DOCUMENT RESUME

D 061 138 SO 002 752

UTHOR Duke, Richard D.; And Others
ITLE Gaming-Simulations in the Teaching of Urban Sociology.
NSTITUTION Michigan State Univ., East Lansing.
UB DATE [70]
OTE 32p.

DRS PRICE MF-$0.65 HC-$3.29
ESCRIPTORS City Planning; City Problems; Computer Assisted Instruction; Ecological Factors; Educational Games; *Games; Higher Education; *Human Geography; Simulated Environment; *Simulation; *Sociology; Systems Approach; Teaching Techniques; Urban Environment; Urbanization; *Urban Studies

BSTRACT

It is time that sociology made use of the ncreasingly popular teaching device of linking computer simulation nd gaming. It is needed because in teaching courses in urban ociology, human ecology, and urban planning, we have found that: a) ost class exercises present the community as a statis phenomenon; b) here is no quick and easy way to impress upon students the nature of he limited resources available and the forces competing for them; nd, c) even sophisticated and well-educated persons have only a hazy onception of how communities function. What is needed is a tool for etting across some perspective and sophistication for dealing with he basic materials that must precede formal analysis, and aming-simulations provide this. METROPOLIS and C.L.U.G. have both een developed into packages that can be adopted by any sociology epartment with computer facilities. C.L.U.G. focuses on the spatial attern of urban growth and land use. METROPOLIS focuses on the olitical and long-range planning roles of urban government. .E.T.R.O. joins the approaches of these two and adds refinements of ts own to make a sophisticated instrument. It deals with ideal-types f governments, roles, issues, programs, and budgets. (All three aming-simulations are described in detail.) (Author/JLB)

Gaming-Simulations in the Teaching of Urban Sociology

by

Richard D. Duke, Michigan State University
Paul H. Ray, University of Michigan
Allan G. Feldt, Cornell University

Gaming-Simulations in Teaching

The past few years has seen an upsurge of interest in the application of systems theory to a new approach to teaching. It is an extension of operational gaming as first developed for war games and extended to business games.[1] Simulated behavior of complex social systems is run as a computerized environment for the gaming. Players take computer output as representations typical of real-world happenings, running parallel to, and responding to, their play of the game. This joining of computer simulation to gaming lets players intervene at regular intervals in the simulated world, to test their understanding of the world and their strategy for operating in it. There is quick feedback on all decisions. Thus, an abstracted situation is created that is a strategic simplification of life's experience, but that is far richer

---

1. War gaming is best summarized in: K.J. Cohen and E. Rhenman, "The Role of Management Games in Education and Research" Management Science VIII (January 1961) pp. 131-166; Donald F. Featherstone, War Games (London : Stanley, Paul & Co. Ltd., 1962); and Clark C. Abt "War Gaming" International Science and Technology (August 1964 p. 29 & FF). On business games see: Cohen and Rhenman, op. cit.; G.R. Andlinger, "Looking Around--What Can Business Games Do?" Harvard Business Review XXXVI, No. 4 (1958); J.R. Green and R. L. Sisson, Dynamic Management Decision Games (New York: Wiley, 1959); and J. M. Kibbee, C. J. Craft and B. Nanus Management Games (New York: Reinhold Publishing Corp., 1961). Similar to our project in scope is Guetzkow's "Inter Nation Game," cf. Harold F. Guetzkow, et al, Simulation in International Relations, (Englewood Cliffs, N.J.: Prentice-Hall, 1963).
For a good general review of the considerations involved in gaming-simulations see Richard L. Meier, "Explorations in the Realm of Organizational Theory: IV, The Simulation of Social Organization" Behavioral Science, vol. 6 (July, 1961) pp. 232-247, and for the theoretical basis see R.D. Luce and H. Raiffa, Games and Decisions: Introduction and Critical Survey (New York: John Wiley and Sons, 1957).
The simulation materials in economics are less relevant to teaching, but quite useful are: G.P.E. Clarkson and H.A. Simon, "Simulation of Industrial and Group Behavior" American Economic Review I, No. 5 (1960) pp. 920-932; M. Shubik, "Simulation of the Industry and the Firm" ibid, pp. 908-919; and G.H. Orcutt, et.al., Microanalysis of Socio-economic Systems: A Simulation Study (New York: Harper and Bros., 1961).

than fun-games such as Monopoly, chess or bridge. It is even richer than the old tried-and-true war games that armies have used for centuries to train their officers. This is because computerization speeds up results and adds a vast information-processing capacity. It is time for sociology to make use of this new teaching device.

The M.E.T.R.O. project is such a gaming-simulation, designed to quickly and efficiently get across long and short run urban social processes to laymen, politicians, urban planners, and social science students. The M.E.T.R.O.[2] instrument is: a) an interlocking and crosscutting set of games, with three prototypical urban area governments (central city, suburb, and urbanizing townships) as one <u>kind</u> of team (each with four functionally differentiated members in the role types that follow), and with metropolis-wide professional associations as another <u>kind</u> of team (politicians, planners, land developers and educators who represent their respective areal teams), such that <u>each player</u> belongs to two types of teams and is appropriately cross-pressured; and b) an interlocked set of computerized simulation models (voters, pressure groups, firms, households-qua-consumers, and growth and redistribution models tying them together) as well as a data bank and programs for printouts of maps, charts and other display materials to aid the game. Player decisions are basic to the simulation inputs, and simulation results that come out each "year" (game-time, consuming 1 1/2 hours real-time) condition player decisions in turn. M.E.T.R.O. uses from twelve to sixteen players and requires an operating staff of half a dozen. The game and simulations are modelled from Lansing, Michigan economic,

---

2. In rough terms M.E.T.R.O. is slightly more complex than Guetzkow's "Inter Nation Game." See the M.E.T.R.O. Phase I Report, to be published in July, 1966 by the Institute for Community Development, Michigan State University, East Lansing, Michigan.

demographic, ecological and political data, slightly abstracted and generalized.[3] M.E.T.R.O. is by METROPOLIS[4] out of C.L.U.G.[5] two earlier and simpler operational games, described in the last half of the paper along with M.E.T.R.O. We have found in teaching courses in urban sociology, human ecology and urban planning: a) that most class exercises present the community as a static phenomenon; b) that there is no quick and easy way to impress upon students the nature of the limited resources available for allocation within the community and for which disparate forces are competing; and c) most important, even sophisticated and well-educated persons have at best only a hazy and warped personal conception of how communities function. Few students know the ethnography of their own society, and consequently an urban sociologist is likely to not be organizing their experience for them, but merely manipulating abstractions. Putting extra content in the course is a laborious and inefficient use of student and teacher time, involving as it does heavy reading assignments that are hard to correlate and excessive lecturing. Under the best of circumstances it is difficult for the uninitiate to relate organizational concepts to experience, even when he has a good intuitive idea of the workings of the social system before going into heavy theoretical sections. For the urban sociologist it becomes mandatory to link principles to the <u>personal</u> experience of the student. We want to get across to the

---

3. There is a bibliography of supporting studies in <u>ibid</u>.

4. A political and planning urban game cf. R.D. Duke, <u>Gaming Simulation in Urban Research</u>, Institute for Community Development, Michigan State University, East Lansing, Michigan 1964.

5. cf. Allan G. Feldt, <u>The Cornell Land Use Game</u>, Center for Housing and Environmental Studies, Division of Urban Studies, Miscellaneous Papers, #3, Cornell University, Ithaca, New York, 1965.

student general and systematic concepts for efficient behavior, not merely for passing the final exam. Even the advanced student will do a far better job of research if he has mastered the heuristics of the complex and interdependent processes of the urban milieu.

