. Finally, he reports on events and occurrences that otherwise would not be a part of the newspaper.

Unlike the rest of the players, the newspaperman has no specialized information or computer output. (In principle, it would be desirable to set up this role as a separate industry with budgets, etc.; however, this is a relatively large task beyond the scope of the initial project of designing the game). His primary sources of information are the game players and their activities. Due to computer storage limitations, the newspaperman has limited space in the newspaper; therefore, he must be selective in the news that he prints. The following guidelines define these limitations: a) the editorial should be limited to 15 lines or about 300 words, b) county wide reporting should be limited to 20 lines or about 400 words, and c) items pertaining to each other jurisdiction and the business page should be limited to ten lines or about 200 words.

In addition to publishing news items in the yearly paper, the newspaperman may act as a communications line between players by posting stories with immediate news value. He may choose to become a radio announcer or town crier to carry out this function of transferring information during the course of a cycle. If videotape equipment is available, the newspaperman may broaden his activities to one of a "media man" by broadcasting news briefs, interviews and editorials.

If the newspaperman role is activated for a given run, he should carry out many of the functions common to other players, such as voting on the Elite Opinion Poll, running for office, participating in hearings, and so on. Because the role is supplementary and less well defined than the standard roles, it is likely to require greater creativity on the part of the player and, perhaps, greater assistance from the operating team.

(2) The Regional Planner's Role. As the game is set up now, the planners' role is the least structured and requires the most ingenuity on the part of the player. Each planner is responsible to a given jurisdiction under the existing system -- the regional planner is charged with comprehensive planning for the region. Supplementing the planning group with a regional planner responsible to a larger political jurisdiction than those represented in the game adds a role which serves as community conscience in the planning process.

It is expected that the regional planner's role, if employed, will be the coordinating force between city, suburb, and county. The larger issues of planning -- overall growth strategies, redistribution of income and wealth, coordinated transportation systems, comprehensive land use planning and so on -- should be considered and acted upon by the regional planner.

(3) The Public Health Planner's Role. The Public Health Planner is appointed by the County Board of Supervisors as a member of the APEX County Planning Commission. In addition to his regular responsibilities as a member of the County Planning Commission (see Planner Role Description), he is responsible for monitoring the community in the area of public health. Specifically, the Public Health Planner's primary duty is to prepare and to secure the implementation of a set of plans for meeting the health needs of the community. During each cycle, the Public Health Planner will submit, with the County Planner's capital improvement and special program recommendations, his own recommendations for projects and programs that will improve health standards in APEX County. In addition, the PH Planner may lobby in favor of allocating an equitable percentage of the County's operating budget to budget line items which pertain to community health (e.g. Public Health, Welfare and Hospitalization, Public Works Maintenance). Moreover the PH Planner is expected to advise the City Planning Commission on public health needs of the city.

To perform his task, the Public Health Planner can use any or all of the information normally available to the County Planners. Also, he can use any of the tactics and strategies of the Planner's position. In general, the responsibilities of the PH Planner may be summarized as follows:

- Monitor conditions of public health throughout the County of APEX (this includes the city which is within the budget jurisdiction of the County);
- Advise the County Board of Supervisors and the City Politicians on problems and issues relating to public health;
- Work as a member of the County Planning Commission and coordinate the efforts of City and County Planners in public health matters;
- As a part of the County Planners' recommendations to the County Board of Supervisors, submit proposals for capital and operating expenditures that are in accord with this analysis of the community health requirements;

- Seek public endorsement and financial assistance from the private sector (Industrialists and Developers) through open hearings, newspaper reports, and personal contacts.

## SECTION 7. A BRIEF DESCRIPTION OF APEX COUNTY

### History

The first settlers of APEX County were farm families emigrating from New England and New York State beginning about 1830; during the middle of the nineteenth century German immigrants continued the settlement pattern of dispersed family farms. Income to pay for necessary imports of products from the East was derived primarily from production of farm crops and, more importantly, timber. Small market towns, often containing milling facilities, developed in the period, roughly, between 1820 and 1860, during which time the County was organized as a unit of government by the State and the basic network of roads was completed.

Major impetus for the development of what was to become the Central City as a regional center came with the location there, in 1847, of the State Capitol. Further potential for the growth of the Central City area came in 1855, when the nation's first land grant university was formed just to the east of the city. Central City was incorporated in 1859; the Suburb in which the university was located was not to be incorporated until 1910. The University's control of a large block of land was to exercise profound influence on the physical pattern of development in the future, since much of the logical development corridor outward from the City was pre-empted by this facility.

Steam railroads were first built into APEX County beginning in the 1860's. Small market-milling communities favored with stops and depots on the rail lines began to assume greater importance, over an expanded hinterland, than the small communities not so favored. The impact of the railroads on these small communities can be seen from the following description of the Central City, which may have been particularly favored:

By the year 1863, the City. . . was a bustling urbanized center. Early accounts tell us that at that time, the City included eleven churches, five hotels, two flouring mills, three tanneries, two breweries, three saw mills, two sash and blind factories, three iron foundries, two printing offices, several brick yards, and a large number of mechanic shops.\*

Despite this bustle, it should be noted that manufacturing was not well-advanced; exports were still dominated by agricultural and timber products; most other industry produced for local consumption only.

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\*Tri-County Regional Planning Commission, "History of the Tri-County Region," Information Report 7, undated. pp. 24-25.



Beginning in perhaps 1880, factories for the production of goods to be exported out of the region were first located in the area, fostered by the completion of railroad ties with the rest of the country. The introduction of factories, mainly built near railroad depots, stimulated the migration of factory-worker families into the region; most of these settled near the factories where they were employed, adding further to the growth of the towns favored by the railroad. Just before the turn of the century, the introduction of the automobile industry into the Central City gave, probably, the final impetus needed to make the Central City into the dominant community in the County. Beginning about the same time, electric inter-urban railways were extended from the Central City to the north, east and west, allowing many workers in the new industries in the City to move further away from their places of employment.

By the 1920's, automobiles had become readily available to many people and their use encouraged by the paving of most of the roads in the County. People who had formerly lived fairly close to the interurban system began to be dispersed throughout larger areas and to settle in lower density neighborhoods. In about 1930, the interurban lines were discontinued. The Depression put a damper on further urban sprawl into the outlying township areas, and, until about 1950, most new development was found in the filling-in of the Central City and Suburb. Although the growth of industrial and bureaucratic functions proceeded in the Central City and the area adjacent to it, the more outlying townships remained, and to some extent still remain, predominantly agricultural. The growing urbanization which has occurred more recently in these fringe areas has been primarily stimulated by the construction of the interstate expressway system, beginning in the 1950's.

