

NBSIR 74-555

COM-74-10704

CITY GAMES
AN EXECUTIVE'S OVERVIEW

NATIONAL BUREAU OF STANDARDS

MAY 1974

DISTRIBUTED BY:

NTIS

**National Technical Information Service
U. S. DEPARTMENT OF COMMERCE**

BIBLIOGRAPHIC DATA SHEET		1. Report No. NTIS-SR-74-03	2.
4. Title and Subtitle CITY GAMES An Executive's Overview		5. Report Date May 1974	
7. Author(s) John Moriarty		6.	
9. Performing Organization Name and Address National Bureau of Standards Technical Analysis Division Washington, D. C. 20234		8. Performing Organization Rept. No.	
12. Sponsoring Organization Name and Address National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22151		10. Project/Task/Work Unit No.	
15. Supplementary Notes For further information about the City Games Systems contact: NTIS - Computer Products, tel. (703) 451-1530.		11. Contract/Grant No.	
16. Abstracts The City Games are realistic gaming simulations of the operation of contemporary cities. They have been in continuous development since the 1960s with their completion by the National Bureau of Standards in 1973-74. In the City Games, participants experience intensive transactions in collaborative planning and in competitive negotiations for the allocation of limited resources. They emulate elements of the government, economic and social sectors of the city system and make planning decisions involving land use, schools, transportation systems, water and sewer facilities, zoning, tax structure, etc., etc.. In a three-hour round of game play, representing a tele-scoped fiscal year, the decision maker makes quantitative decisions, implements them, and (through the computer aided simulation) sees the consequences of his actions. In successive rounds of play, the participant gains experience in Trade-off negotiations, learns systematic approaches to typical problems and acquires new insights into the interdependences of the numerous components of a city system. City Game demonstrations can be conducted over a 2-3 day period and can accommodate between thirty and sixty		13. Type of Report & Period Covered	
17. Key Words and Document Analysis. 17a. Descriptors		14.	
* City * Computer * Simulation * Government * Economic * Social		active participants.	
17b. Identifiers/Open-Ended Terms * Metropolitan Computer games			
17c. COSATI Field/Group			
18. Availability Statement		19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 50
		20. Security Class (This Page) UNCLASSIFIED	22. Price \$3.25

THE CITY GAMES

An Overview

by

John E. Moriarty
National Bureau of Standards
Technical Analysis Division
Washington, D. C. 20234

INTRODUCTION

The City Games are realistic gaming simulations of the operation of contemporary cities. They have been in continuous development since the 1960s with their completion by the National Bureau of Standards in 1973-74. The Games are now being made available to the general public through the National Technical Information Service (NTIS) in cooperation with Ketron, Inc., Arlington, Virginia.

In the City Games, participants experience intensive transactions in collaborative planning and in competitive negotiations for the allocation of limited resources. They emulate elements of the government, economic and social sectors of the city system and make planning decisions involving land use, schools, transportation systems, water and sewer facilities, zoning, tax structure, etc., etc..

In a three-hour round of game play, representing a telescoped fiscal year, the decision maker makes quantitative decisions, implements them, and (through the computer aided simulation) sees the consequences of his actions. In successive rounds of play, the participant gains experience in Trade-off negotiations, learns systematic approaches to typical problems and acquires new insights into the interdependences of the numerous components of a city system. City Game demonstrations can be conducted over a 2 - 3 day period and can accommodate between thirty and sixty active participants.

If a city is viewed as a whole, rather than by separate parts as the budgeting process requires one to do, a new cost-benefit relationship occurs. If the local transportation department develops its budget based solely on real and imagined transportation needs, other facets of impact might be ignored. For example, it may be more important to the city as a whole to place priorities on medical care and schools.

If the transportation department would relate its priorities relative to all public needs, it probably could forego some of its expansion funds for the particular fiscal year to increase the funding needs of other departments. The ultimate allocation of funds will more often than not depend on political considerations of the various departments rather than the overall effect of fiscal distribution on the community as a whole.

It is within this idea of viewing a community as a whole that City Games contributes as a vehicle of learning. The Games are operational simulations in which the participants make economic, government and social decisions affecting a hypothetical metropolitan area. Through the use of a computer, the simulated urban system responds to the participants' decisions as any real city would. Each player is assigned a responsible role corresponding to one in a real city. The interrelated decisions made by the players will guide the way the simulated city changes in composition and size.

The simulation approach to cities offers the players an opportunity not only to make decisions but to implement them. The players receive a feedback from their actions and see the effects from the other forces that are constantly at work altering the outcome of their decisions. Players, therefore, have a learning experience in how to deal with competition for resources in a changing environment. The round-by-round play gives the players the necessary experience in selecting the type of analysis to move them towards their objectives while the allocation of their time and Game resources is a critical determinant of the success they hope to achieve. As the Game progresses, players learn to increase their involvement in the management of the environment while at the same time learning more about the relationships among the business, government and citizen segments of our society.

LEARNING THROUGH REALISTIC TRANSACTIONS

One of the primary purposes of the Game is to improve the players understanding of urban problems in systemic terms. In other words, the aim is to encourage players to view the activities of the City as being closely related and interdependent (e.g., an unemployment problem will exacerbate a health problem, the loss of industry and jobs in the private sector will reduce the number and quality of services offered in the public sector through reduced tax revenues, etc.).

The Game also encourages players to use an interdisciplinary perspective when dealing with urban problems; that is, to look at the problem not only from the viewpoint of an economist, but also from the perspective of a geographer, planner, political scientist, etc. For instance, if a player is dealing with a land use problem such as zoning, he soon realizes that he cannot escape the broader concepts of land-use planning.

The problems of housing, unemployment, education, health, highways, etc., are all related in a system of interconnected activities and institutions to his original land-use problem of zoning. Hence, many of the outputs of this particular gaming model (e.g., land use maps, economic indicator tables, etc.) are designed in such a fashion that the City can be viewed more easily as a single entity than as several separate and disparate parts.