What is needed is a tool for getting across some perspective and sophistication for dealing with the basic materials that must precede formal analysis. Gaming-simulations do this because the rules and strategies of the game must, to be both playable and realistic, become statements about organization and versions of organization theory. We must stress that many of the most useful statements in organization theory are heuristics, and are therefore not amenable to programmed instruction. (Skinner's teaching machines won't save us from our poor teaching!) Our subject matter is not yet a progressively developed whole with a coherent format, but is in clusters of divergent viewpoints from which the student laboriously extracts insights and understandings. The gaming-simulation shortens the time invested in getting across these insights, operating as a cross between a field exercise and a laboratory experiment. This is demonstrated by the enormous popularity of business gaming for teaching decision-making fundamentals to potential and acting managers. In the same vein, the creators of military and industrial systems, with enormously complex and expensive instrumentation, try out their man-machine systems by gaming-simulations. These are low-cost trial runs to check on everyone's understanding of a system's workings and to reduce the likelihood of serious errors in judgment. The urban sociologist would do well to aim at that kind of understanding by his students.

The point to any gaming-simulation is that the player's understanding of the workings of the world is put to the test. He has become a key decision-maker in a working model of the social system being explained. He can experiment with alternative strategies, interact with other decision-makers in dynamic fashion, and compare heuristics for handling the social system. There is no optimal solution intended, but the creation of a complex learning environment that draws upon an evolving system that replicates changes in the world. Players see in rapid feedback the consequences of their actions and of the actions of others, and the world "bites back" if they violated constraints typical of the world.[6] It should be obvious that it is not a point to any gaming-simulation to replicate history or to forecast the future. Rather it is to show the reactions of social systems to different strategies, to give an idea of how social change occurs, to show the highly contingent nature of history, and most of all to illustrate the complex workings of an interdependent set of persons or organizations that constitute a large-scale social system.

Any gaming-simulation is a reduction of the complexity of the world on the order of one to a hundred thousand or one to a million. Only the most strategic elements are selected, the most paradigmatic and prototypical. A good simulation tests its creator's understanding of his field. The situation is still difficult and complex for the players, but it is manageable to the extent that they learn the salient principles of the system. Key gaming relations must also be central to real world institutions, and they must become tools for inference and arguments by analogy. The simulation

6. In M.E.T.R.O. politicians run for re-election every other year, and the simulated voters react to what he's done for, or to, them; the land developers must show a profit like any businessman, and this means they satisfy consumer demands where and when they occur, or else; and so on.

part borrows heavily from systems theory work done on physical systems. It tries to identify all components, or subsystems, of the system under consideration, the modelling of each of the subsystems in mathematical format, the linking of these subsystems by a macro-model stated in similar terms, and finally submission of the equations to a computer for solution. Our problems in urban simulation center on identifying components, partly because subjective selection criteria make it hard to evaluate the appropriateness of our selections. There exist numerous urban models ranging from simple ones on shopping center locations or queuing problems in traffic facilities, to complex linkages of transport models with land use, employment and population models in an attempt to simulate urban growth patterns. but all of these are still in their infancy, if only because we have no tangible and consistently measured components as in physical systems. Certain macro-phenomena such as nation-wide elections can be modelled with accuracy, but as we move down in scale into the urban or bureaucratic milieus, strategies of small groups or individuals enter as disturbing influences. Since we presently have no way of modelling individual human behavior, we must move to man-machine linkages, with circular feedbacks between games and simulations. The problems of data requirements are enormous particularly since we have no good quantitative indicators for many important variables under such headings as attitudes and values. Usually the best we can do is make inferences from their physical manifestations: e.g., vehicle preferences, housing styles, consumption patterns.

The Prototype Urban Games

METROPOLIS AND C.L.U.G., mentioned above, have both been developed into packages that can be adopted by any sociology department with computer facilities. For these, the computer is primarily a calculator, they employ no actual simulations. The two games were independently developed, but are quite complementary in focus. C.L.U.G. focuses attention on the spatial pattern of urban growth and upon land use, illustrating basic principles of land economics and urban ecology in the absence of government. METROPOLIS, by constrast, deals only implicitly with actual spatial patterns, focussing on the political and long-range planning roles of urban government as a force in urban growth, interacting with the urban economic scene via the urban budget.

We think these games can be well-integrated into standard courses. C.L.U.G. makes an excellent adjunct to the presentation of materials on the history of urbanism and the phenomenon of urban growth in the 19th century, and it illustrates principles of human ecology quite concisely. METROPOLIS is better adapted to introducing problems of modern urbanism; the role of government, the need for planning, competition for scarce resources, etc. A logical course sequence in urban sociology would be to go through C.L.U.G. and METROPOLIS in order, with related readings and lectures, and wind up with M.E.T.R.O., the giant synthesis of both games. By the time the students get to M.E.T.R.O. they would be familiar with gaming and little time would be spent on familiarizing them with the new game. (This is important because M.E.T.R.O. runs will be rather expensive, about $2,000 for a day's run.) M.E.T.R.O. will let the teacher end his course with a bang, instead of tailing off into miscellanies the last week before exams.

C.L.U.G. is able to present in one place principles of community growth and development that are widely scattered in publications dealing with urban geography, urban economics and urban ecology. The game reduces the traditionally wide range of variables into those which appear basic to cities and their hinterlands in the development of particular forms of land use in particular kinds of locations. Thus each play of the game is based upon a predetermined set of factors including the location and efficiency of a major highway network, the location of major parts of access to the outside world, a particular form of real estate taxation to support the building and maintenance of various community services required by players in the game, and a particular range of land uses, which may be utilized by the players in their attempts to construct a viable community within which they may seek to earn a comfortable living and maximize their personal utilities. C.L.U.G. is a board game with grid and blocks to represent streets and buildings.

Each player starts in possession of a fixed amount of capital with which he may seek to buy land; construct commercial or residential properties in locations of his choice; and seek to make a profit on his investments a) through the buying and selling of land, b) by putting his industries into operation by hiring employees, or c) by gaining customers for his commercial service establishment from among the residential units located in the community by other players. Player relations are a continually shifting mixture of cooperation, competition and even conflict. Given the constraints of a game (transport networks, taxation policies, location of shipping points, and kinds of land uses allowed) most land use decisions are based upon the degree of accessibility desired between particular forms of land use already developed during the play or upon anticipated land use developments which appear likely to occur in future rounds. Players must manage their money very carefully, for though profits in excess of 20% are possible for a few especially prudent players, bankruptcy is just as likely, with most players being capable of realizing 10-20% on their investments.

Money enters the community from the outside world via payments to industries each round, and is then disseminated among the other players in the community by means of payrolls to employees and payments by residences, for the routinized necessities of life, to persons operating localized or centralized shopping centers. The lesson of ecological dominance is built into the fabric of the game. Money leaves the community primarily in the form of payments made to defray transportation costs, through tax payments made to support community services and through the loss of building value through regular depreciation of buildings each round of play. Careful planning and management by the players allows them to minimize these monetary losses to themselves and to the community: a) through minimizing the distances between particular forms of land use which interact frequently, b) through prudent management of a community capital improvement program which will provide enough services to fulfill the needs of a growing community but not so much that services will be wasted on unoccupied land, and c) through careful juggling of their renovation and construction costs on buildings already in operation. Generalized social utilities are broughthome to the players as well as individual utilities, as in balancing personal gain against investing in community growth to enrich all players.