#### Political Jurisdictions

In the APEX game, the County is composed of four autonomous jurisdictions: The Central City, Suburb, Township 1 and Township 2. The County has been further divided into 29 "Analysis Areas", each resembling a census tract. The Central City comprises Analysis Areas 1 through 13; the Suburb, AA's 17 through 19; Township 1, to the west, contains AA's 23 through 28 and Township 2, to the east, contains AA's 14-16, 20-22 and 29. (See map). In addition to analysis areas, the Central City is politically divided into Wards:

Ward 1 --	AA's 1-4
Ward 2 --	AA's 5-8
Ward 3 --	AA's 9-13

Each Ward is the electoral district for one of the three City Councilmen represented in the game. The County government (Board of Supervisors) is comprised of one member elected from the Suburb, one member from each of the two Townships and two members elected at large from the Central City.



The City Council and County Board of Supervisors are thus the only two governmental units actively represented in the game. Other local governments, including the school boards, are simulated. In some cases, city and County governments have parallel functions; e.g. they both provide police services, planning and capital improvements. The County, however, has area-wide responsibility for three major services not provided by the City government: public health, welfare and air pollution control. In these three areas, county actions directly affect Central City residents as well as residents in the outlying areas. Both the municipal and County governments derive their primary financial support from the same tax base -- real property; County property taxes are paid by land-owners in addition to property taxes collected by the municipal government and the school board in each political jurisdiction.

Data provided to players in the game are nearly always given by analysis area -- this is the primary reference unit. This is also the smallest unit of scale in referring to locations; that is, a project or house or industry is located in "analysis area X" rather than on a particular street or a particular intersection. Characteristics of each individual analysis area, including the socio-economic composition of the residents and the proportions of land area devoted to particular land uses, may be found in the APEX Reference Album. Updates of some of this information are also provided in the computer output from each cycle of play.

A few analysis areas are almost completely characterized by one or two major features which are often referred to throughout play. These major features are given in the following list, with their analysis areas indicated:

Central Business District (CBD) -- nearly all of analysis area 8

State Capitol -- analysis area 8

Ghetto -- analysis area 4 and analysis area 8

University -- analysis area 19 (all)

"Best" residential areas -- analysis areas 9 (all) and 17 (most)

These features are not only unique in the County, but they also dominate the analysis areas in which they are located; in the game they are likely to be referred to as locations in themselves, with no further locational explanation given.

A list of other important man-made features of the County, and their locations, is given later in this chapter.

## Geography and Climate

APEX County is located nearly at the center of an industrialized northern State, some 85 miles northwest of one of the largest metropolitan areas in the United States. The once heavily forested land, extending for roughly 320 square miles, is quite flat, for the most part adequately drained for agriculture.

The Grand River, a major watercourse in the State, enters the County from the South in analysis area 23, meanders north and west, then back to the east and north as it passes through analysis area 8, where it is joined by the Red Cedar River, which comes in from the east. The enlarged Grand River exits from the County in analysis area 26, from which it continues west for some 85 miles before emptying into the Great Lake. Major drainage of the County is through the Grand River system.

Just before it empties into the Grand, the Red Cedar River is joined by Sycamore Creek, which wanders up from the southeast. Much of the area in analysis areas 11 and 13, near this creek, is low and somewhat marshy, not ideal for heavy development. The other major marshy area in the County is in analysis area 14, to the northeast in Township 2. There are also several small lakes in this analysis area and quite a large State Park. The largest lake in the County is located in analysis area 16. This was a primary recreation area in the early part of this century but is less ideal now, due to heavy pollution loads and deteriorating shoreline development. There are small creeks which wander through many analysis areas in the County; the only other river of any significant size, however, is Looking Glass River, which runs east and west through the northern portion of the County, primarily in analysis areas 28 and 29.

The climate of APEX County is temperate, with summer temperatures averaging about 70 degrees and winter temperatures which average about 25 degrees. There is an annual rainfall of roughly 30 inches, with heavy snows to be expected primarily in the months of January and February. Prevailing winds are westerly, swinging to the southwest in summer and northwest in winter.

## Major Public Facilities

As might perhaps be expected, the Central City and Suburb are significantly better endowed with public capital improvements than are the Townships. The following list includes the most important public structures in the County, indicates under whose jurisdiction they are operated and where they are located:

Airport (County) -- AA 29, just outside the City limits. The Airport has three runways and a terminal of 27,000 square feet. Two commercial airlines serve the County through this airport; cargo and general aviation are also served.

Boys Training School (State) -- AA 7.

City Hall -- AA 6. This is an aged structure, built 80 years ago and considered a scandal. A more central location has been chosen for the new City Hall under construction in AA 8.

Community Centers (City) -- AA's 2, 4, 7, 8, 10, 13. These are mostly old houses purchased by the city to house neighborhood meetings and the operation of special programs.

Community Centers (Township Halls) -- AA's 14 (2), 24, 27, 29.

Community College (County) -- AA 8. The facility is currently housed in an old library and elementary school.

County Building -- AA 8. This includes all county offices and the meeting rooms for the County Board of Supervisors.

County Court House -- AA 8, adjacent to County offices.

Fire Stations (City) -- AA's 2, 3, 4, 5, 6, 8 (2), 11, 12.

Fire Stations (Townships) -- AA's 20, 23, 25. These are modest stations housing limited equipment. Volunteers provide firefighting manpower.

Hospital (County) -- AA 7. This was built in 1912 and was added onto in 1922, 1942 and 1960. It contains 362 beds, including a 35-bed tuberculosis wing, and caters primarily to the indigent. There are three private hospitals in the County with an additional 650 beds.

Library (City) -- AA 8. This is an aged building downtown. There are branch libraries in AA's 1, 5, 11, 12 (2), 13.

Library (Suburb) -- AA 18.

Sewage Treatment Plant (City) -- AA 2. This plant provides both primary and secondary treatment and has a capacity of 34 million gallons per day. It currently averages 22 million gallons daily.

Sewage Treatment Plant (Suburb) -- AA 19. This plant also provides both primary and secondary treatment, with a capacity of 12 million gallons per day; it currently handles an average of 6.75 million gallons daily.

Sheriff Station (County) -- AA 8. This is attached to the County Building.

Water Treatment Plant (City) -- AA 8 (2). Water for the City is derived from a total of 123 wells averaging 400-425 feet in depth. Pumping capacity is 42 million gallons per day, with the average daily pumping currently being 22 million gallons daily. Treatment includes filtration, purification, fluoridation and lime softening.

Water Treatment Plant (Suburb)-- AA 17, AA 19 (2). The Suburb's water is drawn from 7 wells with an average depth of 385-400 feet. Pumping capacity is 6 million gallons daily, with current average pumping being 2.5 million gallons per day. Treatment includes chlorination, fluoridation and ziolite softening.

