TECHNOLOGICAL ANALYSIS AND DEMOCRATIC POLICY-MAKING

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Abstract

The paper centers upon the implications of technical analytical methodologies, especially those which are computer-based, for public policy-making. A generalized analysis of the lack of suitable educational and experiental background of most public policy-makers is presented, and it is suggested that this lack makes it difficult for such officials to adequately evaluate technical analyses. Means to ameliorate this problem are discussed, and a model of policy-maker/computer methodology interface is presented. The example used is based on a computer simulation model and related methodologies which are presently developed for HUD to study New Town fiscal and economic viability.

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The increasing necessity to utilize modern technology in the service of the governmental process has raised the necessity of dealing with the question of the interrelationship between the technological experts and decision-making in a democratic context, and also the question of the educational preparation of both these two groups to deal with these problems.

The question issues in several forms. One of these forms was illustrated, several years ago, by the debate over ABM policy. A major difficulty for policy-makers in the political process was the fact that the technological experts, the scientists, could not themselves agree upon the effectiveness of the proposed system. In fact, Senator Edward Kennedy (D-Mass.) was moved to assemble a team of scientists to prepare a volume of pro and con papers on the subject; this collection was subsequently found to be so useful that a publisher produced the volume for public consumption. Until that time, however, copies of the Kennedy volume, in typescript form, were very sought-after items.

Something like the potential workability of the ABM is, of course, a very detailed and technical question, and it becomes obviously difficult for public policy-makers, not knowledgeable in the technological detail required to comprehend and evaluate the pro and con arguments, to go on to make substantive public policy decisions.

This example is one wherein policy-makers must deal with conflicting scientific advice regarding the merits of a proposed technology, with the policy-makers expected to go on and determine whether to adopt the system or not. This situation is a common one, and poses difficulty, obviously. But, some would suggest, things become even much more sticky when the technological experts directly propose public policy directions, based on their expertise (or professed such). This is particularly the case as the social scientists become more active in (1) developing a technology -- or at least the appearance of same (preferably using, somehow, computers and producing computer printout); and (2) suggesting that their policy recommendations are based on their technological expertise -- which methodology or expertise is <u>not</u> understood by the policy decision-maker any more than he understands missile technology.

What is being suggested, in this instance, is that those situations wherein the "expert" becomes much more direct in suggesting policy determinations to the elected decision-makers are becoming more frequent.

The increasing activity of governmental processes in social areas -- such as environment, cities, education, etc. -- in effect guarantees that the social scientists and others will be turned to more and more for their professional advice. A corrolary to this is the likelihood that more and more of these situations will be such that the expert will be providing recommendations directly for public policy formulation, rather than, as in an earlier day, the engineering technician was asked for professional advice on the technical feasibility of a proposal.

Illustrations of this are to be found in many of our domestic social-engineering programs designed for our poverty and/or inner-city problems during the 1960's. A much more glaring example is to be found in American foreign policy, particularly with reference to Southeast Asia. Although it perhaps is not generally known amongst the population at large, the role of selected social scientists, and particularly those of so-called "counter-insurgency school" of thought, was prominent in the decision-making processes which involved this country so deeply in that part of the world.

With the increasing demands for governmental action to deal with the crisis of many social problems, including those of the environment, technologically-oriented professionals are going to be increasingly called upon to provide, based upon their expertise, inputs to the political decision-making process. That this is so should suggest the necessity of undertaking a searching examination of the role and place of technological inputs to public policy-making in a democracy. For the problem is, basically, that if the technicians control the decisions (even if by default of the supposed decision-makers -- or even if the technicians, given their supposed expertise, are allowed in effect to set the agenda for discussable alternatives to be considered by elected public officials), these major public decisions are being made by persons whom the public does not know and has no control over through the ballot box.

Politics, Seniority, and Lack of Computer Education

We might note in this context that the evaluation of new technologies falls particularly heavily upon the political decision-making system, and most particularly the legislatures. For in political decision-making contexts, it is very much the case that age seniority is a corrolary of important political position. Individuals tend to advance in political power in the executive branch of government somewhat more slowly than in the business, or even the academic worlds. In the legislative branch, the seniority system comes full flower, in that the most important committee positions, where most of the major decisions are really made, are occupied by aged men. In short, the political decision-making structure in most countries is occupied by aging men.

It might be remembered that in 1960 John F. Kennedy, a very abnormally young president in terms of historical precedent, became the first president (and indeed, probably the first head of state of a major country in the world) to be born in <u>this</u> century.

Most of our major political decision-makers have, in short, been born and also undergone their formative education (through the college level and thereafter) before the advent of such major political system-affecting events as

--Space travel
--The ICBM
--Television (which only became wide-spread in the '50's)
--The computer (the first, cumbersome and electro-magnetic, was put together in WWII)
--Operations Research (from Britain, in WWII)
--The Bomb -- and the possibility of instant obliteration of all life
--The possibility of collapse of the eco-system
--The <u>possible</u> decline of <u>revolutionary</u> communism
--The <u>jetplane</u> -- and <u>indeed, long distance</u> air travel at all
--The photocopy machine (various variants)
--Etc, etc, etc.
--Even -- the "discovery" of poverty in the U.S.