Players learn to balance building renovation and investment in roads and related services against new investment by two straightforward mechanisms. Periodic losses of building use occur probabilistically, the probability being proportional to the extent of deterioration. Construction and maintenance of roads and the related community services they represent is made necessary to the players by not allowing construction on any lot which is not serviced by at least two roads.

At this point it appears possible to generate a city of between one and two hundred thousand people in about twenty rounds of play requiring from eight to ten hours. This assumes some knowledge on the part of the players of all game operations. Most novices can be expected to learn the basic mechanics of the game in two or three hours of preliminary play, if they have read the mimeographed descriptions of the game beforehand.

METROPOLIS is set up to be played in three phases of three cycles each. The first three are for learning the game operations; the second phase introduces a series of crises and tests the mettle of the student in coping with the situations; the final phase is designed to allow the student to resolve the major crises, and get a feeling of accomplishment in completing the game. Cycles last an average of an hour each, with later cycles moving more rapidly. METROPOLIS is not a board game like C.L.U.G., for it deals with the growth pattern of the city in the aggregate. Interaction of the teams of players centers on the urban budget for public services and for the capital improvement program. The politicized aspects of decisions are emphasized, rather than the economic rationale of C.L.U.G.

The game METROPOLIS consists of four sub-games linked into a joint game of attempting to promote their own welfare and urban growth. The sub-games are the politicians, the city planner-administrators, the real estate investors, and the school board. These roles are stereotypes, which are rather simplistic taken singly, but which mesh into a complex pattern taken together. This is partly because of the divergent payoffs to players and partly because of the complexity of potential and actual interaction patterns and bargaining. The whole is substantially more than the sum of its parts.

The real estate entrepreneur "game" lets players purchase options on land in various areas of the community by land use type. Real estate operators must show a profit, hence they receive a "net worth" statement at the end of each cycle. The politician's task is to get re-elected, which means that he has to satisfy the voters of his ward with the way he spends public funds. He has substantial room for maneuver, but each politician has a ward of different socio-economic type reacting to his actions. He must run for reelection every third year. Ward I is composed of renters, retirees and ethnic groups, Ward 2 has the blue collar and middle income groups, and Ward 3 represents upper income groups and professionals (such as are in a university community or in a research corporation.) Politicians are often at odds with one another as well as with other teams. The administrators are trying to promote good government projects and garner "utiles" of success (poker chips) by getting the politicians to agree to their proposals. Though they are not as closely attuned to the people as the politicians are, administrators are concerned to maximize general public welfare. The school board keeps trying to take a bigger share of the urban budget for the improvement of the quality of schools. All players make their decisions each cycle in ignorance of what the others are doing, and find out next cycle. This forces them to make their best estimates of where the urban area is going and to anticipate the moves and strategies of the other players. Some projects started carry through over several years, reinforcing the idea that players must live with decisions made several cycles earlier, giving a longer run perspective to the meeting of successive crises.

Players receive a newsletter with tabloid type headlines on political demands of the citizenry, background information on particular issues, and general information on the state of the economy. Players use these as cues to coming events. Players must take stands on issues in a public opinion poll. Some get rewards or punishments for the outcomes of various issues and must lobby for them. Where decisions are reached, appropriate consequences change the course of the game; if players postpone decisions they may be penalized for indecision. Individual teams have personal budget forms: the politician deciding how to spend this year's money, the school board likewise, the real estate speculator how much to invest in what kinds of land use in what parts of town, and the administrator prepares a program for next year's urban budget. Budgets are a function of population growth and prosperity, which reflect the community's aggressiveness in coping with its problems, which reflects decisions of previous cycles. Politicians decide on the tax rate, but can get penalized for fluctuations in it, for setting it too low and not meeting demands, or for setting it too high and soaking the voters. Penalties affect probabilities of reelection. A number of growth indicators are computed each cycle as a result of player decisions.

It is true both of C.L.U.G. and of METROPOLIS that the players develop a high emotional involvement in the game. Players develop subtle relationships and become more acutely aware of the ramifications of the decisions required of them. It is also not uncommon for players to insist that games be continued beyond the scheduled quitting times; and they have even become so involved in the game that they do not take out time to eat! From time to time bitter arguments develop such that it is hard to bring them back to the realization that it is "only" a game and that they shouldn't become upset over a particular chain of events. Even for "simple" games such as these, there is no problem in getting player interest or belief in the veracity of the representation. But exactly <u>what</u> is learned is hard to measure, largely because the gains are in the direction of sophistication, perspective, and the use of heuristic concepts. Nevertheless, all who have participated thus far have found the games interesting, and the vast majority say they are worthwhile as teaching devices.

<u>The M.E.T.R.O. Gaming-Simulation</u> joins the approaches of C.L.U.G. and METROPOLIS, and then adds refinements of its own to make a sophisticated instrument. The teams and players were described above, and are summarized in the "Team Matrix." A specific "game" will be played by each team; it is linked into the overall game with realistic interaction between all types of roles. The gamed decisions are injected into the simulation of the metropolitan area, and feedback from the computer relates both to player positions and to the growth pattern that results from the aggregate of gamed decisions. Typical decisions required of each team (different in detail and scope, as appropriate to the particular governmental unit or professional role) will be of three main types: budgets, issues, and policies. The rationale is as follows:

> <u>Budgets</u> -- Each unit of government is accustomed to making an annual commitment of funds. Many policies and relationships are implicit or revealed in the distribution of funds by a unit of government, and these decisions can represent a more meaningful revelation of actual policy than can more explicit statements drawn from these office holders. The budget function will have to recognize the need for the distribution of formal funds - governmental expenditures - as well as that pressure exerted on or by informal funds (influence on or by private investment capital).

Figure 3

TEAM MATRIX

Areal Teams

	Central City	Suburbs	Urban Townships	Team Advisors
Politicians	2 or 3	1	1	1
Planners	2	1	1	1
School People	2	1	1	1
Land People	------------3------------			1
Judge	------------1------------			--

Personnel: 16 or 17 Players
+ 4 Advisors
+ Operating Staff

Issues - Each governmental unit will have to be confronted with various issues in the form of a referendum or simply a secret poll on opinions. These will be translated into an index by a conversion program.

Policies - Each governmental unit has a series of policies under which they operate. Some of these are explicit, many more are implicit, based on tradition or custom for that particular unit. In either case these policies are the standards, or decisions rules, which control the behavior of that unit of government under certain circumstances.

Explicit Policies - Are evident in the form of zoning regulations, subdivision controls, utility extension policies, and recorded opinion on issues such as annexation vs. incorporation. There are, of course, many other examples.

Implicit Policy - Is evident in more subtle and perhaps more revealing ways. The ratio between actual and assessed value of property types, level, and costs of services provided; extent of professionalization of public employees; and many other factors are indicative of the general state of management which might be expected. The players' reactions to contrived, but typical issues may also be revealing (i.e., the suggestion of some innovative approach for coping with a problem, as the creation of a regional authority.)