STEP BY STEP DESCRIPTION

In the playing of the actual game, participants assume various roles in the public and private sectors. The Game Director begins the Game with a classroom type lecture devoted to the discussions of the major decision rules in the City Model as well as the many printouts and reports that result from each role-player's decision inputs. During this session, players are assigned a particular role (i.e. economic decision maker, mayor, school board member, etc.) and asked to read that portion of the Player's Manual dealing with his role.

Using the manual as a technical guide, the players address themselves to the mechanics of coding forms and interpreting the computer printouts. It is at this time that the Director describes the preprogrammed city in the computer to the players. The Director has the option of choosing initial parameters such as economic growth rates, social conditions, production capacities, etc. to suit the particular objects of the players and thereby making the Game more flexible and susceptible to innovative approaches to urban problem solving.

The Director can structure the role assignments to be directed at individuals who concentrate on single objectives such as heavy industry or to multi-disciplinary task forces which consider urban problems within an interdisciplinary framework (e.g., a task force on transportation policy might include a sociologist, political scientist, geographer, planner, engineer and an economist).

The City model selected for game play may be a typical city or it may be the player's own city. The model employs a grid board geographical map that can be loaded with data from any regional or metropolitan area. The map contains 625 parcels in which each parcel represents one square mile of land. Many of these land parcels are unowned at the beginning of play and those that are occupied are represented by a specific, representative land use. For instance, if a square mile consists mainly of middle income residences, this parcel would be designated as such even though there could be a few commercial businesses within the square mile. The only requirement in assigning parcels is that the assignment typify the most representative land use. In a similar manner, highways and roads are represented along the boundaries of the parcels. If you imagine a parcel as represented by a square, then a road is described as one or more sides of the square.

Once the representations are made, there remains the task of assigning numerical values and indexes to the many parts of the city's functions. For example, when various types of businesses are identified, they must be labeled with their dollar volume and prices for their products. Residences must be identified as to type and amount of rent paid. Voter registration and social dissatisfaction indexes must be established along with zoning classifications, cash availabilities, government expenditures, taxes, road configurations and utilities. These inputs, along with the parcel classifications, describe the starting city. The files of this starting city are stored in the computer and can be altered by the game director to suit the players needs.

Changes in these files may affect the output of the computer but will have no bearing on how the computer calculates the output. The computer program directs the computer to act upon the data files in fixed relationships using the various data stored in the city file. In this way the computer can respond to updated file changes, act as an outside system, perform routine functions or processes that would be time consuming for the players and finally act as a bookkeeper.

Each player studies his printout generated from the starting city to evaluate his status as an individual and as a team member. Each team defines its specific problems, establishes objectives and develops strategies. Various groups will then gather for informal sessions for the purposes of bargaining, trade-offs and consumating deals. Eventually each group arrives at final decisions for actions to be taken in that particular round of the game. These decisions are then entered into the computer by a special code and the model is ready to run. The computer then prints out a new series of data representing the changed city.

In a typical game play the players generally behave in a predictable way with a minimum of player interaction early in the game. Players tend to feel that most interrelations should be avoided for the sake of secrecy. Most players use the guise of ignorance when talking to their peers early in the game and their contacts are limited to attempts at acquiring knowledge. As the player's command over the technical content increases, so does his awareness of the necessity for a properly functioning system. The player realizes that his economic aspirations will not be achieved unless his public counterpart can create a suitable "service-rich" environment in which he can operate. Typically, one or two players generally emerge quickly with an extensive grasp of the system and its technical content and assume the role of educator. In a fashion similar to the old ward politicians, the educator dispenses favors (the patronage in the form of technical explanations), to gain the initial respect of his constituents. Needless to say, it is then a simple matter for the educator to insure his election to the mayoralty of the city.

As time passes, other players come to understand their role and the role of others and begin to realize that the mayor, although helping the city to function, often is insuring his own economic prominence at their expense. At this point, the era of the ward politician is inevitably (or generally) over and with this passing comes the emergence of the city-manager. The political cooperation that grows from the new regime eventually leads to a full appreciation of the efforts of others and will open up higher levels of discussion concerning city-wide urban problems. Although the previous discussion concerns player behavior during game play, the influence of the gaming process tends to create a learning experience which is one of the fundamental purposes of City Games and these experiences with the game can be transferred to the problems of the real city.

In most games, the Game Director's role diminishes as the play progresses and players become more familiar with the technical content of the game. Since bribes and boycotting are allowed along with collusion and other forms of special interest groups, a new aspect of the game appears, namely law and order. Players rapidly learn that disputes cannot be settled by opposing interest groups and the enforcement of agreements and compromises becomes almost impossible. Players demand legal systems and police departments and the local government is faced with new expenses to deal with. If these demands are met, the City managers must generate more income to meet these expenses and forego other spending plans.

At this point, the hypothetical city is becoming very real and very complicated to run. Even though it is a hypothetical city, players become emotionally involved and the intensity of their involvement permeates the playing area. Time is a constant enemy

for the players just as in real life. Everyone wants everything at once and a typical game play allows the players about two to three hours per round to make their decisions. One round of the game is equivalent to one year of real time. If elections are required every two years, only two rounds are played before new elections. If the newly elected officials fail to honor prior commitments by their predecessors, well, the best laid plans...!

GAME STRUCTURES

The primary object of the Games is a learning experience. Each Game is designed to dynamically teach the participants the intricate problems confronting the city and the ramifications of poor or improperly funded decisions which can only create new problems. A Game may be structured such that one or two rounds are played, the starting city is then reconstituted, and the players are asked to replay the rounds and profit by their prior mistakes. For variety, the time between rounds may be extended so that players can perform a more sophisticated analysis on their decisions.

Games may also be played straight through for a predetermined number of rounds using the computer output as given or submit the output to other programs for additional information. As in example of the latter, consider the problem of crime. It is possible to have a computer program that stores various crime statistics and will generate levels and types of crime providing census data is inputted to the program. The City Game output provides statistics on population by type, dwellings by conditions and information about the people and characteristics of neighborhoods in the City. These outputs can be fed into another program and result in crime statistics for the community. If the players wish to institute social reforms or implement federal programs, they then can see the results of their effort in the crime statistics.

It must be reemphasized that the Games are merely simulations and represent only the thought process of the particular player groups. These players will probably not represent an unbiased sample of the general population. Possibly the most significant point of departure from a real city population is the volume of information available to the players and its accuracy. In real life, special interest groups tend to dramatically publicize their cause in a favorable light.