Zoo (City) -- AA 7.

In addition to the airport, major transportation into and out of APEX County is provided by rail (primarily freight) and expressway. The attached map outlines the routes of the three rail lines, which generally follow the river valleys and intersect in analysis area 8. It also delineates the expressway system and the main arteries feeding the City. One major expressway comes from the Southeast, sweeps around the southern and western fringes of the City and leaves the County from its northwestern corner. A second expressway comes up from the south, intersects the first and continues northward into the Suburb. It is anticipated that in the future this expressway will be continued northwards, then swing west to finish an expressway loop around the City (dashed line).

#### Industry and the Economy

Major employment in APEX County is provided by the State Capitol Complex, the University and a huge automobile assembly plant, located in analysis area 4. While State Government is a stable, slow-growing industry, the University, typical of "research and development" operations elsewhere, is growing at a very rapid rate. The automobile plant exhibits characteristics similar to any large manufacturing operation, fluctuating considerably in response to the national business cycle.

In addition to these "big three" employers, there is a host of industries supplying parts to the automobile industry, as well as independent industries exporting goods which have no relationship to autos. (A map and listing of the major industries in the County are found on the following two pages.) These include the five gamed industries:

Shear Power Company (Industrialist 1)  
People's Pulp Plant (Industrialist 2)  
Rusty's Iron Foundry (Industrialist 3)  
Caesar's Rendering Plant (Industrialist 5)  
Dusty Rhodes Cement (Industrialist 6)

Members of the population of APEX County constitute a work force of about 101,000 people, nearly half of them employed by the major "exporting" industries previously mentioned. About 9% of total County employment is found in lighter industry and 41% in commercial and service activities for the resident population. The greatest concentration of manufacturing employment is, as expected, to be found in the Central City. The highest proportion of white collar workers is found in the Suburb, not unexpectedly, due to the predominance of the University as an employer there. In the future, it is probable that more and more new industrial growth and employment will occur in outlying areas, particularly among firms requiring significant amounts of land for their plants.

### Population

Within the physical and political environment described in the preceding pages resides a population of some 227,000 persons, a tiny fraction of whom are represented in APEX as players. The remainder of the population is simulated by the computer in the game. About 63% of the population resides in the Central City, 10% in the Suburb and the remainder in the two Townships.

Only about 9.2% of the County's population is black; however, virtually all of this population is found in the Central City, of which 14.4% of the total population is black, primarily in Ward 1, where the number of non-white households approaches 38%. The only other significant ethnic minority is found in a Mexican-American community in the east-central portion of the city.

For purposes of the game, the population of APEX County has been divided into five "household types", each representing different occupations and educational achievements, life-styles, voting habits and consumption behavior. These will be described briefly here; more detailed information about each may be found in the Glossary.



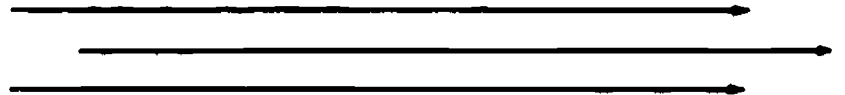
Household type 1 is a combination of upper- and upper-middle class families whose household heads are likely to be employed in the professions and business management. Household type 2 is typical middle class, occupations usually found in clerical and lower-level public service areas. Household type 3 includes very low white-collar workers and skilled craftsmen and shop foremen, the latter two predominating. While members of household types 1 and 2 have attended college, some going on for advanced degrees, household type 3 members are typically high school graduates. In outlying areas, farmers are included in this latter type. In household type 4 are found semi-skilled workers and non-domestic service workers. Usually household heads have not completed high school, and while many household type 4's are homeowners, the value of their housing is quite low. Household type 5 includes laborers, domestic workers and the unemployed, with a large number of the elderly. A majority of these households live in rental units of low value.

Initially, about 17.5% of the County population is found in household type 1, 16% in household type 2 and 27% in type 3; about 32% is of household type 4 and 7.5% fall into household type 5. The household composition of a particular analysis area, and of an entire jurisdiction, will affect significantly the demand for both public and private goods and services. It will also affect voting behavior on financial issues and in elections.