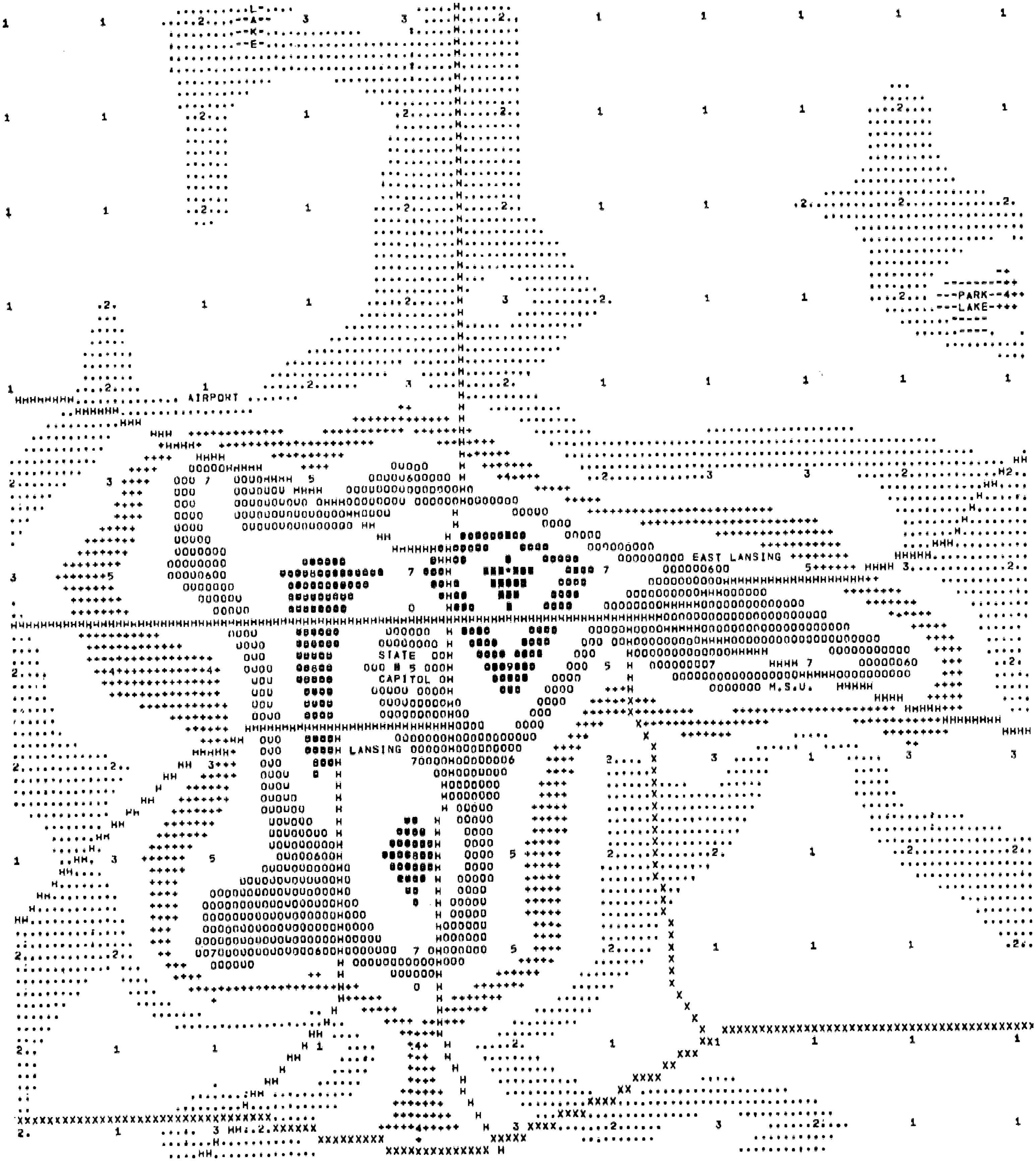
In each case--budgets, issues, and policies--the results of fresh decisions (annual budget) or of changed policy (change in ratio of assessed value to real value) must be recorded for each cycle, converted to an appropriate index, and applied, through the use of the growth models, to all geographic units having similar characteristics, thus setting the stage for a new machine iteration of the appropriate growth model.

M.E.T.R.O. is dealing with ideal-types of governments, roles, issues, programs and budgets, all abstracted from the Lansing area data. We game for each modular unit and attribute the gamed results to all like units in interpreting any given run. Similarly, in the simulation, we have abstracted characteristics of organizations and subpopulations in the Lansing area. For example, there are three dominant industries: a) a heavy industry manufacturing plant that is tied to the fluctuations in the national economy and whose urban area employees are predominantly blue collar workers; b) a fairly large firm whose business is clerical and other white collar transactions, with a slow-growing but highly stable employment outlook (an abstraction of the state government whose role in the area is like national commercial firms' branch offices, insurance and banking firms, etc.); and c) a high-growth, technologically-oriented, "firm" whose major product is concerned with innovation and the knowledge or research and development industries whose employees are heavily professional, technical, and managerial types that are oriented to world and national markets and who are sophisticated in their demands for urban services and culture (this is an abstraction of Michigan State University, comparable in its urban role to aerospace firms and other research and development firms oriented to the new technologies). Our rationale is that basic industry products are unimportant compared to the kinds of employees they hire, the inherent stability of their economic activities, their growth rates, and the ancillary firms they support. We give this example in detail to illustrate the processes of ideal-typing that go on. We have similar rationales for selecting five social classes for the region, which are translated into household types for correlation with consumption patterns residential mobility, and voter responses on political candidates and issues. For the modelling, regression equations have been used on historical data to establish base-line and response-to-change parameters. The game starts with 1965 and goes on from there, so it is future oriented, and concerned to explore possibilities of innovations, technological and social, in metropolitan areas.

The major simulation models are: a) A Monte Carlo type of voter response model that generates turnout and support rates on issues and candidates. Its parameters are largely abstractions of historical tendencies in the Lansing area, and its workings are very sensitive to player decisions in the game; b) A macro-economic and demographic growth model that generates growth of population, employment and income for the whole metropolitan region. It is a series of lagged finite difference equations relating basic industries, the regional growth pattern and the pattern of the national economy. It is sensitive to the aggregate decisions of players with respect to investment in firms, housing, capital plant, public facilities, and urban welfare services; and c) A population (by households) and economic firm redistribution model that allocates the above growth to specific areas of the city (consolidated pairs of census tracts) on the basis of transport accessibility to employment and urban services, attractiveness to residential use by social class, density constraints, and the particular locations of facilities, etc., in public goods determined by player decisions. It is an elaboration of the "T.O.M.M." model developed by J. P. Crecine for a Pittsburgh land-use simulation,[7] and is a complex gravity-type model. In addition to the simulation models, we use computer print-out mapping to represent growth of all kinds, or any other variables that are spatially distributed and are held in the data bank. The technique is called "SYMAP"; it was developed by Howard Fisher[8] of Harvard University. A typical example is given in Figure 2 showing contour lines of subdivision frequencies. The establishment of a miniature prototype of a computerized data bank in the game means that players can query the system on a vast variety of issues;

7. John Patrick Crecine "T.O.M.M. -- A Time-Oriented Metropolitan Model for Spatial Location" Technical Bulletin No. 6, Consad Research Corporation, Jan. 1964.

8. cf. Howard Fisher



NUMBER OF SUBDIVISIONS

0	1 - 5	6 -11	12-16	17-22	23-27	28-33	34-38	39-44	45-50
	...2...	3	+++4+++	5	0006000	7		9	

SUBDIVISION ACTIVITY IN THE TRI-COUNTY REGION, LANSING, MICH.
NUMBER OF SUBDIVISIONS PLATTED WITHIN EACH SECTION OF THE NINE TOWNSHIP AREA AROUND LANSING, 1870 TO 1965

population projections, the areas of blight, or unemployment, or of recent growth, etc. Players must buy information, however, so that this becomes a problem of rational adaptation like everything else.