Local politicians tend to vote to please their electorate and businessmen and social groups push for objectives favorable to their selfish interests. These ingredients are all present in City Games with the difference being that a player can sort out the misinformation and become informed whereas the average citizen appears to have neither the time nor the desire to become fully informed about all issues. The Games overcome this difficulty by teaching the players where to look for information and reduce the time lag of decisions to manageable proportions.

As stated earlier, the simulated city is not limited to a hypothetical one. In fact, the Game does not have to represent a city at all. Rural areas or counties may be represented as well as

towns. The data bases are real numbers taken from the official records of the area to be simulated. The demographic information is accurate within the one square mile constraints and every effort is made to insure an accurate representation of the social, economic, and governmental conditions of the area. The Games can be bought with a complete starting city in the data bank or replaced with a City of the purchasers choice. Arrangements may also be made through the National Technical Information Service (NTIS) for demonstrations of the Games.

CITY GAME DOCUMENTS

CITY I is the smallest of the Games utilizing an IBM 1131 computer. It contains economic and government sectors and is primarily a large scale land use model. The documentation for this game consists of a Director, Player's, and Computer Operator's manual along with an IBM Disk Pack and control cards. The language is Fortran and the Game requires only the Director and Computer Operator to have any knowledge of computers. The only contact with the computer that the players have is in filling out simple sending sheets for input. Details and specifications are given in the price listings of the NTIS Catalog.

CITY III is a larger Game played on a Univac 1108. The language is Fortran and the Game contains economic, government and social sectors. The documentation for this Game consists of a combined Director-Computer Operator manual and a Player's manual along with a tape and control cards. As in CITY I, this Game requires only that the Director and Computer Operator have a knowledge of computers. Details and specifications are given in the price listings.

CITY IV is essentially the same as CITY III except it is played on an IBM 360/70. The documentation consists of a Director, Player's and Computer Operator's manual along with a tape and control cards. Again the players need have no knowledge of computers and the details and specifications are given in the price list of the NTIS Catalog.

Another unique piece of documentation is available entitled "Mathematical Foundations". This manual is designed to acquaint interested readers in the actual mathematical models used in the Games. It defines the models in such a way that each model can stand alone. The uniqueness of the Games is really not the individual models but the interrelations among them. Individuals interested in programming parts of City Games for more detailed study will find this modeling guide invaluable.

As an aid to appreciating how comprehensive the city modeling effort is, the table of contents for each manual is included in this brochure. If further information on City Games is desired, you may direct your inquiry to the National Technical Information Service, 5285 Port Royal Rd., Springfield, Virginia, 22151, or Ketrone, Inc., 1400 Wilson Blvd., Arlington, Virginia, 22209.

CITY I DIRECTOR'S MANUAL

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
II. MODEL PROCESSES	11
A. The Computer	11
B. The Two Sectors	11
1. The Economic Sector	11
2. The Government Sector	12
C. The Game Board	12
D. Levels of Aggregation and Scale	15
E. How to Begin Play of City I	15
F. The City I Round	15
G. Optional Citizen's and Mass Media Team	16
III. LOADING A NEW BOARD CONFIGURATION	17
IV. ADMINISTERING A GAME-PLAY	20
A. The Game Room	20
B. The Computer	20
C. Game Materials	20
D. Pre-Game Planning	21
E. Directing Play	21
V. EXAMPLES OF DECISION CODES AND FORMATS	23
A. MUN (Government Decisions)	23
1. Enter the Department's Appropriations for the Round	23
2. Set Tax Rates and Enter Tax Base Estimates	23
3. Public Land Purchase	23
4. Build Utility Lines and Plants	23
5. Change Zoning Classification on a Parcel	24

	<u>Page</u>
6. Build Schools or Change Teacher Assignment	24
7. Renovate Schools	24
8. Build Municipal Services or Change Employee Assignment	24
9. Renovate Municipal Services	25
10. Demolish MS or School	25
11. Change MS or School Employee Salaries	25
12. Build or Upgrade Roads	25
13. Renovate Roads	25
14. Build or Upgrade Terminals	25
 B. City I (Economic Decisions)	 26
1. Headings for Output	26
2. Loans from Bank or Another Team	26
3. Cash Transfer at No Cost to Team	26
4. Subsidy from Chairman	27
5. Invest Outside the Local Economy	27
6. Restore Slums	27
7. Purchase Land by Private Team	27
8. Demolish Residences	28
9. Demolish Businesses	28
10. Renovate Any Land Use	28
11. Build or Upgrade Residences	28
12. Build Businesses	29
13. Upgrade Businesses	29
14. Change Prices or Salaries	29
 C. Samples	 30
 VI. GENERAL INFORMATION	 33
 A. Description of General Computer Output	 33
1. The Status Map	33
2. The Change Map	33
3. The Summary of Economic Status	33
4. Distribution of Population	33
5. Voting Power of Teams	34
6. Real Assets	34
7. Socio-Economic Parameters for the Round	34
8. Employment Status	42
9. Outside Economic Status Report	42
10. Predictions	48
11. Assessed Value of Land Map	48
12. Property Damage	48
13. Residence Income Class Succession	49
14. Danger of Lowering of Income Class	49

	<u>Page</u>
B. Glossary of Terms	56
C. Master Sheets	66
D. The Flow and Interactions of Private and Public Functions in City I	69

CITY I OPERATOR'S MANUAL

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
II. MODEL PROCESS	2
A. The Computer	2
B. Game Sequence	2
C. Program Design	2
III. GENERAL INPUT PROCEDURE	5
A. Preparing the Computer for Input	5
B. Processing Decisions	5
IV. RETRIEVING DATA FROM STORAGE (before input)	7
V. INPUT CODES AND FORMATS	9
A. Ordering the Data	9
1. Government Sector	9
2. Economic Sector	9
B. Summary of MUN Input Programs	10
C. Summary of City I Input Programs	11
VI. SAMPLE TRANSACTIONS WITH THE COMPUTER	13
VII. OUTPUT PROCEDURE	17
VIII. COPYING DATA (end of output)	20