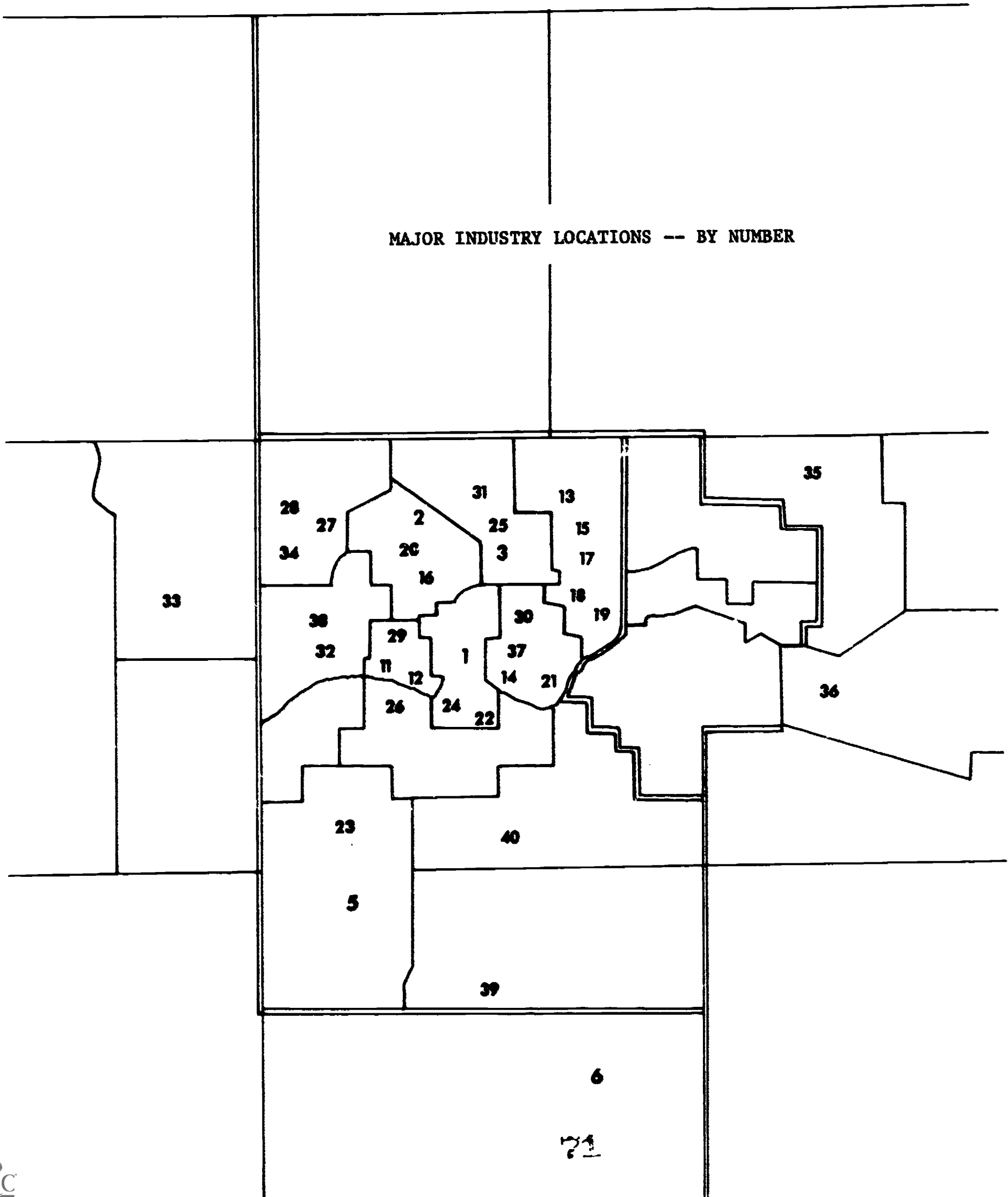




**A LIST OF MAJOR INDUSTRIES  
LOCATED IN APEX COUNTY**



MAJOR INDUSTRY LOCATIONS -- BY NUMBER



## List of Major Industries

1. Shear Power Company (A.A. 8)
2. People's Pulp Plant (A.A. 2)
3. Rusty's Iron Foundry (A.A. 5)
5. Caesar's Rendering Plant (A.A. 12)
6. Dusty Rhodes Cement Company (A.A. 23)
11. Auto Assembly Abel (A.A. 4)
12. Auto Assembly Baker (A.A. 4)
13. Auto Assembly Charlie (A.A. 6)
14. Wolverine Forging Plant (A.A. 7)
15. Finch's Forging Plant (A.A. 6)
16. Smithy's Forging Plant (A.A. 2)
17. Ahead Forging Plant (A.A. 6)
18. Wordy Printing Company (A.A. 6)
19. Bogus Printing Company (A.A. 6)
20. Boylan's Fertilizer (A.A. 2)
21. Peter's Water Heaters (A.A. 7)
22. Tar Heel Asphalt Paving (A.A. 8)
23. Concrete Batching (A.A. 12)
24. Spartan Galvanizing Company (A.A. 8)
25. Monkey Brass Melting Company (A.A. 5)
26. Trojan Varnish Manufacturing (A.A. 10)
27. Hannah Feed and Grain (A.A. 1)
28. LaRue Soap and Detergent (A.A. 1)
29. Acme Dry Cleaning (A.A. 4)
30. Trojan Dry Cleaning (A.A. 7)
31. Losten Foundry -- Iron (A.A. 5)
32. Dusty's Cement Products (A.A. 3)
34. Wiffenpoof Fertilizer (A.A. 1)
35. Saint Andre Asphalt Paving (A.A. 15)
36. Oriental Concrete Batching (A.A. 20)
37. Daily Journal Printing (A.A. 7)
38. Tiger Body Assembly (A.A. 3)
39. Academic Feed and Grain (A.A. 13)
40. Spotless Dry Cleaning (A.A. 11)

## Section 8 -1

### STEPS

Supplemental Training Exercise Programs (STEPS) were designed to enhance the APEX game through the use of structured sub-games within the context of the larger exercise. STEP exercises provide an opportunity for players to temporarily step out of compressed "game time" and to re-enter "real time" for the purpose of focusing on certain specific issues. During a normal cycle of the APEX game, players are too busy making decisions on a myriad of topics to concentrate on any one. During a STEP exercise, the pace changes and players are forced to study one particular problem in detail.

The setting for a STEP exercise can be conveyed verbally, or through the use of memos. In either case, the ground rules for the exercise must be stated explicitly. Sometimes players may be asked to limit their data to that generated by the computer within a given cycle and other times they may be asked to draw from additional sources. Sometimes they will be asked to continue in the assigned roles, other times they will be asked to assume new roles. Decisions made during a STEP are often binding on subsequent cycles if the situation arises naturally during the game run and the STEP fits logically into the sequence of events. Otherwise, they are independent. In order to minimize confusion, the game director must clearly distinguish between these alternatives.

Activities similar to STEPs will inevitably occur during the course of a typical cycle. The only difference between these activities and STEPs is the degree to which they have been pre-planned. Because of these spontaneous activities, it may be difficult to plan for a certain STEP to occur at a specified time. For example, a STEP exercise on setting air quality standards may be scheduled to follow cycle 4 but the Air Pollution Control Officer may decide that he needs to consider air quality standards sometime during cycle 2. At this point, the game director may choose to intervene and delay the activity until the scheduled time, thereby risking some loss of spontaneity. Or, the game director may choose to let the spontaneous activity continue and simply cancel the planned STEP. With this choice, there is a risk that presentations will be less sophisticated since there has been no time to prepare. There is no simple solution to this problem. Each game director will have to analyze the trade offs and choose the style that best meets his objectives.

Each STEP exercise involves approximately two hours, excluding preparation time, and should be followed by a thorough critique usually requiring another hour. This means that a total of three hours should be allotted for most STEP exercises. (This could be a convenient block of time in which to process the decisions from a preceding cycle of APEX. Players could then be given a new computer printout at the close of the STEP.)

It is often useful to videotape parts of the exercise and use the replay as a starting point for the critique; however, this is by no means necessary. Another useful aid is to have a short but well chosen list of books to be considered reference or required reading for each STEP.

Included in this chapter are samples of STEP exercises covering several topic areas. Care should be taken to choose a logical sequence of STEPs which build upon each other when possible. The STEPs described below are flexible in design and should be tailored to meet the needs of a particular group. It is the job of the game director not only to choose appropriate STEPs but also to expand or limit them as necessary. (Additional STEPs can, of course, be designed as needed.)

### Hiring an Air Pollution Control Officer

Objectives: To familiarize the student with the recruiting process; to give the student experience in preparing a resume and filling out application forms; to provide an opportunity to prepare and evaluate interview questions; to familiarize the student with some of the typical tasks and responsibilities of an Air Pollution Control Officer.