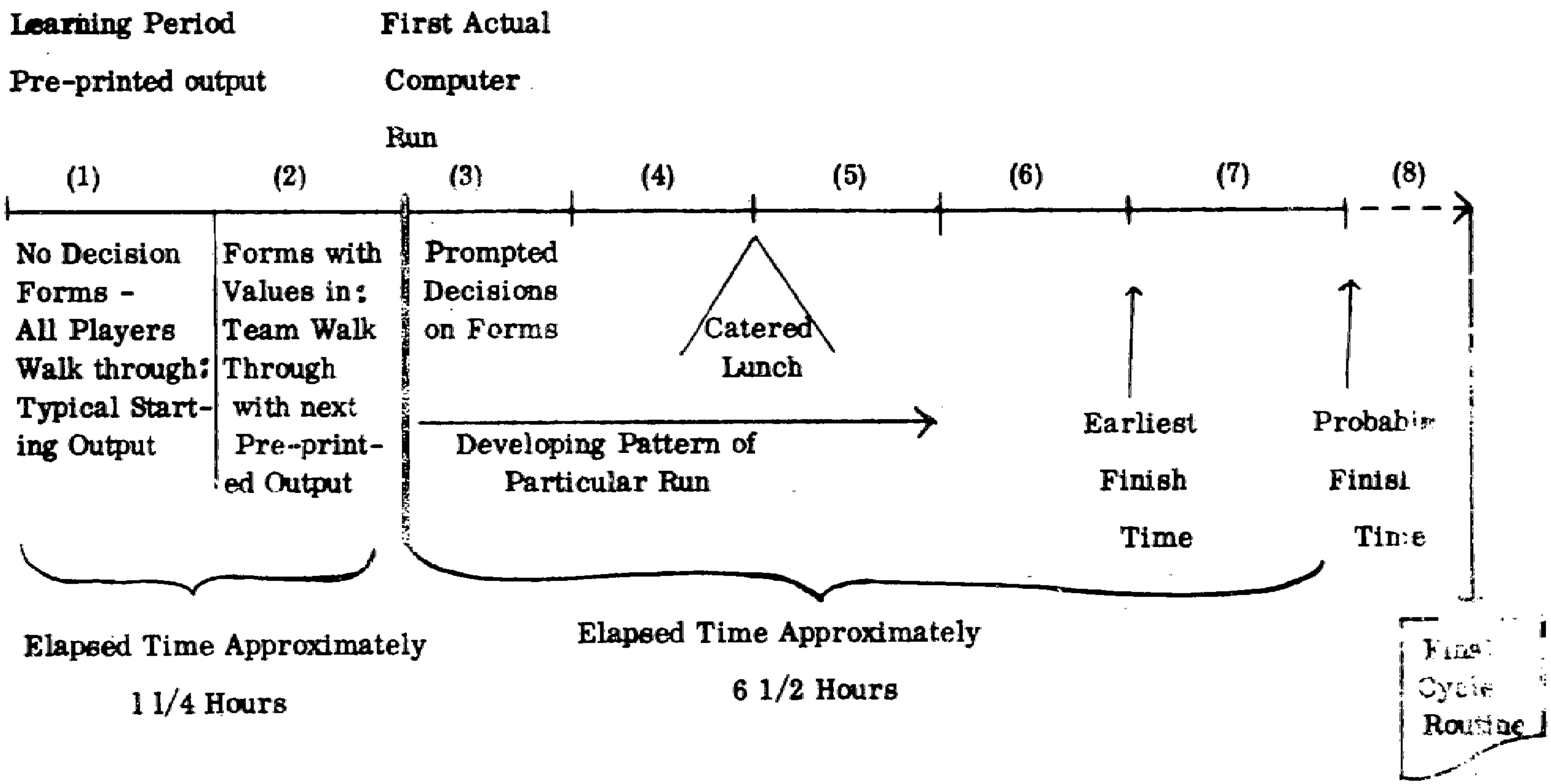
We see the typical M.E.T.R.O. run as involving seven cycles of play in one day, each cycle representing one year. If players are already familiar with the game then all seven cycles may be active play, and sets of seven may be indefinitely strong together over several days to make for many years of hypothetical urban development. But for naive players, the first two cycles will involve learning the nature of the game, its tasks, operations and strategies. The third cycle will start actual play and this will run five "years" at the end of which the computer will calculate the projected growth of the city on the basis of trends established by the players. Projections will be printed out for the next year, five years, ten years and twenty years hence. These will be part of the critique session that follows the run of the game. (See Figure 3, "M.E.T.R.O. Run Sequence").

Cycles are carefully elaborated into a tight sequence of activities and interactions among players, and between the players and the computer. The structuring of interaction is facilitated by the layout of the room in which gaming takes place (see Figure 4). The inner ring of tables is for the first half of the cycle when areal teams meet to make key decisions and the outer ring of tables is for the second half of the cycle when players change hats and meet as metropolis-wide teams to discuss area-wide problems. Since the computation time, even given the speeding-up by computerization, cannot be less than half an hour, the meeting of metropolitan functional teams keeps the players on the track during this period, as well as ensuring a useful perspective on the metropolitan area. (See Figure 5, "Typical Cycle

Figure 5

M. E. T. R. O. RUN SEQUENCE

(Activity Types for Introduction, Play and Evaluation of Run)



INPUTS FOR CRITIQUE

A. If session is not successful, we can have an immediate 1 hour critique (4 P.M. - 5 P.M.)

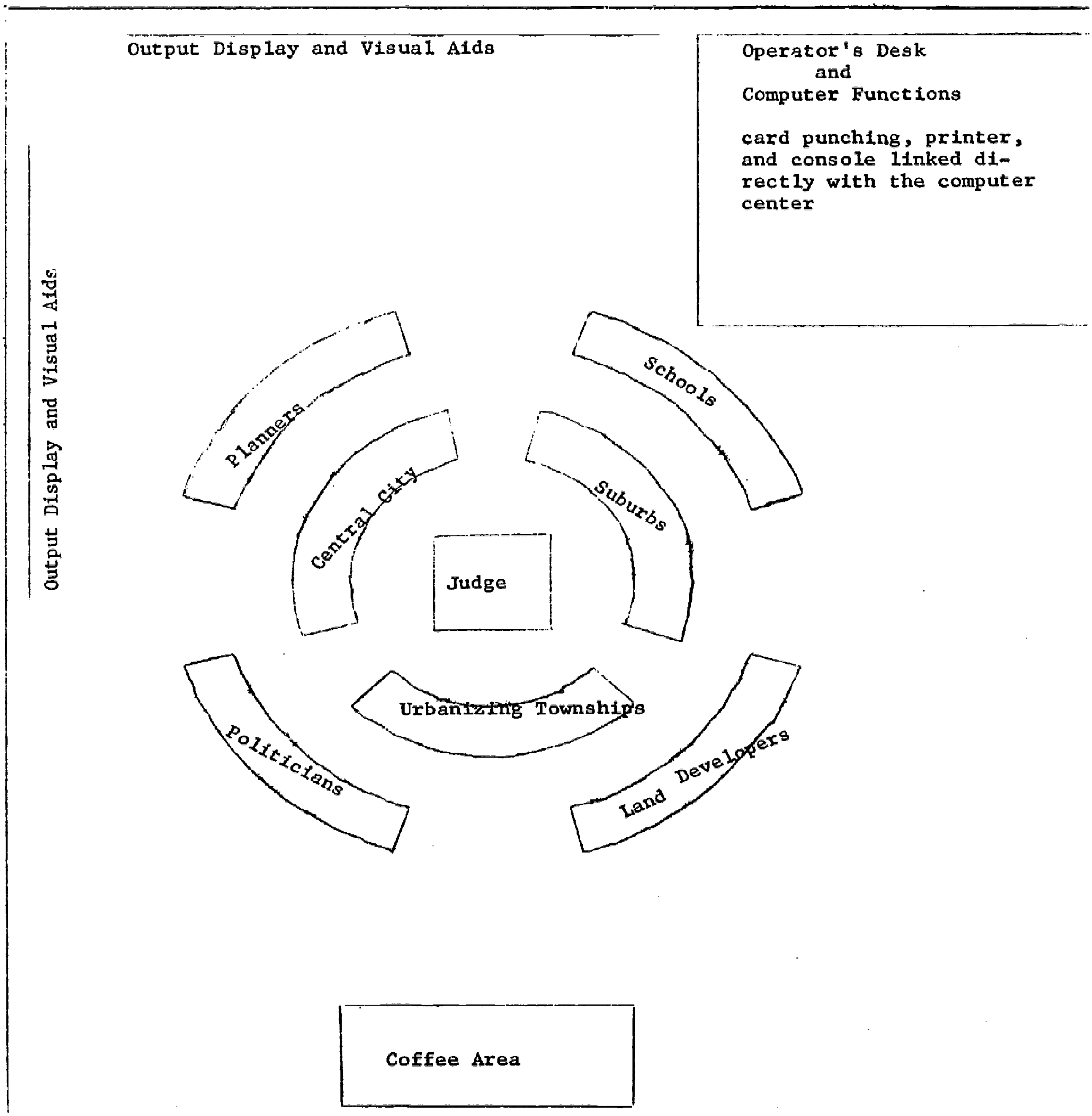
B. If session generates marked enthusiasm, then more extended critique can follow dinner.