In short, many of the major issues in this country today -- and many other countries, for that matter -- are simply beyond the educational preparation patterns of many of the aged people making the political decisions today -- both in the U.S. and in other countries as well.

It may also be interesting to note that the social sciences exhibit, in terms of personnel, a somewhat similar time lag. The university-level "methodological course," particularly one that deals with the use of computers, is a relatively recent phenomenon in political science education -- dating from the last decade for the most part. And a detailed discussion of the <u>implications</u> of modern computer capabilities for political/social analysis in terms of <u>substantive</u> possibilities is still almost ignored in political science curricula -- up to and including that of the doctoral level.

So, all of this and more raises, pointedly, the question of an appropriate role for technological and/or analytical expertise in terms of political democratic theory, and appropriate computer education for this purpose. It seems that there may be an increasing interest amongst political decision-makers for technological inputs to political decision-making which are framed in a manner so as to be of use to them instead of being framed in a manner primarily oriented to the needs of bureaucratic systems. There are also indications that there are an increasing number of political decision-makers who feel the need for a more adequate education in computer analysis techniques, at least to the point where they may more adequately evaluate implications for public policy.

An Illustrative Model

A model of a system to deal in part with this problem may be taken from a project the writer presently is involved with for the U.S. Department of Housing and Urban Development. The project was a feasibility study of adopting a previously-developed urban simulation analysis system to a procedure for evaluating the fiscal and financial viability of New Town development plans or proposals.[1]

In this work an adaption of the previous urban analysis system to an analysis of a specific New Town was made, and the resultant prototype New Towns Simulator is called NUCOMS. This prototype NUCOMS system has been utilized to explore the development of one New Town, and it also constitutes the basis for a more extended analysis system being developed for generalized New Towns proposal evaluation.

Historical Development of the NUCOMS Project

The components of the Basic NUCOMS System have evolved over a period of about ten years. Part of the historical antecedents of the work can be traced back to the pioneering work of Professor Ira Lowry,[2] and its modification by Crecine as represented in "TOMM," the Time Oriented Metropolitan Model.[3] The TOMM model has been modified for use as a component in the New Community Simulator (NUCOMS) by substituting generalized "attractiveness coefficients" for the geographic distance parameters used in the original Lowry model and TOMM systems.[4]

Other components of the New Communities Simulator find their intellectual antecedents in the SCANCAP and SCANPED Systems, developed in 1966 and 1968 respectively. These systems augmented TOMM by producing detailed projections of neighborhood characteristics such as health, education, crime, ethnic composition, and others.

These various components, and other refinements, were brought together in the Provincial Municipal Simulation System (PROMUS) under development by D.F. Blumberg and other staff members of Decision Sciences Corporation. It incorporates the features described above, and in addition, contains a complete urban financial model for use in planning and budgeting. It is being developed for the city of Toronto, Canada.

The PROMUS system (Figure 1) consists of two major sub-systems:

The Community Model Subsystem (CMS) --
which describes an existing or new community in terms of size, location, internal diversity, etc.

The Financial Policy Planning Subsystem (FPPS) --
which provides the basis for computing the costs, cash flow, and return on investment of given development and operation programs. Within this system is a specific model used for the financial evaluation of new community or area development programs.

These two models are connected through a policy implementation program. In essence, the community development plan is first tested in terms of its initial financial viability (i.e., cash flow, basic return on invested capital, etc.). The community structure is then implemented through the community model (through the Policy Implementation Program), and the actual community growth and change is then projected, considering both the internal demographic-economic structure and the exogenous factors which may affect the community. This system, in conjunction with other elements of the Financial Planning Model will

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[1] This work was carried out in 1971 by Decision Science Corporation, in fulfillment of contract #H-1496 for the U.S. Department of Housing and Urban Development.

[2] Lowry, I.S., A Model of Metropolis, RAND Corporation, RM-4035,RC, August 1964.

[3] Crecine, J.P., TOMM: Time Oriented Metropolitan Model, Technical Bulletin Number 6, Pittsburgh Community Renewal Program, 1964.

[4] For a more complete review of the historical development of the Lowry Model, see "The Lowry Model Heritage," by W. Goldner in American Institute of Planners Journal, March 1971. The revisions in the original Lowry Model made by Decision Sciences Corp. are detailed in New Communities: Systems for Planning and Evaluation, Decision Sciences Corp., P.O. Box 1010, Jenkintown, Penna., 1971.

then evaluate and project the effects of the internal development plan of the community on housing mix, community services and government, social factors (which can be quantitatively measured), etc. Thus, the PROMUS system provides the basic capability to evaluate the viability of the community plan, as well as the economic, demographic, social and industrial impact which will result from this plan.