Description: This exercise deals with the recruiting of an Air Pollution Control Officer for APEX County and encompasses the various stages of the recruiting process including filling out applications, formulating resumes, taking written examinations, conducting oral interviews, and carrying out the final selection process. All students are asked to apply for the position by presenting a resume and a completed application. The game director may decide to administer a written examination as an additional part of the application process. After all the applications are received and rated, a certain number of the students are informed that they will be given an oral interview as the final stage of the application. From the remaining students, two or three are asked to serve on the Oral Interview Board. A Professional Personnel Officer may be on the Board also. The rest of the students are asked to watch the interviews on closed circuit television, if available, and be prepared to critique both the questions and the answers. Each interview takes approximately fifteen minutes with time before and after for the Board to discuss and rate each candidate. Shortly after all the interviews are conducted, the Board announces their choice for the new Air Pollution Control Officer. In the critique, an opportunity is provided for the Board to explain why they chose one particular candidate over the others. Opportunity may also be given for the candidates to reply and for the observers to add their comments.

Preparation: Staff should 1) prepare and distribute appropriate handouts, 2) contact a Professional Personnel Officer to help with the oral interview, if desired, 3) initiate news media items relevant to the coming exercise, 4) plan, administer, and correct written examinations, 5) review and rate applications, resumes, and written exams, 6) set up a room for the interview with closed circuit television, and 7) distribute to the members of the Oral Interview Board a folder on each of the candidates which includes the applicant's resume, application, and written exam, an interview schedule and an evaluation sheet.

Students should 1) prepare an application and resume, 2) take the written examination, 3) familiarize themselves with the characteristics of APEX County, especially those relevant to the air pollution situations, 4) familiarize themselves with the job specification for the position of Air Pollution Control Officer, and 5) if serving on the Oral Interview Board, look over resumes, applications, and written examinations and prepare several key questions for each applicant.

Suggested Handouts: 1) Announcement for News Media; 2) APCO Job Specification; 3) Application Form; 4) Written Examination; 5) Letter to Oral Interview Board; 6) Letter to Top Scoring Applicant; 7) Sample Evaluation Sheet.



Town Hall Meeting

Objective: To provide an opportunity for each student to prepare and deliver a short speech; to serve as an incentive for students to study role manuals and the background information on the APEX community; to provide an opportunity for each student to develop a short policy statement; to familiarize students with roles other than their own.

Description: The setting for this STEP is a Town Hall Meeting to which all the community has been invited. The purpose of the meeting is to give all the citizens of APEX a chance to get to know their community leaders. Each student plays the role of a different community leader and as such is called upon to give a short speech introducing himself. These speeches should be about five minutes in length and draw upon information in the role manuals, background information on APEX County and any other lecture materials. It is helpful to have the speeches videotaped and to replay them during the critique. Both the content and the manner of presentation should be discussed in the critique.

Preparation: Staff should 1) prepare and distribute handouts, 2) secure the assistance of a Professional to help critique the speeches, if desired, 3) announce the meeting in the newspaper, 4) prepare a room for the meeting with a podium for speakers and props such as maps of the community, and 5) arrange for a video camera to be close enough to get a clear picture of each person as he delivers his speech.

Students should 1) read role manuals, 2) study other literature on the APEX community, 3) prepare a short speech, and 4) prepare an agenda, if serving as moderator.

Suggested Handouts: 1) Newspaper headline announcing the meeting; 2) Memo to Chairman of the Meeting; 3) Letter to Politicians, Industrialists, Developers, Planners, and APCO staff asking each of them to speak on a certain topic.

APCO Application for Federal Grant

Objective: To acquaint students with the management techniques of PPBS and network analysis and to give them experience in the use of these techniques; to familiarize students with the various elements and/or subsystems of an Air Pollution Control Agency; to acquaint students with the Federal Grant Application Forms and the importance of establishing a "workable program".

Description: The Air Pollution Control Officer and his staff are asked to prepare a budget and an application for a three year federal establishment grant. This application requires the formulation of a "workable program" which is defined as "a comprehensive statement of objectives for the prevention and control of air pollution and the current and proposed measures to achieve these objectives". Some of the topics that should be covered are: 1) a description of the applicants' legal authority and responsibility for the administration of the air pollution control program, 2) a description of the nature, effects and extent of the actual and potential air pollution problems, including a identification of the major sources of air pollution, and 3) a description of the applicants' administrative organization, procedures, facilities, financial and other resources, and staff, together with plans for changes and development. (See Federal Register, Vol. 32, No. 104, Title 42.)

This exercise is designed to encourage Air Pollution Control Officers to utilize systems analysis techniques in formulating their agency's program. They will be referred to the Executive Order of August 25, 1965, which requires that all Federal Budgets be prepared using the techniques of PPBS (Planning-Programming-Budgeting System). The Air Pollution Control Officers may be asked to use network analysis charts to delineate the various stages needed to accomplish the goals and objectives of the air pollution control agency. For example, the acquisition and operation of monitoring stations involves a series of progressive stages beginning with the establishment of objectives for the program and going through a determination of the type of equipment and personnel needed, to operation of stations with fully trained maintenance personnel, and finally to an evaluation of the program. The budgetary requirements associated with each stage should also be delineated on the network analysis charts.

After completing the network analysis charts and the associated budgetary requirements, the APCO staff will fill out a Federal Grant Application Form. (The game director may choose to eliminate sections of it which seem less relevant than others.)

All these activities are in preparation for the actual STEP exercise which involves a formal presentation of the completed budget and grant application form to a Federal Review Team. Following the formal presentation by the APCO and his staff, the Review Team will begin an extensive question and answer period. All of the students that are not involved as part of the Review Team or as the APCO staff should take notes indicating the questions they would ask as members of the Review Team and specific strong and weak points of the APCO presentation.

A possible modification of this STEP involves the presentation of a budget request to the County Board of Supervisors, rather than the Federal Government. In this case, it could be an open hearing with an opportunity for all students to state their feelings concerning the air pollution control program for the county. Memos could be written to players in all roles encouraging them to challenge the APCO proposal on certain specific grounds.

Preparation: Staff should 1) procure copies of the Federal Register and Grant Application forms, 2) prepare and distribute handouts, 3) announce the meeting in the APEX Gazette and invite the public if it is to be an open hearing, and 4) arrange a room to resemble a hearing room with a table for Federal Review Team and a table for the APCO staff.

Students should 1) familiarize themselves with the literature on systems analysis, PPBS, and network analysis, 2) read the appropriate section of the Federal Register, and 3) prepare a budget and Federal Grant Application.

Bibliography: Evarts, Harry F., Introduction to PERT, Allyn and Bacon, Inc., Boston, 1964, pp. 1-44.  
 "Planning-Programming-Budgeting System: A Symposium",  
Public Administration Review, Vol. XXVI, No. 4,  
 December, 1966, and Vol. XXVII, No. 1, March,  
 1967, Washington, D. C.  
 Federal Register, Vol. 32, No. 104, Title 42, part 56,  
 Tuesday, May 30, 1967.

Suggested Handouts:

- 1) Memo to APCO staff;
- 2) Memo to Federal Review Team;
- 3) Newspaper Headline;
- 4) Federal Grant Application Form.