Print-outs:

1. of previous cycle
2. 5 year projection (happy ending)
3. 10 year projection (high, medium, low alternatives for teaching purposes, critique, etc.)
4. 20 year projection
5. Gives what long-term policies are required for each areal and functional team.

December 1?, 1965

Figure 4
ROOM LAYOUT



Phasing for M.E.T.R.O."). The intertwining of the operation of the computer (for simulation and game-supporting output) and the gaming allows a maximum of learning activity with a minimum of wasted time.

This phasing directly affects player interaction patterns. Their content within areal teams is given in "M.E.T.R.O. Functional Interactions" and the sequences of who interacts with whom is given in "General Paradigm for Interaction and Decision Patterns within a Gaming Cycle". Few unilateral decisions are possible; most player plans and enterprises are highly interdependent, leading to extensive bargaining and coalition-formation. Players mutually define their own and others' roles in response to gamed constraints, interaction contingencies and simulated outcomes. Much of a player's personal standing (likelihood of winning the next election, or personal profit position, etc.) depends on his accurate estimation of how the world will move next year, and his ability to modify, or to take advantage of, the course of events. Though his predictions are aided by data bank outputs and the opinons of his colleagues, his is not a mere optimizing task so much as strategy, bargaining and balancing-off power equations in a complex social system. Interaction focuses on the urban budget, upon short-term feedbacks of particular rewards and punishments, and upon the prospects for enhancing most players' chances by growing the area to make a larger base from which to get rewards.

The man-machine interaction system is based on the concepts in Türing machines. The player is in a closed-off place receiving signals about the outside world from a "Black Box." And _if_ the messages he gets are artfully enough conceived, and are similar enough to expert expectations and experience, _then_ the messages from the black box could represent either simple translations of _real_ events or simulations from a machine, and even

Figure 6

TYPICAL CYCLE PHASING FOR M. E. T. R. O.

(A) TIMING OF METROPOLIS-WIDE ISSUES

CYCLE N		CYCLE N + 1	
AREAL TEAMS MEET	METROPOLITAN FUNCTIONAL TEAMS MEET	AREAL TEAMS MEET	METROPOLITAN FUNCTIONAL TEAMS MEET
	Raise issue as mandatory discussion item -- each functional team makes recommendations to respective areal teams	Areal teams vote on issues on basis of own interests and functional team recommendations	

(B) TIMING OF COMPUTER OPERATIONS

input N of gaming results	output #1	output #2	output #3	output #4	input N + 1

|------------1 hour ----------|

--------- 60 min. — ---	-----30 min. ----	------60 min. -------	----30 min. -----

(C) MASTER PROGRAM SEQUENCE

Output #1 = Polls, Issues, Referenda, Elections, etc. (4-ply output)

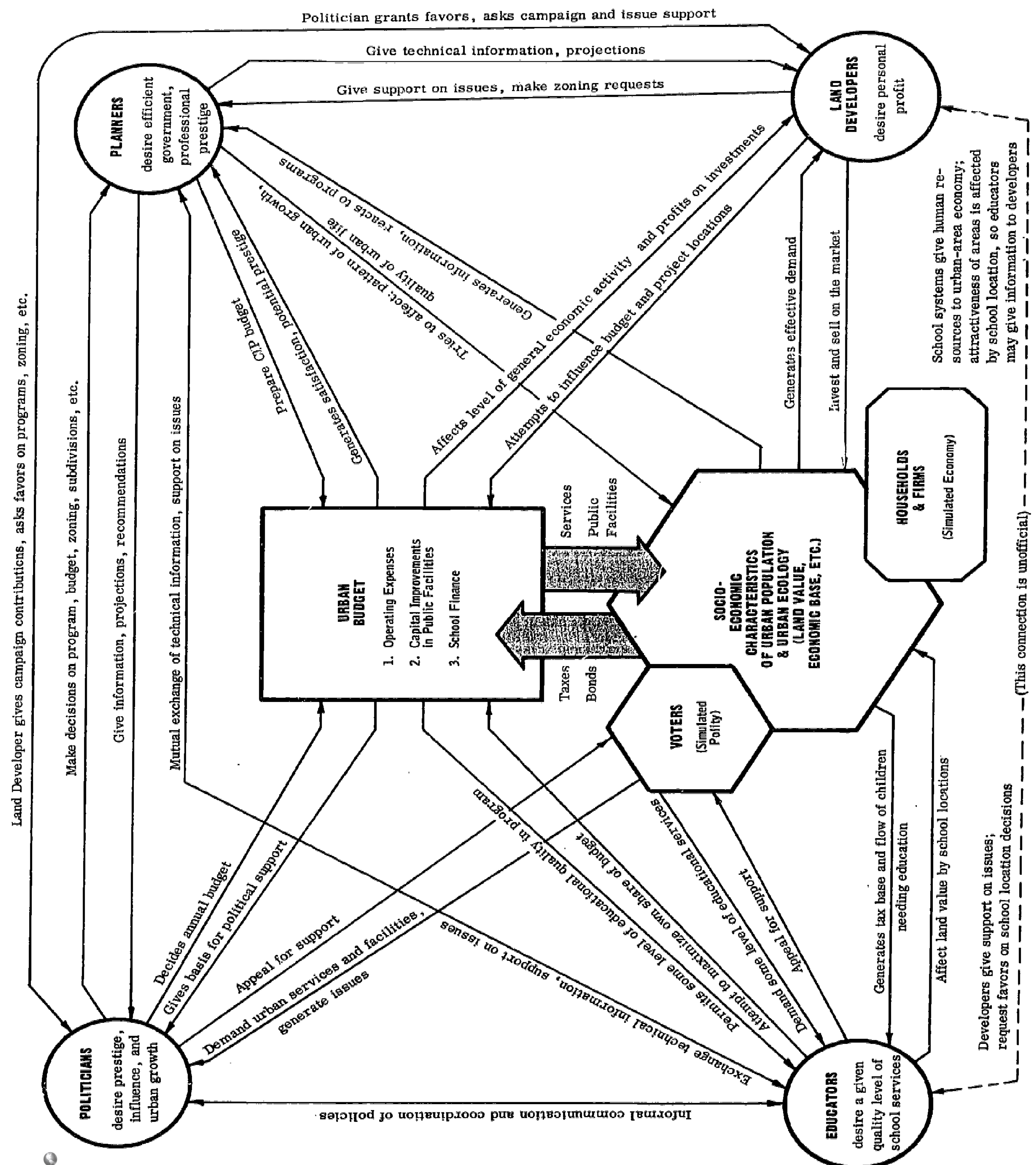
Output #2 = Cyclical Team Interaction Results (4-ply output)

