THE RELATIONSHIP OF SIMULATION, INFORMATION, AND INTERACTIVE GRAPHICS TO PUBLIC PARTICIPATION PROGRAMS

Michael A. Goldberg and Douglas A. Ash, University of British Columbia

This paper discusses the dissemination of simulation models by urban information systems as initiated by the University of British Columbia. The model building process includes great emphasis on disseminating the generated information. Each stage of the process feeds back ultimately to the model conceptualization phase through publication of information. The role of computer graphics and public demonstrations is a key part of the process. The first public demonstration in this study met with mixed response. Most felt the demonstration was too technical and contained too much jargon. Some felt that the intricacies of the computer could not be explained in 1 or 2 h. The most successful demonstration began with a 1-h discussion of what the audience was going to see during the computer show so that the audience would know what to expect before the computer terminal was used. The actual graphics provided the catalyst required to start the group interacting with each other and the computer system. Only special interest groups and sociopolitical institutions related well to the graphics demonstrations. Most of the general public usually lack the interest to achieve a minimal level of understanding. It also was found that, unless a graphics system has a variety of users, it tends to be used as a means to achieve some end, rather than as a tool to promote discussion. The information being displayed by the graphical system was the key to the usefulness of the system.

•THE HISTORY of urban simulation models is not glorious. Valid criticisms have been made about virtually all elements of the model-building process, from the model conceptualization and calibration stages to public policy (1, 7). The criticisms generally have been well founded. The study described in this paper was begun in the winter of 1969-70 (2). It was the hope of the interinstitutional policy simulator (IIPS) project that evolving tools from a number of disciplines could be brought to bear on construction of a simulation model for the Vancouver, British Columbia, region.

Figure 1 shows the overall institutional base for the project. The model-building process as it has evolved is shown in Figure 2. It can be seen that the process is continuous; each stage feeds back ultimately to model conceptualization. It was hoped that, by this, the process of model building could be emphasized and the danger of creating a rigid model set that was unchangeable and unresponsive to new information of new policy needs could be avoided. This process orientation has been stressed elsewhere (3, 4). We mention it here because information, especially that provided from interactive graphics, keeps the process functioning. In Figure 2, the public input requirements are significant. The key to this type of input is easily understood information. Interactive graphics are a means to an end; they provide information to the public to involve them clearly and directly in model building and the political process. This paper will briefly illustrate, by use of simple flow charts and diagrams, the nature of the model set.

Figure 1. Framework for interinstitutional and public involvement.

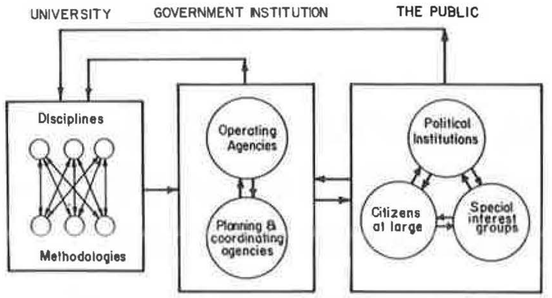


Figure 2. Framework for model refinement, policy evolution, and public involvement.