CITY III PLAYER'S MANUAL

Table of Contents

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
A. The Computer	1
B. The Game Board	2
C. The Three Sectors	3
1. The Economic Sector	4
2. The Social Sector	5
3. The Government Sector	5
D. How to Begin a Play of CITY MODEL	6
E. The CITY MODEL Round	6
II. THE ECONOMIC SECTOR	9
A. The Economic Decision-Maker	9
B. Economic Land Uses	9
C. Common Characteristics of Economic Land Uses	10
1. Development Level	10
2. Land Requirements	11
3. Value Ratio (VR) and Quality Index (QI)	11
4. Depreciation	11
5. Maintenance and Normal Operation	12
6. Utility Requirements	14
7. Employment Requirements	15
8. Taxes	18
9. Capacity	19

<u>Title</u>	<u>Page</u>
D. Effects of the Outside System on the Economic Sector	20
E. Basic Industry	21
1. Income	21
2. Expenditures	21
F. Construction Industry	22
1. Income	22
2. Expenditures	23
G. Commercial Establishments	26
1. Buyers and Sellers	26
2. The Commercial Process	27
3. Boycott	27
4. Income	27
5. Expenditures	27
H. Residences	29
1. Income	29
2. Expenditures	30
I. Economic Sector Decisions	31
1. Bid on and/or Purchase Land or Developments (\$PU)	31
2. Change Rents, Prices, Salaries, and Maintenance Level (\$CVPT)	31
3. Transfer Cash (\$CASH)	32
4. Boycott (\$BYCT)	32
5. Lend, Borrow, and Invest (\$OTHER)	33
6. Build, Upgrade, or Demolish Developments (\$BUILD or \$OUBLD)	33

<u>Title</u>	<u>Page</u>
III. THE SOCIAL SECTOR	36
A. Population	36
1. Income	36
2. Expenditures	37
B. Dissatisfaction	38
C. Migration	39
1. Internal Migration	39
2. Out-Migration	39
3. In-Migration	40
D. Types of Decisions	40
1. Voting (\$VOTE)	40
2. Boycotting (\$BYCT)	41
3. Time Allocation (\$TIME)	41
4. Setting the Dollar Value of Time (\$VALUE)	46
IV. THE GOVERNMENT SECTOR	48
A. The Chairman and Council (CH)	48
B. Chairman Decisions	49
1. Appropriate Funds (\$CASH)	49
2. Distribute Subsidies (\$CASH)	49
3. Transfer Cash (\$CASH)	49
4. Set Tax Rates (\$TAXES)	50
5. Set Welfare Payments (\$OTHER)	51
6. Float Bonds (\$OTHER)	51

<u>Title</u>	<u>Page</u>
C. The Bureaucracy	52
1. Common Characteristics	52
2. Source of Income	53
D. Assessment Department	54
1. Assessment Rate	54
2. Market Value	54
3. Assessed Value	57
E. Assessment Department Decisions	57
F. School Department	59
1. Employment and Capacity	59
2. School Assignments	60
3. Adult Education	60
4. Revenues	61
5. Expenditures	61
G. School Department Decisions	62
1. Purchase Land (\$PU)	63
2. Change Employment (\$CVPT)	63
3. Change Maintenance Level (\$CVPT)	63
4. Award Contracts (\$CVPT)	64
5. Change District Boundaries (\$REDIST)	64
6. Transfer Cash (\$CASH)	64
7. Change Salaries (\$OTHER)	64
8. Build Schools (\$BUILD or \$OUBLD)	64
9. Request Federal-State Aid (\$FSA)	65
10. Adult Education (\$OTHER)	65

<u>Title</u>	<u>Page</u>
H. Municipal Services Department (MS)	65
1. Employment and Capacity	65
2. Drain on Municipal Services	66
3. Revenues	67
4. Expenditures	68
I. Municipal Services Decisions	69
1. Purchase Land (\$PU)	69
2. Change Employment (\$CVPT)	70
3. Change Maintenance Level (\$CVPT)	70
4. Award Contracts (\$CVPT)	70
5. Change District Boundaries (\$REDIST)	70
6. Transfer Cash (\$CASH)	71
7. Change Salaries (\$OTHER)	71
8. Build, Upgrade or Demolish MS Plants (\$BUILD or \$OUBLD)	71
J. Highway Department (HY)	71
1. Highways	71
2. Terminals	72
3. Revenues	73
4. Expenditures	74
K. Highway Department Decisions	75
1. Purchase Land (\$PU)	75
2. Transfer Cash (\$CASH)	75
3. Change Maintenance Level (\$CVPT)	75
4. Build Highways and Terminals (\$BUILD or \$OUBLD)	76
5. Request Federal-State Aid (\$FSA)	76

<u>Title</u>	<u>Page</u>
L. Planning and Zoning Department (PZ)	76
1. Zoning	76
2. Parkland and Public Institutional Land	77
3. Revenues	77
4. Expenditures	77
M. Planning and Zoning Department Decisions	78
1. Purchase Land (\$PU)	78
2. Change Zoning (\$CVPT)	78
3. Transfer Cash (\$CASH)	79
4. Request Federal-State Aid (\$FSA)	79
5. Create or Demolish Public Public Institutional Land Uses (\$CVPT)	79
N. Utility Department (UT)	79
1. Installation of Service	80
2. Revenues	81
3. Expenditures	82
O. Utility Department Decisions	83
1. Purchase Land (\$PU)	83
2. Change Level of Utility Service (\$CVPT)	83
3. Transfer Cash (\$CASH)	84
4. Change Prices (\$OTHER)	84
5. Build Utility	84