Output #3 = Newspaper and Issue Generation (4-ply output)

Output #4 = General Data (1-ply output)

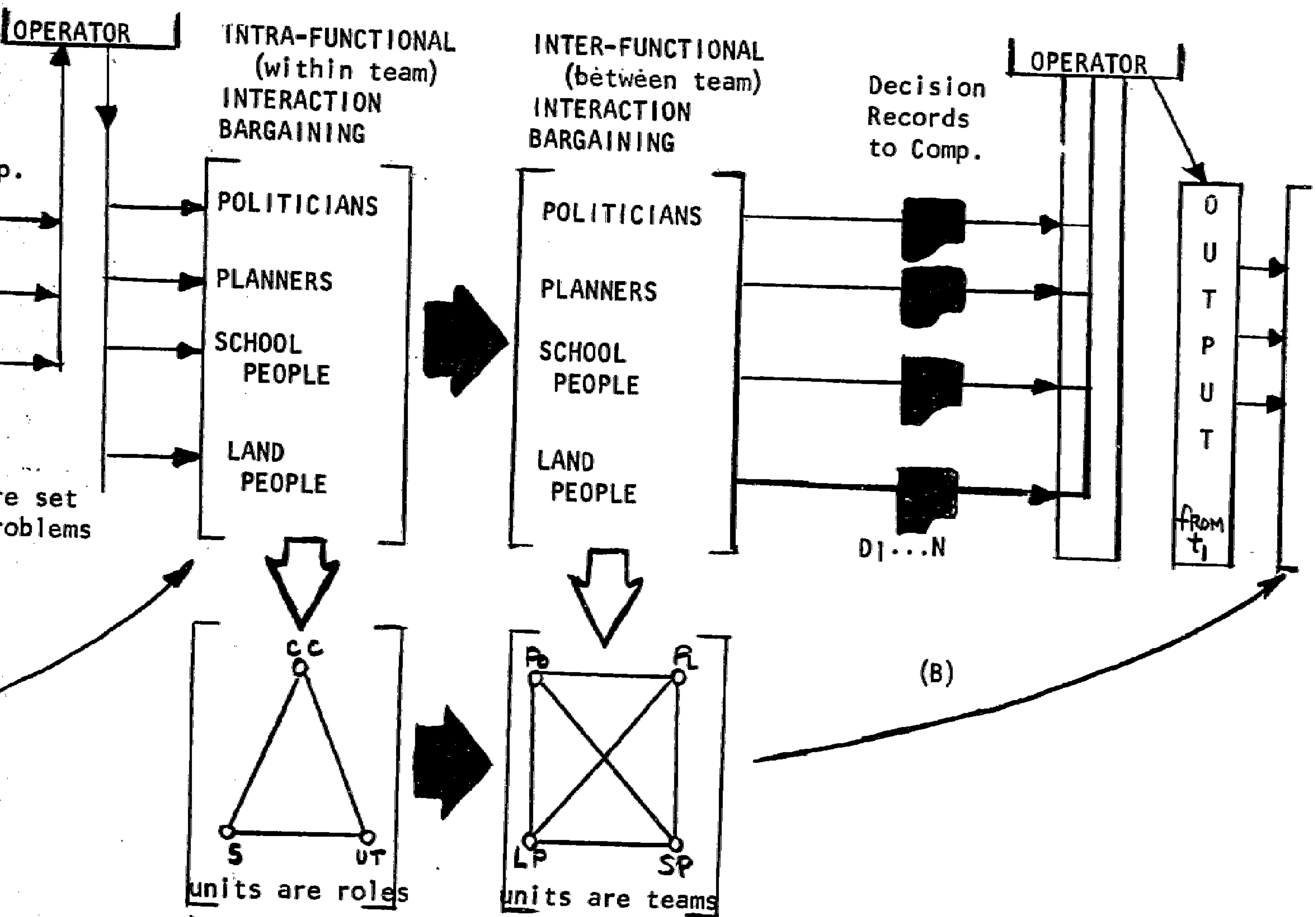
FIGURE 8

M.E.T.R.O. Functional Interactions



GENERAL PARADIGM FOR INTERACTION AND
N F RNS within a Gaming Cycle (time "t")