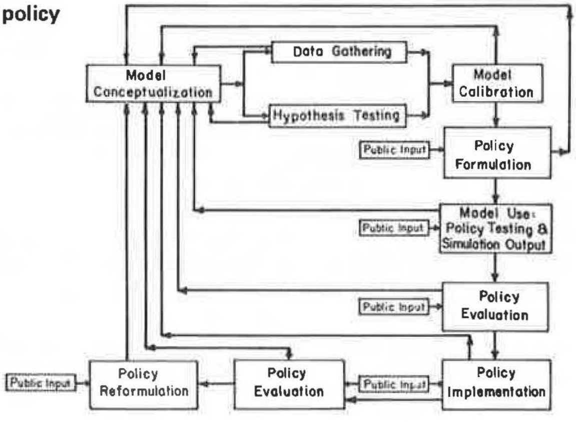
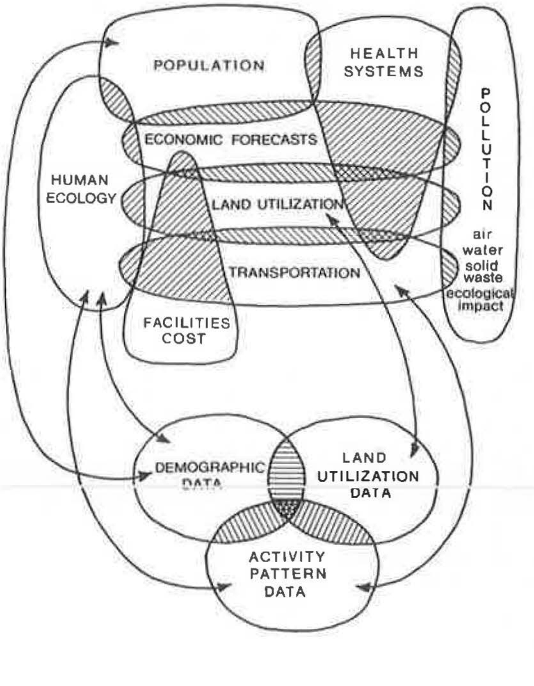


Figure 3. Relationships among the interinstitutional policy simulator (IIPS) subgroups.



MODELS AND THEIR EVOLUTION

At the outset of the project, some 70 individuals from 15 different academic departments in the university were involved. Disciplines that were represented ranged from the physical to the behavioral sciences. The major modeling groups shown in Figure 3 evolved from this broad participation. The groups at the top of the figure represent modeling efforts; those at the bottom represent service activities engaged in developing the necessary data bases on which the models could be built.

From these diverse modeling efforts a subset of 4 central models—population, land use, employment, and transportation—were identified. These are shown in Figure 4. Figure 4 shows the nature of the linkages among the models. A more detailed description of these models is available elsewhere (5).

Forecasts of employment (disaggregated into as many as 27 sectors) and population (disaggregated into as many as 100 age groups and for males and females) are derived from the economics and population models. (These aggregate forecasts are aspatial in that they treat the entire region as a single point in space.) They then are allocated to anywhere from 17 to 180 regional subareas depending on the level of spatial disaggregation desired. This spatial allocation is done by the land use models, which are shown in simplified form in Figure 5. Land use models break down into the 2 principal components of supply and demand. Both are further broken down into subclasses. In general, supply traditionally has been the area in which government policy has been focused, and the degree of disaggregation is needed for testing a range of policies.

Demand is broken down into 2 principal components: demand for land for employment and demand for land for population (housing).

The land use model then allocates demands by type of land use to subareas and compares demand to supply. If supply is sufficient, then the activity is located in that subarea. If supply is insufficient, available supply is used up and excess demand is reallocated. This process continues until all forecasted employment and population is allocated to a subarea. When this is done, then the employment and population models generate a forecast for another year, and the process continues over the time period being simulated. Policy variables include zoning; urban demolition and renewal; creation of new towns, subdivisions, and shopping centers; and rezoning for other uses.

Land use and population variables, which citizens tend to be most concerned about, will be used to illustrate the graphics capabilities of the system.

PROGRESS OF INTERINSTITUTIONAL POLICY SIMULATOR GRAPHICS

Interactive graphics displays sometimes large quantities of numbers in an interesting and easily assimilable fashion so that the user is able to modify or easily change both the type of graphics and the actual information being displayed. Computer software in 1971 was inadequate for this. It was too rigid in graphic style, and often only a preselected set of information could be graphed. This inadequacy together with a need for an automatic monitor for the set of models previously described prompted the development of a number of computer systems at the University of British Columbia in conjunction with the IIPS project (8, 9, 10, 11).

The 2 principal systems developed were SIM-SUP, a simulation supervisor with graphics for multiple simulators, and GIDS, a geographic information display system. SIM-SUP allows the user to display subsets of a large set of information on a variety of paper and cathode-ray-tube (CRT) graphical devices, change the assumptions of the model set, and easily use the simulation models. All of this is attained by using a simple command language. For example, DISPLAY TOTAL—POPULATION BY TIME would produce a graph of total population on the Y axis versus time in years on the X axis. CHANGE MIGRATION—OPTION TO 3 would cause the population model to use equation set 3 in computing the migration component of the population. A more complete discussion of the command language can be found elsewhere (6).