<u>Title</u>	<u>Page</u>
P. Bus and Rapid Rail Companies (BUS,RAIL)	84
1. Capacity	84
2. Equipment	85
3. Depreciation and Maintenance	85
4. Employment	86
5. Passenger Assignments	86
6. Routes	87
7. Land Requirements	88
8. Revenues	88
9. Expenditures	88
Q. Bus and Railroad Company Decisions	91
1. Change Level of Service (\$ROUT)	91
2. Purchase or Sell Rolling Stock (\$OTHER)	91
3. Set Fares (\$OTHER)	92
4. Change Salaries (\$OTHER)	92
5. Change Maintenance Level (\$OTHER)	92
6. Transfer Cash (\$CASH)	92
7. Purchase Land (\$PU)	92
8. Build Rail Lines and Stations (\$RAIL)	92
V. COMPUTER OUTPUT	93
A. Status Maps	94
1. Economic Status Map	94
2. Government Status Map	98
3. Social Decision-Maker Map	98
4. Preempted and Public Institutional Land Map	98
5. Demographic Map	102

<u>Title</u>	<u>Page</u>
B. Land and Building Value Maps	104
1. Auction Asking Price Map	104
2. Land Market Value Map	104
3. Development Market Value Map	108
4. Total Market Value Map	108
C. Employment Detail	111
1. Part-Time Work	111
2. Employment Selection Information	111
3. Employment Summary	111
D. Commercial Detail	116
1. Personal Goods Allocation Summary	116
2. Business Goods Allocation Summary	118
3. PG, PS, BG, BS Allocation Map	118
4. Business Goods Government Contracts	118
5. Terminal Allocation	118
E. Migration Detail	122
1. Migration Statistics	122
2. Final Population	122
F. Summary Information	125
1. Demographic and Economic Statistics	125

<u>Title</u>	<u>Page</u>
G. Economic Decision-Maker Output	127
1. Financial Summary	127
2. Loan Statement	129
3. Land Summary	129
4. New Construction Table	132
5. Economic Boycott	132
6. Residence Detail	135
7. Basic Industry Detail	139
8. Commercial Establishment Detail	143
H. Social Decision-Maker Output	148
1. Population Detail	148
2. Boycott Status	150
I. Government Output	152
1. Government Financial Summary (Chairman and Council)	152
2. Tax Summary (Chairman and Council)	152
3. Assessment Constants	152
4. Assessment Factors	152
5. Land Assessment Map	152
6. Development Assessment Map	152
7. Total Assessment Map	162
8. School Department Detail	162
9. School Map	165

<u>Title</u>	<u>Page</u>
10. Municipal Services Map	165
11. Municipal Services Detail	165
12. Highway Department Detail	170
13. Highway Map	170
14. Total Planning and Zoning Land and Institutional Land Map	170
15. Parkland Map	174
16. Zoning Code Map	174
17. Planning and Zoning Detail	174
18. Utility Map	178
19. Utility Department Detail	178
20. Bus Company Report	178
21. Rail Company Report	183
22. Transportation Network Maps	183
VI. INPUT PROCEDURES	187
A. Using Forms	187
1. Decision-Code	187
2. Decision-Maker	189
3. Additional Information	189
VII. MASTER SHEETS	215
Master Sheet for Basic Industry	216
Master Sheet for Construction Industry	218
Master Sheet for Commercial Establishments	221
Master Sheet for Residences	224
Master Sheet for Social Sector	226
Master Sheet for School Department	228
Master Sheet for Municipal Services Department	230
Master Sheet for Highway Department	232
Master Sheet for Planning and Zoning Department	234
Master Sheet for Utility Department	235
Master Sheet for Bus Company and Rail Company	237

CITY III DIRECTOR'S MANUAL

Table of Contents

<u>Title</u>	<u>Page</u>
I. BEGINNING OF PLAY	1
A. Choice of City	1
B. Formation of Teams	6
1. Altering the Number of Teams	6
2. Making Teams Operate Across Sectors	7
3. Changing the Resources of a Team	7
C. Distributing General Output	8
II. RUNNING THE ROUND	9
A. Prefatory Notes	9
B. The Computer Round	10
C. The Players' Round	13
1. Game Formats and Strategy Formulation	13
2. Director Interaction with the Players' Input Procedure	25
3. Director Input Decisions	26
4. Putting in Decisions and Punching Cards	33
APPENDICES	
A. Player Thumbnail Decision Checklist by Sector Economic, Social, Government (11 pages)	
B. Flow Diagrams (4 figures)	
C. Inputting Decisions in the CITY MODEL (12 pages)	
D. Edits (30 pages)	

MATHEMATICAL FOUNDATIONS

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
II. PRIVATE CAPITAL ALLOCATION	8
A. Choice of Investment.....	8
B. Types of Investment.....	10
C. Generalized Private Capital Allocation Equation.....	14
D. Residential Housing.....	16
E. Commercial	20
F. Industrial	23
III. GOVERNMENT CAPITAL	26
A. Government Decision Objectives	27
B. Departmental Rates	28
1. Ratio for Education	28
2. Ratio for Adult Education	29
3. Ratio for Municipal Services	29
4. Ratio for Welfare Payments	30
5. Ratio for Utilities	30
6. Ratio for Transportation	30
C. Budget Allocation	31
IV. TIME ALLOCATION	32
A. Allocations	33
1. Part-Time Work (r_w)	34
2. Free Training and Adult Education (γAF_c)	35
3. Paid Training and Education (γAP_c)	35
4. Political Activities (r_{PC})	36
5. Recreational Activities (γR_c)	36
B. Decision to Invest Time	37
V. PUBLIC AND PRIVATE INFLUENCE	39
A. Voting	40
B. Allocation of Power	41
C. Power Objective	43

<u>Title</u>	<u>Page</u>
VI. OPERATION OF THE MODEL	45
A. Business Goods and Services	45
1. Demand	45
2. Supply	45
3. Price	46
4. New Prices	46
B. Employment	47
1. Demand for Jobs	47
2. Supply of Workers	47
3. Matching	48
4. Part-Time Employment	49
5. Salaries	49
C. Land Use	51
1. Residential	52
2. Industrial	53
3. Commercial	53
4. Government Facilities	54
D. Land Value	54
E. Rent	55
F. Location of a Commercial Site	56
G. Migration	58
H. School Assignments	60
I. Transportation	62
J. Value of Structure and Capital Equipment	64
K. Water	65
VII. POST SCRIPT	68
A. Glossary of Terms	69
B. List of Symbols	76