INTERACTION PATTERNS FOR
STAGED METROPOLITAN-WIDE PROBLEMS
AND PAYOFFS

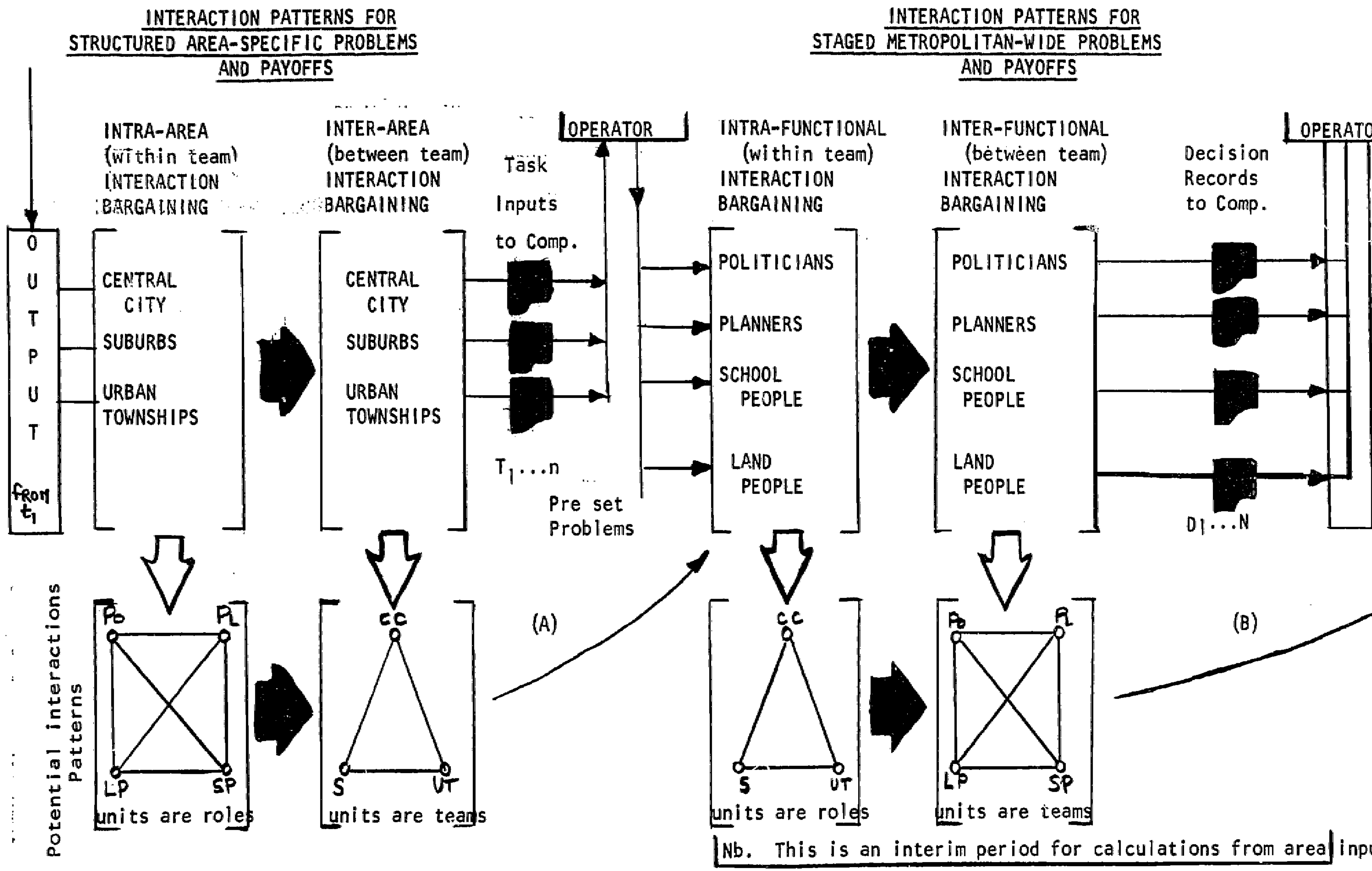


Nb. This is an interim period for calculations from area inputs

e problems for Metropolitan Functions (not pre-programmed by Operator)
Teams may set up new programs for Areal Teams to decide upon

Figure 7

GENERAL PARADIGM FOR INTERACTION AND
DECISION PATTERNS within a Gaming Cycle (time "t")



(A) Areal Teams may generate problems for Metropolitan Functions (not pre-programmed by Operator)
(B) Metropolitan Functional Teams may set up new programs for Areal Teams to decide upon

the sophisticate could not tell the difference.[9] This is possible because the reality re-created in abstracted form in the machine is based upon the same kinds of data as in the player's experience, and is manipulated by generalizations and rules isomorphic to the common sense of the expert. The machine linkage is a tool, not for extending man's arms, hands or legs as in the past, but for extending his thought processes. Real-world experience that may be hard-won, time-consuming and costly is approximated in a collapsed form readily accessible and in challenging forms. Gaming-simulation follows the time-honored format universal to human beings that nothing is so exciting as a contest; and it takes advantage of the fact that quick feedback on decisions gives the best learning experience. Hence, the real educational gain from giant and sophisticated instruments like M.E.T.R.O. is that the student is able to evaluate his own action, learn from his mistakes, and master complex problems in a relatively short time period. Taken in combination with regular course work, it is in our opinion a major advance in educational techniques in the social sciences.

---

9. The M.E.T.R.O. output is listed in "Typical Computer Output per Cycle."

Figure 8

M.E.T.R.O. 12/13/65

TYPICAL COMPUTER OUTPUT PER CYCLE

I. General
  A. Identifying Data (date, location, cycle #, title, etc.)
II. Newspaper
  A. Budget (one for each areal team)
    1. Tax Rate
    2. Equalized Assessed Value
    3. Revenues
    4. Expenditures
    5. Estimated Budget for Next Cycle
  B. Growth (by areal unit and total)
    1. Population -- total, change, rate
    2. Median Family Income
    3. Exogenous Growth Factors
    4. Infrastructure Accumulation
    5. Cumulative Investment totals
  C. Public Opinion Poll
    1. Referendum (by whom initiated, amount, nature, outcome)
    2. Bond Issue (by whom initiated, amount, nature, outcome)
    3. Payoff Matrix on Public Opinion Poll
    4. Issue Outcome
  D. Election Section
    1. Voter Response Output
      a. Referendum
      b. Bond Issue
    2. Present Probability of Reelection
    3. Campaign Expenditure Commitments
III. Graphic Output (Charts, Maps, Matrices, Graphs, etc.)
    1. Requested Information (format determined by calling subroutine)
    2. Projections
    3. Land Characteristics Matrices (e.g. zoning, land use, value)
    4. SYMAP showing improvements since 1st cycle
    5. Data Bank Table Updated
IV. Output for Players
  A. Politicians
    1. Capital Improvement Budget (projects carried, not carried, multi-year projects)
    2. Payoff Matrix
    3. Operating Budget (by%)
    4. Projects (location, type, $, duration)
  B. School Board
    1. Payoff Matrix
    2. Accreditation Data
      A. Average Teachers Salary
        1. National Trend
        2. Local Status

b. Children / classroom
    1. National Trend
    2. Local Status
c. Operating expenses / pupil
    1. National Trend
    2. Local Status

3. System Data
    a. Number of Teachers
    b. Number of Classrooms
    c. Number of Students
4. Tax Rate -- Current and change
5. Revenue -- Property Tax, bond issue, referendum, state, federal
6. School Room supply-demand by grade vs. areal units

C. Land People
    1. Matrix by areal unit including acres owned, zoning, acres sub-divided, public improvements, construction (# and $), and asking price.
    2. Payoff Matrix
    3. Promotion Expenses
    4. Net Worth
    5. Credit Rating
    6. Cash on Hand
    7. Investments this Cycle
    8. Interest on Cash and Loans
    9. Contributions
    10. New Construction, Quantity and Cost

D. Planners
    1. Payoff Matrix (planner override, CIP error, P.O.P. response, C.P.I. discrepancy, political confidence scale)
    2. CIP -- by Project
    3. Operating Budget -- by %
    4. Discrepancy Index (planned use vs. zoned use x areal unit)
    5. Planning Budget % Distribution Matrix by year for operating expenses, research, data bank, long range planning, current planning and public relations.

V. Administrative Output
    A. Computer Details (e.g., timing diagnostics, etc.)
    B. Next Cycle Data
    C. Run Records
    D. Areal Team Data
        1. Central City
        2. Suburbs
        3. Urbanizing Township

M. E. T. R. O. PLAYERS CHECKLIST*

12/13/65

ROLE: ____________ AREA: ____________

1. AGENDA: a. What is your standing? b. What is the area's standing? c. What are your teammates' standing?	4. Actual budgeting a. operating expenses b. capital improvements	Cycle # Time Player's Name
2. Prepare public opinion poll positions.	5. Operations to improve current standing	7. Note Taking a. Information needed b. Bargains made c. Pending actions (Applications) d. People checked with
3. Budget Preliminaries ____________ ____________ ____________ ____________	6. Memo to check on information needed.	

* Forms to be preprinted in desk pad format

PAYOFF MATRIX FOR ANY GIVEN ISSUE

	CENTRAL CITY +1 -1	SUBURBS 0 -1	URBAN TWPS. +1 0
POLITICIANS +1 -1	∑Pass CC∩Pol. +2 ∑Fail CC∩Pol -2	∑Pass Sub ∩ Pol. +1 ∑Fail Sub.∩Pol. -2	∑Pass Twp∩Pol. +2 ∑Fail Twp.∩Pol. -1
PLANNERS 0 -1	∑Pass CC∩Plan +1 ∑Fail CC∩Plan -2	∑Pass Sub.∩Plan 0 ∑Fail Sub∩Plan -2	∑Pass Twp∩Plan +1 ∑Fail Twp.∩Plan -1
LAND PEOPLE -1 +1	∑Pass CC∩LP 0 ∑Fail CC∩LP 0	∑Pass Sub∩LP -1 ∑Fail Sub∩LP 0	∑Pass Twp.∩LP 0 ∑Fail Twp.∩LP 0
SCHOOL PEOPLE +1 0	∑Pass CC∩SP +2 ∑Fail CC∩SP -1	∑Pass Sub∩SP +1 ∑Fail Sub∩SP -1	∑Pass Twp∩SP +2 ∑Fail Twp.∩SP 0