The graphic package started with simple line graphs, but the more complex struc-

Figure 4. Interaction between the module and the regional transportation model.

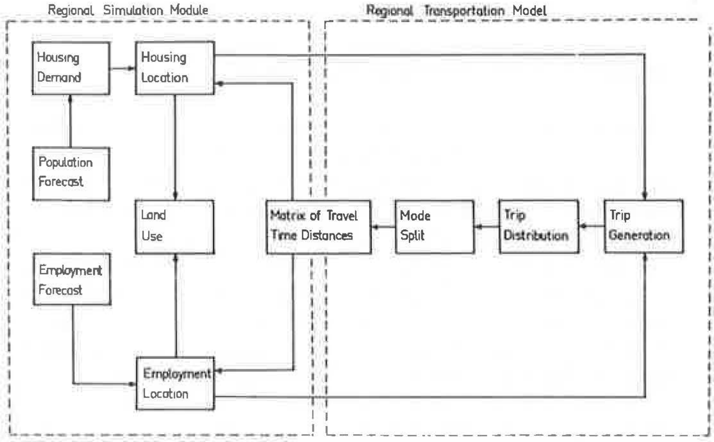


Figure 5. Land use models.

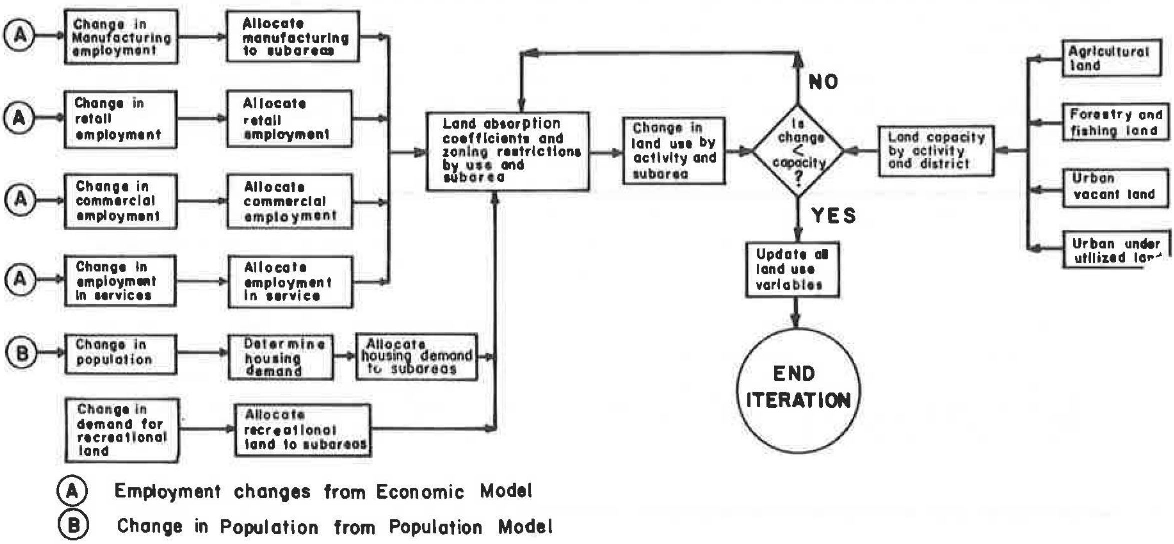


Figure 6. Low-cost housing for all municipalities.