### Election Debate

**Objective:** To serve as a mechanism for evaluating the Politician's performance; to encourage discussion about the important issues in the community; to give students experience in making campaign speeches.

**Description:** This exercise should take place just before election ballots are to be cast. Some time prior to the STEP, all those running for office should be notified that they will have an opportunity to make a campaign speech which will be taped if videotape is available and shown during the STEP. The game director may also decide to provide time for supporting speeches. During the STEP the speeches should be shown in the following order: incumbent's speech, challenger's speech, supporting speeches for incumbent, supporting speeches for challenger. (If videotaping facilities are not available, those speeches could also be given "live".)

Following the showing of the speeches, the incumbent and the challenger should be allowed to rebut each other's campaign platforms. The game director may choose to structure this part of the STEP in such a way that there is a formal debate on some preplanned topic or on some issue that arises in the course of the game.

After the speeches and rebuttals, the students will have a chance to cast their ballots. If there is no challenger for an office, one will be supplied by the computer. It should be made clear that students are voting merely as an elite -- there is an entire community within the computer that will also vote. The gamed players' votes will be fed into the computer and will be just one of many factors deciding the outcome of the election. Some of the other factors include the EOP voting records and the past performance of the incumbent. These can be discussed in the critique of the election results.

**Preparation:** Staff should 1) announce the upcoming election in the Newspaper, 2) distribute memos, 3) designate computer challengers, if needed, 4) arrange for videotaping of campaign speeches, and 5) prepare and count ballots.

Students should 1) prepare campaign speeches, 2) prepare supporting speeches, and 3) campaign informally throughout the game.

**Suggested Handouts:** 1) Newspaper headline announcing time and place of election; 2) Newspaper headlines for players to announce their candidacy; 3) Memo to Incumbent Politician; 4) Memo to Challenging Politician; 5) Election Ballots.

### Strike Against a Gamed Industry

**Objective:** To expose students to the trials and tribulations of labor relations, to provide the opportunity for students to participate in formal negotiations.

**Description:** The operator or some designated agent acts out the role of a labor union negotiator pressing for higher "wages and fringe benefits" from a particular gamed industry, except the power plant. The areas of contention may include the wage rate, length of new contract, length of work week, etc. Arguments for higher wages might include the skyrocketing cost of living, the relative position of the industry as compared to similar firms, the relative rate in the industry as compared to the prevailing rate in the region, etc.

The strike may be enforced if agreement is not reached by reducing the production rate set by the industrialist to reflect the percentage of the year that workers went out on strike. That percentage may be function of the time spent in negotiation -- each 10 minutes might represent another month (8.6%) without production. Input of a new wage rate is achieved by a simple file change (described in the preceding chapter). The agreement must take into account the "cost of living factor", based on the Consumer Price Index, because such a factor is automatically applied by the computer.

This STEP would probably not involve the entire group and might be activated during the normal play rather than between cycles. It is used primarily to complicate and enrich the role of the industrialist.

**Preparation:** The labor representative should 1) carefully select his demands to put pressure on the industrialist, 2) inform the industrialist of the strike deadline and the nature of the repercussions of not reaching settlement, 3) receive information on industry's pay levels and union demand, 4) negotiate union demands with the industry, 5) act as a communication link between industry and union, 6) insure that full news coverage is afforded labor negotiations and 7) report the outcome of labor negotiations on an appropriate form.

**Suggested Handouts:** 1) Memo to labor representative; 2) Memo to industrialist; 3) Pay level/demand information; 4) Newspaper Headline.



Addition of a Major Industry

Objective: 1) To force participants to consider the advantages and disadvantages of unusual economic growth, 2) to emphasize the need for and difficulty in achieving long-term comprehensive planning, and 3) to create a situation in which the larger group must agree on a single policy despite the obvious differences in rewards to individuals within the group.

Description: The game director or his designated agent announces that a large industry is interested in moving into the community. The announcement should be made near the end of a cycle to allow debate and discussion to go on between cycles.

Preparation: The representative of the industry should be prepared to describe the characteristics of his industry -- land needed, employees needed, equal opportunity employment policy, addition to the tax base, and pollution profile. He should also be prepared to specify demands on the community -- investment in streets, sewer or water, tax break, police or fire protection, public housing project nearby, improvement in mass transit, or zoning variances.

The players should come up with a coherent planned package to accommodate the new industry, if, in fact, they choose to admit it at all.

Suggested Handouts: 1) Gazette announcement; 2) Memo to industry representative.



Presentation of Master Plan

Objective: To provide an opportunity for the Planners to prepare and present a detailed city and county master plan; to encourage the community-at-large to consider the goals and future direction of the county as determined by the plan.

Description: The County Board of Supervisors will call for a public hearing to consider a five year Master Plan for APEX County to be presented by the City and County Planners. The plan should begin with a thorough discussion of both short and long term goals and objectives for the community. The plan may also include a discussion of land use, housing, employment, education, transportation, open space, commerce and industry, urban renewal, and sources of revenue for APEX County.

Following the presentation by the Planners, there will be an opportunity for any interested members of the community to speak. The Air Pollution Control Staff should consider any implications of the proposed Plan for the future quality of the air in APEX. The Industrialists and Land Developers should also consider any implications of the Plan for the future of their interests.

Preparation: Staff should 1) generate interest in the Plan with items in the News media, 2) collect sample planning documents to help the students, 3) prepare and distribute memos, and 4) provide materials for student displays, if desired.

Students should 1) study representative planning documents from cities with similar problems, 2) prepare a written summary of the major elements of the Plan, to be distributed to the community before the meetings, and 3) prepare a formal presentation including visual materials if appropriate.

Suggested Handouts: 1) Gazette notices, 2) Memo to County Board of Supervisors, and 3) Memo to Planners.

### Meeting with Citizen's Groups

Objective: To expose students to the problems arising from dealing with radical, potentially disruptive groups; to encourage the Air Pollution Control Office to develop an effective, workable plan of air pollution control which involves the citizens of the community.

Description: Students will be asked to act as members of two citizen groups which are concerned with fighting air pollution. One group is the local chapter of the Stamp Out Smog (SOS) Organization, and the other is a radical group of students from the University. Each of these groups will have to get together before the STEP to determine the goals and objectives of their respective organizations. It is assumed that the SOS group is the more moderate of the two, and will come to the STEP with "reasonable" proposals for air pollution control. The student group, on the other hand, should be encouraged to develop very radical proposals.

This meeting can be structured around a specific topic, such as the possibility of a new Industry entering APEX, or the structure can be left very loose. The SOS group will be asked to call the meeting and invite the students and the Air Pollution Control Officer to attend. They should announce that the purpose of the meeting is to discuss the possibility for citizen action in the fight for cleaner air in APEX. If there is a more specific topic, it would, of course, be announced also.