CITY I PLAYERS MANUAL

Table of Contents

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
II. MODEL PROCESSES	12
A. The Computer	12
B. The Game Board	14
C. Levels of Aggregation and Scale	16
D. How to Begin Play of <u>City I</u>	16
E. The <u>City I</u> Round	17
F. Optional Citizen's and Mass Media Team	
III. ECONOMIC SECTOR	19
A. Economic Land Uses	19
1. Development Level	20
2. Value Ratio	20
3. Capacity	21
B. Buyers and Sellers	22
1. The Commercial Process	25
C. Employment Process	26
D. Income	28
E. Expenditures	34

<u>Title</u>	<u>Page</u>
IV. INPUT	40
A. Economic Sector Decisions	40
1. Borrow or Lend Money	40
2. Transfer Cash	40
3. Invest in Speculative or Conservative Stocks	40
4. Restore Slums	40
5. Purchase and Bid on Land	40
6. Build or Upgrade Residences	41
7. Build or Upgrade Businesses	41
8. Demolish Residences	42
9. Demolish Businesses	42
10. Renovate Residences or Businesses	42
11. Change Prices or Salaries	43
B. Procedures and Formats	45
1. Decision Code	45
2. Additional Information	46
V. OUTPUT	52
A. Description of Economic Output	52
1. Detailed Property Statement	52
2. Summary Property Statement	60
3. Summary Financial Statement	63

<u>Title</u>	<u>Page</u>
VI. GOVERNMENT SECTOR	66
A. Chairman and Council	68
1. Explanation of the Role	68
2. Chairman and Council Decisions	69
3. Input Procedure	71
4. Sample Decisions	73
5. Computer Output	75
B. Finance Department	78
1. Explanation of the Role	78
2. Finance Department Decisions	79
3. Input Procedure	81
4. Sample Decisions	83
5. Computer Output	85
C. Public Works and Safety Department	88
1. Explanation of the Role	88
2. Public Works and Safety Department Decisions	92
3. Input Procedure	95
4. Sample Decisions	97
5. Computer Output	99

D. School Department	104
1. Explanation of the Role	104
2. School Department Decisions	106
3. Input Procedure	109
4. Sample Decisions	111
5. Computer Output	113
E. Highway Department	117
1. Explanation of the Role	117
2. Highway Department Decisions	119
3. Input Procedure	122
4. Sample Decisions	124
5. Computer Output	126
F. Planning and Zoning Department	133
1. Explanation of the Role	133
2. Planning and Zoning Department Decisions	134
3. Input Procedure	135
4. Sample Decisions	137
5. Computer Output	139

CITY I PLAYERS MANUAL - COMPUTER PRINTOUTS

<u>Title</u>	<u>Page</u>
Chairman's Report of County Budget for Round 1	76,77
Congestion Map for 1	130
Finance Department Report, Round 1	86,87
Game Board	14
Game Board Sample	120
Highway Department Report for 1	128,129
Municipal Services Map for Round 1	102
Planning and Zoning Department Report for 1	140,141,142
Public Works and Safety Department, Report for 1	100,101
School Department Report for 1	114,115
School Map for Round 1	116
Simulated County, 4 Areas	15
Summary Financial Statement for A, Round 1	64
Summary Property Statement for A, Round 1	61
Team A for Round 1	54,57,58
Total Cost Increment Map for 1	132
Utility Map, Round 1	103
Value Ratio Map for 1	131

CITY IV COMPUTER OPERATOR'S MANUAL

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
II. THE COMPUTER SYSTEM	11
A. Computer Specifications	11
B. City IV Model Installation	12
C. The Game Sequence	13
D. Loading the Data Base	13
E. Running the Model	14
F. Running Multiple Game	15
G. Problems With Hardware Requests	16
III. Appendixes	17
A. The System JCL Library	17
B. Data Set Description	25
1. Data Sets	26
2. EPA049. DATADECK LIBRARY	26
3. EPA049 DATABASE SCRT	27
4. EPA049. DATABASE	27
5. EPA049. LODMOD	27
6. EPA049. Source LIBRARY	28
7. EPA049. LIBFL	28
C. EDIT ERROR Messages	29
1. General Error Messages	30
2. \$ASMNT	32
3. \$BUILD-\$OUBLD	32
4. \$BYCT	34
5. \$CASH	35
6. \$CVPT	37
7. \$ENDS	39
8. \$FSA	40
9. \$ODDS	41
10. \$OTHER	42
11. \$PU	43
12. \$RAIL	44
13. \$REDIST	45
14. \$ROUT	46
15. \$TAXES	46
16. \$TIME	46
17. \$VALUE	47
18. \$WRBLD	47
19. \$WRPRC	49

CITY IV PLAYER'S MANUAL

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. MODEL PROCESSES	11
A. The Computer	11
B. The Game Board	12
C. The Three Sectors	13
1. The Economic Sector	13
2. The Social Sector	14
3. The Government Sector	15
D. How to Begin a Play of City Model	15
E. The City Model Round	15
F. Organization of the Player's Manual	16
III. THE ECONOMIC SECTOR	17
A. The Economic Decision-Maker	17
B. Economic Land Uses	17
C. Common Characteristics of Economic Land Uses	18
1. Development Level	18
2. Land Requirements	19
3. Value Ratio (VR) and Quality Index (QI)	19
4. Depreciation	20
5. Maintenance and Normal Operationa	20
6. Utility Requirements	24
7. Employment Requirements	25
8. Taxes	27
9. Capacity	29

	Page
F. Construction Industry	33
1. Income	33
2. Expenditures	35
G. Commercial Establishments	38
1. Buyers and Sellers	38
2. The Commercial Process	38
3. Boycott	38
4. Income	40
5. Expenditures	40
H. Residences	41
1. Income	41
2. Expenditures	42
I. Economic Sector Decisions	42
1. Bid on and/or Purchase Land or Developments (\$PU)	42
2. Change Rents, Prices, Salaries, and Maintenance Level (\$CVPT)	43
3. Transfer Cash (\$CASH)	43
4. Lend, Borrow, and Invest (\$OTHER)	44
5. Build, Upgrade, or Demolish Developments (\$BUILD or \$OUBLD)	44
IV. THE SOCIAL SECTOR	48
A. Population	48
1. Income	48
2. Expenditures	48
B. Dissatisfaction	50
C. Migration	51
1. Internal Migration	51
2. Out-Migration	51
3. In-Migration	51