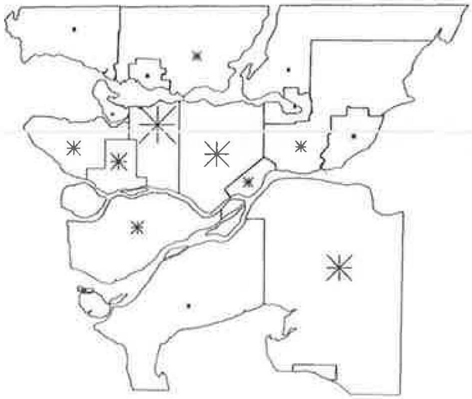
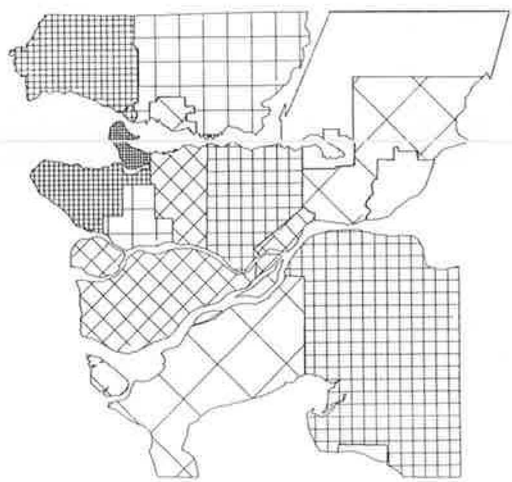


Figure 7. Advanced method of showing expected relative total employment for each municipality after 15 years of simulation.



tures of urban information forced the graphics to be more flexible. The problem of easily displaying large quantities of geographical information also had to be solved. A housing distribution for 17 subareas cannot be adequately displayed on a line or bar graph. This must be done on a series of maps that are sequenced through time. (Compare Figures 6 and 7 with Figure 8.)

It must be stressed that the present interactive graphics system is functional and deals with these complex urban information structures. It has proved useful in displaying population and demographic data and employment, housing, recreation, and transportation information. It has also been used for public finance and capital expenditure analysis for local governments.

This computer system can be used on-line or interactively from a computer terminal. The user enters a display command and observes the requested output within seconds. The user can then use the change command to modify the constraints of the models. Another display command that is superimposed on top of the previous one or is plotted beside it on a split screen will force the simulation models to be rerun and will show the effects of the modified assumptions. This entire process only takes 1 or 2 min, and the user is in complete control of the information being displayed and the assumptions being used for the simulation. The process is interactive because the user is able to respond to output from the computer almost instantaneously.

Figures 6 through 11 show some of the permanent (hard-copy) graphical output that is available.

PUBLIC REACTION TO THE GRAPHICS PACKAGE

The graphics package and the format for giving demonstrations were evolved from a series of IIPS forums or internal reviews. The forums were attended by IIPS participants, but usually some invited guests were present. These demonstrations, then, were given to a highly skilled and knowledgeable group that did not represent a fair test group. The level of the demonstration was far too technical for the general public.

The first public demonstration, which was given to a college class of political science students, was met with mixed response. Most of the group felt the demonstration was too technical and contained too much jargon. Some felt that the intricacies of the computer could not be explained in 1 or 2 h. Most, however, found the diagrams and predrawn graphs useful. The computer terminal, a portable Texas Instruments Silent 700, was used by means of a telephone line. The style of graphics on this particular machine was very primitive and was found to be inadequate for a group of more than 10 people. In other public demonstrations, a Techtronix CRT graphics device was used. This machine, although small, had excellent resolution and worked well, but it required proximity to the main computer.

Some demonstrations were given without the use of a computer terminal. All computer output was either prefilmed or preplotted on paper. Although this method is safer (the computer system cannot fail during the demonstration), the premade graphics tend to be too static and less stimulating to an audience.

The most successful demonstration was given to a group of about 10 urban professionals. The session started with a 1-h talk about the simulation models and the simulation supervisor. At the end of this discussion a brief premade computer demonstration was given. All of the commands had been previewed by the demonstrator, and all of the results were known. Following this, a discussion period was used to debate various options available to planners in the region. Suggestions on land banking, satellite cities, light rapid transit, and subsidized housing were put forth. At this point we chose the option on satellite cities to be worked through to a conclusion, and discussion was channeled toward this topic. The various interventions available were debated and decided on. Most of the options were listed on a blackboard and were erased or rewritten as the discussion progressed. After the final set of policy options were decided on, a set of corresponding computer commands were written on an adjacent blackboard. It must be noted that the discussion was always focused toward the options that were handled easily by the simulation model.

Figure 8. Housing units by time by region (too much information).