The Air Pollution Control Office should recognize that they are guests at this meeting, but should take the opportunity to develop plans for utilizing citizen volunteers in their control programs, if appropriate. A possible modification of this STEP is to turn it around so that the Air Pollution Control Office has initiated the meetings, and the citizens' groups are the guests.

Preparation: Staff should 1) assign roles, 2) prepare and distribute memos, 3) provide a place for pre-meetings as well as for the STEP itself, and 4) provide for news coverage of the event.

Students should 1) meet in their respective groups to determine the goals and objectives of their organizations, 2) research various plans for citizen action and involvement in control programs, 3) set the topic and publicize the meeting, if they are the SOS group.

Suggested Handouts: 1) Memo to SOS members, 2) Memo to Student Environmental Group, 3) Memo to APCO.

Hearing on Air Quality Standards

**Objective:** To familiarize students with the process of setting air quality standards; to synthesize and digest the federal documents in this area; to provide an opportunity for the community-at-large to express their opinions on a technical subject.

**Description:** As background for this STEP, APEX County will be designated part of an Air Quality Control Region. The Governor of the State will hold hearings in each of the counties involved in the region. At these hearings, the Governor's Representatives will solicit recommendations for air quality standards and implementation plans, first from the APCO staff, and then from other interested citizens.

The game director may decide to limit the discussion to one or two pollutants, such as particulates and sulfur dioxide. The Federal Air Quality Criteria documents should be available for all the pollutants to be discussed. These documents summarize the available information on the relationship between exposures to air pollutants and their effects on man and his environment, including injury to health, damage to materials and vegetation, reduction of visibility, and economic losses. The Federal publications which report on available control techniques should also be made available.

The meeting should begin with a formal presentation by the APCO and his staff, in which they state their recommendations. There will then be an opportunity for presentations by other interested members of the community who have notified the Governor's Representatives that they would like to be on the agenda. Following the formal presentations, there may be an opportunity for the community to respond with questions or further comments.

**Preparations:** Staff should 1) announce the meeting in the Gazette, 2) collect literature on the subject, and 3) prepare and distribute memos.

Students should 1) study Federal documents, and 2) prepare formal presentations.

**Bibliography:** "Guidelines for the Development of Air Quality Standards and Implementation Plans," U.S. Department of Health, Education, and Welfare (May, 1969).  
 "Air Quality Criteria for Sulfur Oxides", U.S. Department of Health, Education, and Welfare, (Jan.1969)  
 "Air Quality Criteria for Particulate Matter", U.S. Department of Health, Education, and Welfare, (January, 1969).

**Suggested Handouts:** 1) Gazette headline; 2) Memo to Governor's representatives; 3) Memo to APCO staff, and 4) Notice to community-at-large.

## A Trial

Objective: To familiarize students with the role of the court in air pollution control; to expose them to the administrative requirements of prosecution; to give them experience in building and developing a court case; to allow them to play the role of expert witness.

Description: The game director will choose one industrial plant to be the target for the STEP. (Obviously, it would be better if the selection of the defendant evolved naturally from the game. But because this STEP requires so much preparation it is better if the students know the defendant beforehand.) This plant will be instructed to initiate, or continue in a policy of non-compliance with Air Pollution Control rules and regulations.

The Air Pollution Control Office will be forced to take some action to remedy the situation. They will be encouraged to exhaust all administrative remedies before resorting to civil or criminal proceedings (see Legal Reference Manual for discussion of civil vs. criminal proceedings). It generally takes at least five cycles of play for the Air Pollution Control Office to gather sufficient information to build a thorough court case.

One or two students should be asked to serve as attorneys for the defense, and likewise for the prosecution. It may be helpful, also, to have a lawyer or law student advise each side -- especially in relation to legal technicalities. The remaining students could be assigned by either the defense or prosecution to act as witnesses. Some of the witnesses that the prosecution may need are: inspectors, source test engineers, a chemist, a meteorologist, an epidemiologist, and complaining citizens. The defense may want to call as witnesses: the plant manager, an engineer, a consultant on control systems, a consultant chemist, and area residents.

Sometime before the STEP, the defense and prosecution will have to come to agreement on items concerning the physical conditions of the plant (stack locations, stack heights, etc.), the actual items of inspection, and the prevailing weather conditions and the in-plant operations at the times of the inspections.

The trial itself requires more time than most STEP exercises. Both sides should be given about fifteen minutes for opening statements. Then each will need approximately two hours to develop their respective cases. After the presentations, about fifteen minutes should be provided for closing statements.

Preparation: Staff should 1) arrange for legal assistance, if necessary, 2) assign roles, 3) arrange for a moot court room to use for the trial, if possible, 4) help students prepare cases by providing information on precedents, court procedures, etc.

Students should 1) study case precedents and court procedures, 2) prepare witnesses, and 3) develop cases.

Suggested Handouts: 1) Appropriate sections of Legal Reference Manual, 2) Memo to Industrial Plant Manager from his Board of Directors, and 3) Memo to APCO staff from the County Air Pollution Control Board.



Power Plant Rates

Objective: To introduce students to the relationships between regulatory agencies where authority overlaps; to demonstrate the relationship between the costs of expansion and rates charged to the consumer; to encourage students to explore the problems associated with supplying electrical power to a growing community.

Description: This exercise involves a meeting of the Public Utilities Commission in which the Plant Manager of the Shear Power Company will propose a rate increase. The Company will be forced into a position where it must expand its productive capacity in order to meet both the present and projected power needs of the community. Since large capital outlays are necessary to purchase the required land, buildings, and equipment, the Plant Manager will propose a rate increase to defray some of these costs. It will be up to the Plant Manager to develop supporting data concerning the projected demand for power, the effects of the proposed rate increase on the income/expenditure picture of his plant, the implications of the proposed rate increase for the different power users, etc.

All citizens should consider the implications of the proposed expansion and rate increase. The Air Pollution Control Office, however, has a special interest in the proposal, since the power plant is among the largest potential polluters of the community. The Planners, also, have a special interest in this proposal and its possible effects on the growth pattern and direction of the County.

Preparation: Staff should 1) assign students to play the role of the Public Utilities Commission, 2) prepare and distribute handouts, 3) make file changes, if necessary, to put the plant in a position where it is forced to expand, 4) collect extra data on the power plant, if necessary.

Students should 1) research implications of power plant expansions, 2) prepare a short release for the Gazette summarizing need for expansion and extent of proposed rate increase, 3) prepare formal presentations including visual materials, if desired.

Suggested Handouts: 1) Memo to those being asked to serve on Public Utilities Commission, 2) Memo to Plant Manager of Shear Power Plant from his Board of Directors, 3) Gazette release announcing the public meeting of the Utilities Commission, 4) Data sheet on power usage in APEX County.