	Page
D. Types of Decisions	52
1. Voting (\$VOTE)	52
2. Boycotting (\$BYCT)	52
3. Time Allocation (\$TIME)	53
4. Setting the Dollar Value of Time (\$VALUE)	58
V. THE GOVERNMENT SECTOR	60
A. The Chairman and Council (CH)	60
B. Chairman Decisions	60
1. Appropriate Funds (\$CASH)	61
2. Distribute Subsidies (\$CASH)	61
3. Transfer Cash (\$CASH)	61
4. Set Tax Rates (\$TAXES)	61
5. Set Welfare Payments (\$OTHER)	62
6. Float Bonds (\$OTHER)	63
C. The Bureaucracy	64
1. Common Characteristics	64
2. Source of Income	65
D. Assessment Department	66
1. Assessment Rate	66
2. Market Value	66
3. Assessed Value	68
E. Assessment Department Decisions	68
F. School Department	70
1. Employment and Capacity	70
2. School Assignments	71
3. Adult Education	72
4. Revenues	72
5. Expenditures	73
G. School Department Decisions	74
1. Purchase Land (\$PU)	74
2. Change Employment (\$CVPT)	74
3. Change Maintenance Level (\$CVPT)	75
4. Award Contracts (\$CVPT)	75
5. Change District Boundaries (\$REDIST)	75

	Page
6. Transfer Cash (\$CASH)	75
7. Change Salaries (\$OTHER)	75
8. Build Schools (\$BUILD or \$OUBLD)	76
9. Request Federal/State Aid (\$FSA)	76
10. Adult Education (\$OTHER)	76
 H. Municipal Services Department (MS)	 76
1. Employment and Capacity	77
2. Drain on Municipal Services	77
3. Revenues	79
4. Expenditures	80
 I. Municipal Services Decisions	 81
1. Purchase Land (\$PU)	81
2. Change Employment (\$CVPT)	81
3. Change Maintenance Level (\$CVPT)	81
4. Award Contracts (\$CVPT).	81
5. Change District Boundaries (\$REDIST)	82
6. Transfer Cash (\$CASH)	82
7. Change Salaries (\$OTHER)	82
8. Build, Upgrade or Demolish MS Plants (\$BUILD or \$OUBLD)	82
 J. Highway Department (HY)	 82
1. Highways	82
2. Terminals	83
3. Revenues	84
4. Expenditures	84
 K. Highway Department Decision	 85
1. Purchase Land (\$PU)	86
2. Transfer Cash (\$CASH)	86
3. Change Maintenance Level (\$CVPT)	86
4. Build Highways and Terminals (\$BUILD or \$OUBLD)	86
5. Request Federal/State Aid (\$FSA)	87
 L. Planning and Zoning Department (PZ)	 87
1. Zoning	87
2. Parkland and Public Institutional Land	87
3. Revenues	88
4. Expenditures	88

	Page
M. Planning and Zoning Department (PZ)	88
1. Purchase Land (\$PU)	89
2. Change Zoning (\$CVPT)	89
3. Transfer Cash (\$CASH)	90
4. Request Federal/State Aid (\$FSA)	90
5. Create or Demolish Public Institutional Land Uses (\$CVPT)	90
N. Utility Department (UT)	90
1. Installation of Service	90
2. Revenues	92
3. Expenditures	94
O. Utility Department Decisions	95
1. Purchase Land (\$PU)	95
2. Change Level of Utility Service (\$CVPT)	95
3. Transfer Cash (\$CASH)	96
4. Change Prices (\$OTHER)	96
5. Build and Demolish Utility Plants (\$OUBLD)	96
P. Bus and Rail Companies (BUS, RAIL)	96
1. Capacity	96
2. Equipment	97
3. Depreciation and Maintenance	97
4. Employment	97
5. Passenger Assignments	98
6. Routes	98
7. Land Requirements	100
8. Revenues	100
9. Expenditures	100
Q. Bus and Railroad Company Decisions	102
1. Change Level of Service (\$ROUT)	102
2. Purchase or Sell Rolling Stock (\$OTHER)	102
3. Set Fares (\$OTHER)	103
4. Change Salaries (\$OTHER)	103
5. Change Maintenance Level (\$OTHER)	103
6. Transfer Cash (\$CASH)	103
7. Purchase Land (\$PU)	103
8. Build Rail Lines and Stations (\$RAIL)	103

	Page
VI. COMPUTER OUTPUT	104
A. Status Maps	104
1. Economic Status Map	104
2. Government Status Map	109
3. Social Decision-Maker Map	110
4. Preempted and Public Institutional Land Map	110
5. Demographic Map	115
B. Land and Building Value Maps	115
1. Auction Asking Price Map	115
2. Market Value Map	115
3. Assessed Value Map	120
4. Farm Assessed and Market Value Map	120
5. Farm Map	120
C. Employment Detail	124
1. Part-Time Work Allocation	124
2. Employment Selection Information	124
3. Employment Summary	124
D. Commercial Detail	128
1. Personal Goods Allocation Summary	128
2. Personal Goods Allocation Map	128
3. Personal Services Allocation Summary	131
4. Personal Services Allocation Map	131
5. Business Goods Allocation Summary	131
6. Business Services Allocation Summary	131
7. Business Commercial Map	131
8. The Terminal Usage	131
9. The Terminal Allocation Map	131
E. Migration Detail	141
1. Migration Detail	141
F. Summary Information	141
1. Demographic and Economic Statistics	141
2. Transactions with the National Economy	141
G. Economic Decision-Maker Output	145
1. Financial Summary	145
2. Loan Statement	147
3. Land Summary	147
4. New Construction Table	150
5. Economic Boycott	150
6. Residence Detail	153
7. Basic Industry Detail	156
8. Commercial Establishment Detail	160
9. Farming Activity Detail	164