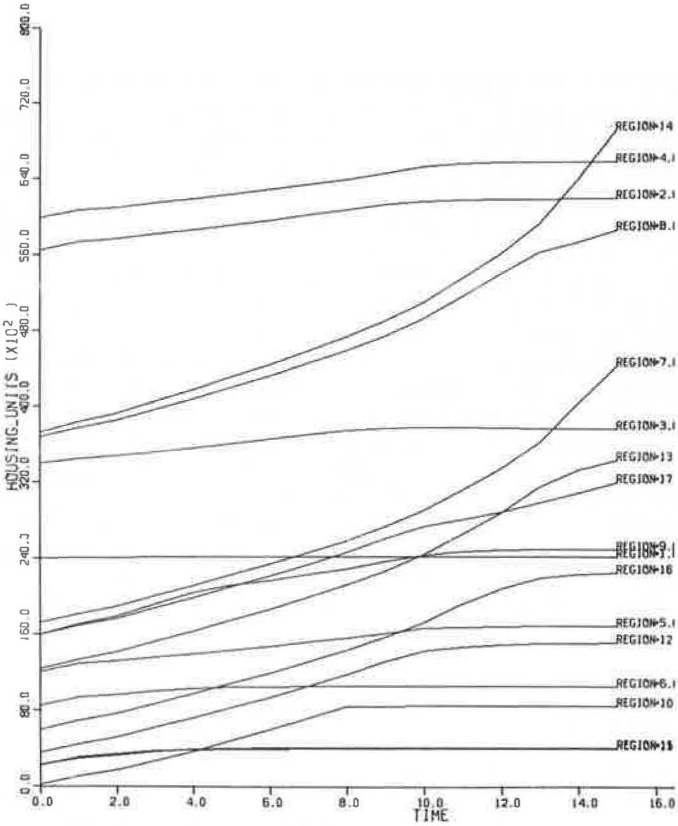


Figure 9. Total people by time for 2 migration options.

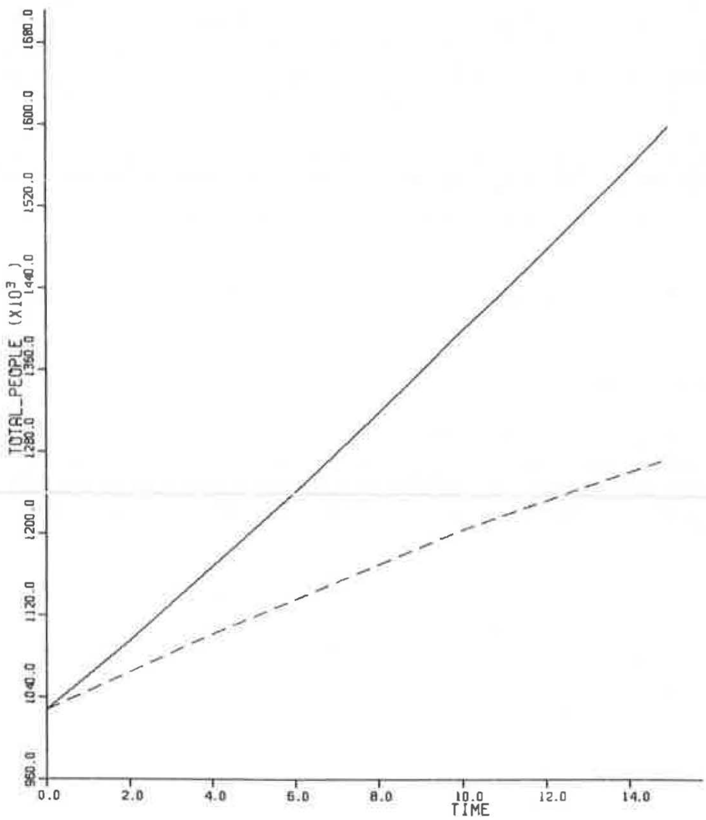


Figure 10. Male population by time by age.