Smog Alert

Objective: To place students in a situation where they have to react to an emergency condition; to demonstrate the need for a comprehensive plan for dealing with emergencies.

Description: There are two ways that this STEP can be handled, one involves surprise and the other does not. If the element of surprise is to be retained, the students will be prepared for this STEP only through indirect means. There will be a series of headlines which warn of an upcoming disaster. These will be planned so that the early headlines are of a wild and speculative nature, and the later ones are more sensible, believable and urgent. There could also be an editorial on the videotaped news broadcast which predicts an emergency situation in APEX County if more stringent air pollution control measures are not enacted. Then, on the day of the STEP exercise, the news media would report that APEX County had entered into a disaster situation. The computer printout of the APCO role would reflect the disaster situation with greatly increased background pollution levels, and double or triple the usual number of citizens' complaints. The exact cause (if known) and the duration of the disaster would be determined by the Game Director and reported in the news.

In reaction to the disaster, the County Board of Supervisors will call an emergency hearing to determine what can be done. The APCO staff will be requested to submit their plans for dealing with the situation, and may be asked to explain why the situation was allowed to occur in the first place. The Board may request other citizens to submit suggestions also.

If it is not important to retain the element of surprise, this STEP can be structured in a different way. A hearing to discuss emergency procedures can be called as a preventive measure, to determine appropriate measures in the event of a disaster. If a disaster actually occurs, it would take place sometime after the meeting, and it would be a means of testing the workability of the plan that was adopted.

The advantage to this second format is that students can prepare for the STEP by doing research into different methods of handling emergencies, and they will have time to come up with a complete and thorough proposal. The advantage of the first format is just the opposite ← students are placed in a situation for which they are probably unprepared. It may be possible to combine the two formats in such a way that some advantages of each are retained.

Preparation: Staff should 1) prepare news headlines, 2) prepare an editorial, 3) prepare and distribute memos, 4) make appropriate file changes.

Students should 1) research methods of handling emergencies, 2) devise an emergency plan of control to be implemented in APEX County.

Suggested Handouts: 1) Gazette headlines, 2) Memo to County Board of Supervisors.

● 29 APEX ANALYSIS AREAS

TOWNSHIP 1

Areas 23, 24, 25, 26, 27 and 28

TOWNSHIP 2

Areas 14, 15, 16, 20, 21, 22 and 29

SUBURB

Areas 17, 18 and 19

CENTRAL CITY

Ward One: Areas 1, 2, 3, and 4

Ward Two: Areas 5, 6, 7 and 8

Ward Three: Areas 9, 10, 11, 12 and 13

Township 1 Township 2

28

29

27

26

25

24

20

23

5

1

3

4

10

12

13

ward 1

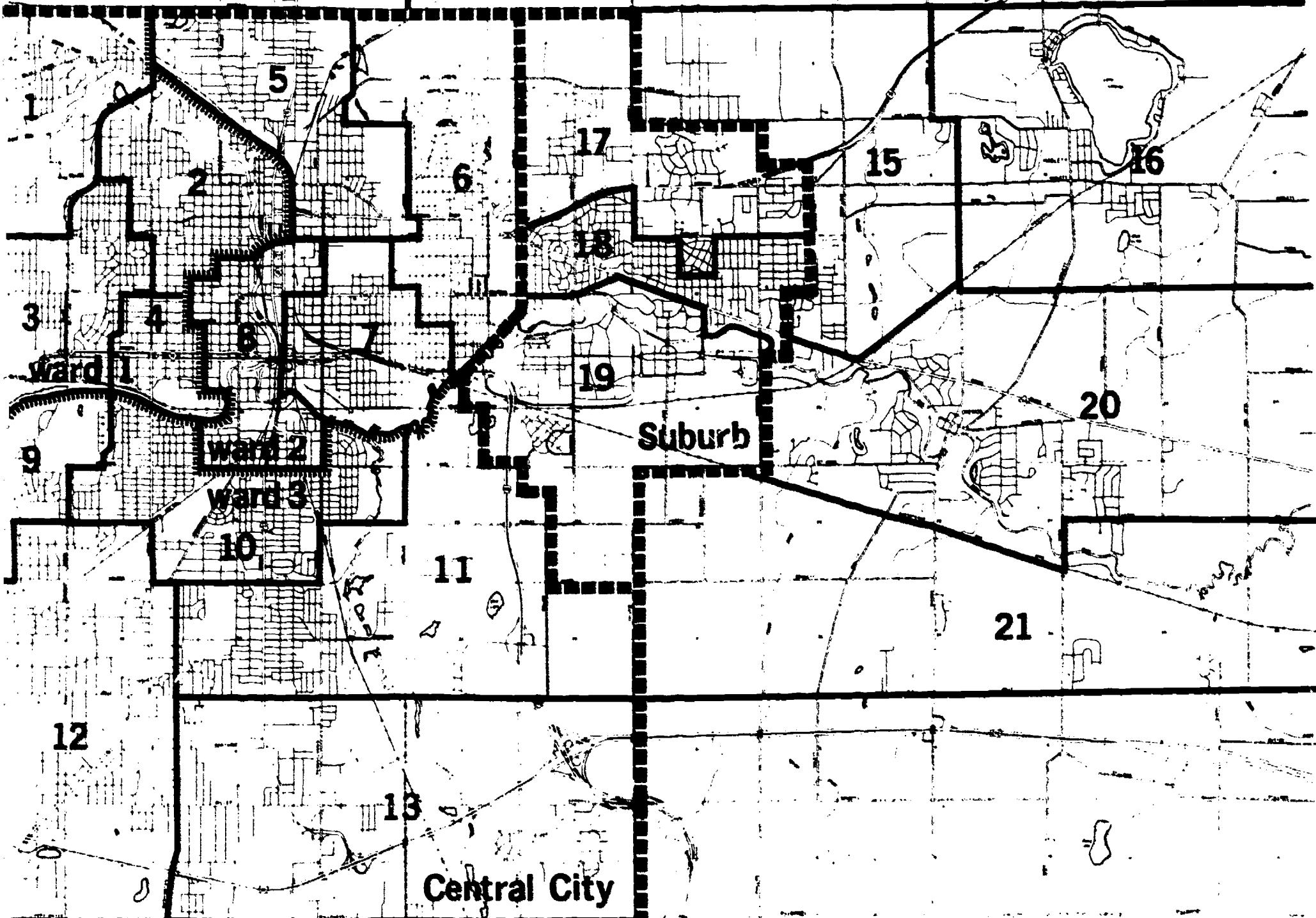
ward 2

ward 3

wnship 2

29

14



Suburb

Central City

Township 1

Township 2

22

23