	Page
H. Social Decision-Maker Output	164
1. Population Detail	164
2. Boycott Status	167
I. Government Output	167
1. Government Financial Summary (Chairman & Council)	167
2. Tax Summary (Chairman & Council)	167
3. Financial Summary	172
4. Assessment Factors	172
5. School Department Detail	172
6. School Map	178
7. Municipal Services Map	178
8. Municipal Services Detail	178
9. Highway Department Detail	184
10. Highway Map	184
11. Total Planning and Zoning Land and Institutional Land Map	184
12. Parkland Usage Map	184
13. Zoning Code Table	190
14. Planning and Zoning Detail	190
15. Utility Map	190
16. Utility Department Detail	193
17. Bus Company Report	193
18. Rail Company Report	198
19. Transportation Network Maps	198
VII. INPUT PROCEDURES	201
A. Using Forms	201
1. Decision-Code	201
2. Decision-Maker	203
3. Additional Information	203

	Page
VIII. MASTER SHEETS	229
Master Table for Economic Teams	230
Master Table for Industrial Establishments	232
Master Sheet for the Construction Industry	236
Master Table for Commercial Establishments	238
Master Table for Residences	240
Farm Master Table	243
Planning Master Table	244
Master Tables for Social Teams, Population Unit	245
Quality of Life Factors for Population Units	249
Master Sheet for the School Department	251
Master Sheet for the Chairman	253
Master Sheet for Municipal Services Department	254
Master Table for the Highway Department	255
Planning Master Table	256
Operation of Federal/State Aid	257
Planning Master Table	258
Zoning Master Table	259
Parks Master Table	260
Planning Master Table	261
Master Sheet for the Utility Department	262
Utility Department Master Table	263
Characteristics of Outflow Treatment Plants	264
Master Sheet for Bus Company and Rail Company	265

CITY IV DIRECTOR'S MANUAL

Table of Contents

<u>Title</u>	<u>Page</u>
I. INTRODUCTION	1
II. BEGINNING OF PLAY	14
A. Choice of City	14
B. Formation of Teams	20
1. Altering the Number of Teams	20
2. Making Teams Operate Across Sectors	21
3. Changing the Resources of a Team	21
C. Distributing General Output	21
III. RUNNING THE ROUND	23
A. Prefatory Notes	23
B. The Computer Round	23
C. The Player's Round	26
1. Game Formats and Strategy Formulation	26
2. Director Interaction within Player's Input Procedure	30
3. Director Input Decisions	37
Appendix A	
Player Thumbnail Decision Checklists by Sector	48
Economic Sector	48
Social Sector	51
Government Sector	52

<u>Title</u>	<u>Page</u>
Appendix B	
Flow Diagrams	59
Economic Sector	60
Social Sector	61
Government Sector	62
Interrelationships in the City Model	63
Appendix C	
Inputting Decisions in the City Model	64
Appendix D	
EDITS	76
1. General Error Messages	78
2. \$BUILD and \$OUBLD Error Messages	80
3. \$CASH Error Messages	83
4. \$PU (purchase) Error Messages	84
5. \$OTHER and \$CVPT Error Messages	85
6. \$TAXES Error Messages	91
7. \$FSA Error Messages	91
8. \$REDIST Error Messages	92
9. \$RAIL Error Messages	92
10. \$ROUT Error Messages	93
11. \$TIME Error Messages	94
12. \$BYCT Error Messages	94
13. \$VALUE Error Messages	95
14. \$ASMNT Error Messages	95
15. The Concluding Messages	96
a. Auctioned Parcels	97
b. Federal-State Aid	97
c. Redistricting Error Messages	98

<u>Title</u>	<u>Page</u>
Appendix E	
Maximums and Minimums in the City Model Inputs and Files	99
1. Input Maximums/Minimums	100
2. File Maximums	102
3. Director Override	102
Appendix F	
List of Output Sections	105
Appendix G	
Elaboration of Some Player and Computer Processes	116
I. Introduction	116
II. The Full-Time Employment Process	118
III. The Part-Time Work Allocation Process	121
IV. The Commercial Allocation Process Overview	124
Detail on Parts of the Allocation Process	128
V. The Effects of Time Allocation in Education	130
VI. Bus and Rail Company Output	132
VII. The \$REDIST Input	135
IX. The Effects of the Outside System	138
a. Business Cycle	138
b. Federal-State Aid	140
c. Federal-State Taxes	142
d. Migration	143
e. Auction and Bids	143
f. Construction Industry	144

<u>Title</u>	<u>Page</u>
X. Business Profitability	146
XI. The Migration Process	148
1. Summary	148
2. Index Calculations	148
3. Outmigration Due to Unemployment and Underemployment	152
4. Selection of those Seeking Housing	152
5. Housing Placement	153
XII. Operating Programs of the City Model: 360 Version	155
 Appendix H	
Optional Game Formats and Suggestions	160
1. Mass Media	160
2. Federal-State Aid Controller	160
3. Data and Information Consultant	161
4. Alternative Forms of Government	161
5. Legal System	162
6. Insurgency	162
7. Holding Corporations	162
8. Building Inspector	163
9. Citizen Commissions	163
10. Citizen Interest Groups	164

<u>Title</u>	<u>Page</u>
Appendix I	
Scenarios for the Five City Model Configurations	166
1. Big City Scenario	166
2. Tri-City Scenario	169
3. Moray County Scenario	171
4. Dimbeath Scenario	172
5. Lothian Scenario	174
Appendix J	
Definition of Land Use Types	177
Appendix K	
City Model - Small Scale	180
1. Master Sheet for Basic Industry	180
2. Master Sheet for the Construction Industry	182
3. Master Sheet for Commercial Establishments	185
4. Master Sheet for Residences	188
5. Master Sheet for Social Sector	190
6. Master Sheet for the School Department	193
7. Master Sheet for Municipal Services Department	195
8. Master Sheet for the Highway Department	197
9. Master Sheet for Planning and Zoning	198
10. Master Sheet for the Utility Department	199
11. Master Sheet for Bus Company	201
12. Input Explanation Forms	202

<u>Title</u>	<u>Page</u>
Appendix L	
Designing a New Starting Point (Load) to the City Model	226
Steps in Designing	226
Loading Real-World Data	235
Appendix M	
Load Deck Input Card Formats	260
Appendix O	
Notes on the Load Program	263
Appendix P	
The Vote Procedure	274