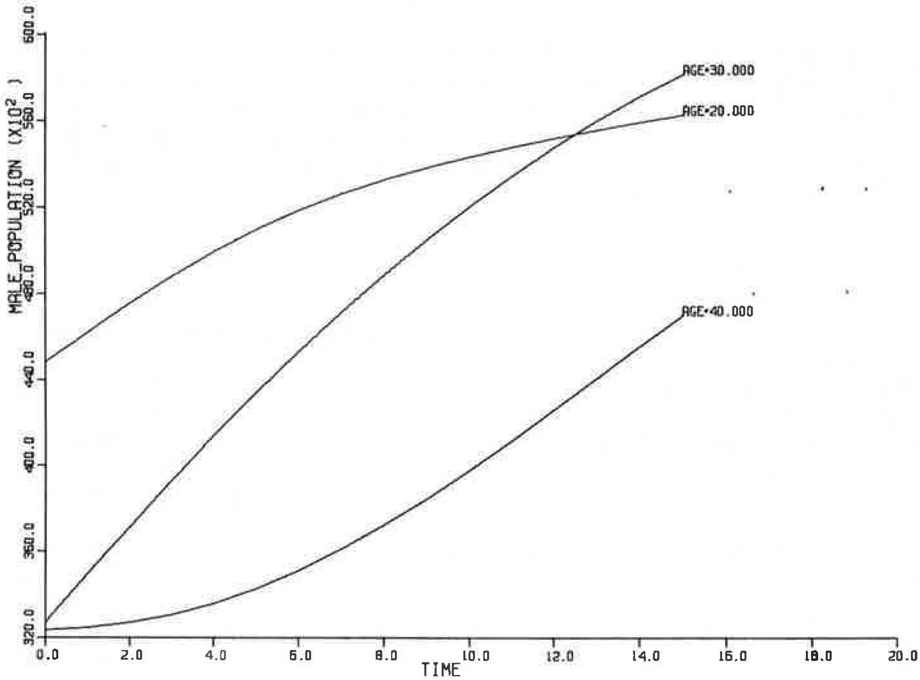
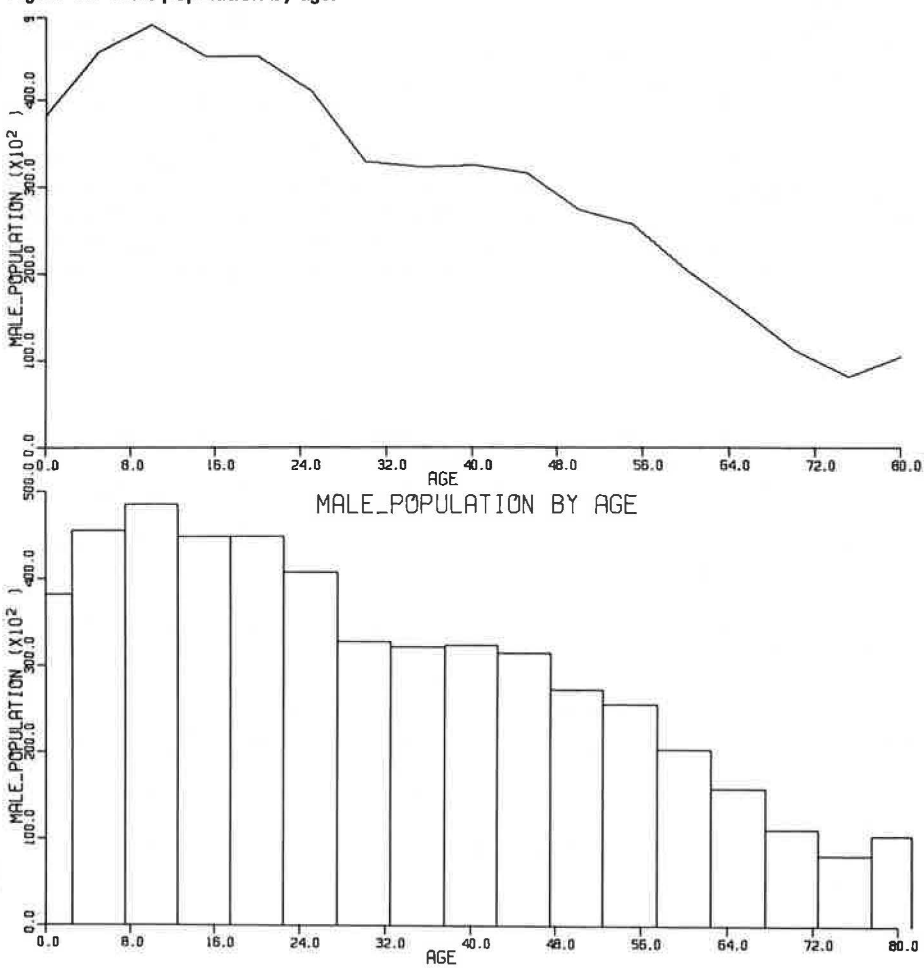


Figure 11. Male population by age.



After the discussion was complete and the computer commands had been constructed, one of the audience entered the commands into the computer. The results were overwhelming. The audience crowded around the display screen and everyone wanted to try other planning options. In this case the audience knew what to expect before the computer terminal was used. The actual graphics provided the catalyst to start the group interacting with each other and the computer system.

RECOMMENDATIONS AND CONCLUSIONS

Of the 3 public groups shown in Figure 1, only the special interest groups and political institutions were catered to with any success. These graphics systems were designed originally so that the untrained person could use them, but the system required at least a fundamental understanding of the information being displayed for the user to effectively interact with the urban simulation models. Most of the general public (those who are not affiliated with some special interest group) usually lack the interest to achieve this minimal level of understanding. Those who do future work in this area should be aware of this.

In theory, interactive graphics can be used to promote discussion of urban system dynamics. The primary danger is that these usually stimulating graphical tools can be used as a means to promote a particular scheme. Many people can be overwhelmed by the computer graphics if sufficient background discussion and explanation are not provided. This is a typical problem encountered when there is only 1 major user of the system (a city planning department may try to push for a pet project). We have found that a strong user-oriented program based in a multi-institutional framework is best for circumventing the problems associated when there is a single user.

The major concern of any interactive graphics system is the quality of the information being displayed. Even if the graphical system is very stimulating and interactive, the audience will not respond properly if its information is questionable. A sound data base (including a reliable set of models) is an essential prerequisite for a meaningful interactive graphics and public information program.

There are many pros and cons regarding interactive graphics as a public involvement tool. Against the promise of interactive graphics one must weigh the dangers of narrow in-house use. Against the promise of graphics as a discussion stimulator, one must acknowledge the dangers of graphics as a justifier of decisions. We hope that shedding light on these problems and prospects can advance the public decision-making process.

REFERENCES

1. D. E. Boyce, N. Day, and C. McDonald. Metropolitan Plan Making. Regional Science Research Institute, Philadelphia, 1972.
2. M. A. Goldberg and C. S. Holling. The Vancouver Regional Inter-Institutional Policy Simulator. Resource Science Centre, Univ. of British Columbia, 1970.
3. M. A. Goldberg. Development of a Metropolitan Environmental Quality Simulator. In Land Management in the '70's (W. L. Bathke and W. A. Haney, eds.), San Francisco Press, 1972, pp. 137-147.
4. M. A. Goldberg and H. C. Davis. An Approach to Modeling Urban Growth and Spatial Structure. Highway Research Record 435, 1973, pp. 42-55.
5. M. A. Goldberg. Simulation, Synthesis and Urban Public Decision Making. Management Science, Vol. 20, No. 4, Part II, 1973, pp. 629-643.
6. L. D. Hueftlein and D. A. Ash. The User's Manual for the Simulation Supervisor. Resource Science Centre, Univ. of British Columbia, 1974.
7. D. B. Lee. Requiem for Large-Scale Models. Journal of American Institute of Planners, Vol. 39, No. 3, 1973, pp. 163-178.
8. R. N. McRae. A Supervisor to Monitor Multiple Simulators. Department of Computer Science, Univ. of British Columbia, 1973.

9. J. L. Parker. Information Retrieval With Large-Scale Geographic Data Bases. Department of Computer Science, Univ. of British Columbia, 1971.
10. J. L. Parker. A Graphics and Information Retrieval Supervisor for Simulators. Department of Computer Science, Univ. of British Columbia, 1971.
11. J. L. Parker. Graphics and Information Retrieval for Large-Scale Simulators— A Virtual Data System. Department of Computer Science, Univ. of British Columbia, 1973.