The PROMUS system also incorporates a graphic output subsystem called SYMAP, originally developed by the Harvard Computation Laboratory as a general graphics output system. This system produces maps showing urban growth characteristics on the regional level, the study area level, and at the community level. Capabilities permit a wide variety of physical, economic, and social outputs to be displayed. A representative SYMAP output for the City of Toronto is shown in Figure 2.

Basic New Community Simulator (NUCOMS) Structure

The collection of programs described above formed the nucleus for the Basic NUCOMS evaluator system. The Basic NUCOMS System is comprised of three separate, but interlocking submodels as shown in Figure 3. The first is the Small Area Submodel which predicts the change in population and employment by small area. Optionally, the Small Area Submodel may drive the Neighborhood Submodel which can produce tabular output, as well as graphic ouput through SYMAP. In this case, the Neighborhood Submodel combines the policies of local governments and institutions, the changes in employment and population, and past socio-economic indicators to predict future socio-economic patterns. The basic spatial organization predicted by the Small Area Submodel from regional and study area data drives the Financial Model System (FMS). The FMS produces tabular output establishing the financial viability of the New Community proposal.

NUCOMS and Public Policy-Makers

One of the several fundamental goals of this research program is to produce a management information system which can assist HUD in the evaluation of New Community proposals. The system being proposed must meet higher demands than most management information systems because of the special requirement placed upon it:

> The necessity for policy-makers to interact with the system and to explore the effects of alternative policies.
>
> The need for a system that is easy and simple for decision-makers to utilize. A system that is complicated to use, no matter how useful its output, will tend to be under-utilized by decision-makers.

It follows, given the busy schedules of decision-makers, that it is desirable to automate the evaluation system as much as possible, consistent with the policy content of the data, so that as much of the review process as possible may be accomplished by lower level administrators. Conversely, however, control over policy content must be allocated to the higher level policy-makers. The distinction here is between bureaucratic implementation of policy and higher level formulation of policy.

The problem of creating a management information system for new communities is further complicated by the necessity to incorporate qualitative and/or subjective factors into the review process. Such factors, while difficult to incorporate into an analytical and systematic process, nevertheless may play a major role in the success or failure of the proposed new community. The research undertaken in this study suggested the potential of making explicit these subjective evaluation data which, although present in existing decision analysis modes, are often unrecognized as playing a role in the decision-making process.

Furthermore, the output of the New Communities evaluation system must clearly be matched to HUD's *modus operandi* for decisions of the magnitude of New Town loan guarantees. A simple "yes or no" answer would be inappropriate, but so would a highly detailed technical report which is extremely difficult for public officials to comprehend. The ideal intermediate solution is a hierarchial information structure in which suitable outputs are provided to each level within HUD in a sequential fashion.

Based upon these considerations the proposed structure of the evaluation system in which the New Towns evaluation programs are to be embedded should have the following characteristics:

> A step-wise graduation of review modes starting with checklist criteria against which the developer's proposal can be verified by low level administrative

assistance;

If the developer's proposal passes this easy-to-administer checklist, the proposed development data are passed through a computer simulation model (NUCOMS) to evaluate the financial and economic feasibility of the new community proposal.

The NUCOMS system produces extensive quantitative output in terms of tables and maps for various future periods in the New Community project. Given the high speed of modern computers, alternative planning and program mixes for the new community can be explored, and extrapolations of projected outcomes for ten or twenty or more years into the future rapidly obtained. Since this procedure is in large measure mechanistic, most of these analyses can be accomplished by relatively low-level bureaucrats.

If the developer's proposal has passed these thresholds or cut-off criteria, it is necessary to move on to incorporate policy and qualitative factors into the evaluation procedure. The proposed system incorporates policy-makers at this stage of the process, after the preliminary evaluation steps listed above which can be handled by lower level people have been executed. This is the point at which the knowledge and expertise of the higher level people should be brought to bear upon the qualitative aspects of the proposed new community plan.

Figure 4 shows the general scheme of this parallel qualitative and quantitative evaluation process. The individual steps are described below. The step numbers are also indicated on Figure 4.

Step 1: The developer prepares an initial analysis and decides to go ahead with development of a proposal. He will check informally with HUD periodically and develop a formal proposal for submission to HUD. The data format requirements of HUD for these proposals should be such as to expedite the evaluation steps below.

Step 2: After the proposal is received at HUD, those aspects of the proposal which are easiest and most mechanical to check are examined first. Consequently, the proposals can be screened in the early stages by lower-level personnel at HUD, and some proposals may be screened out at this stage without requiring effort by higher-level personnel of use of a simulation analysis.

Step two provides a checklist of some basic quantitative requirements; the developer's proposal can be quickly examined to see if a fit is obtained. If not, the proposal is returned to the developer. If the proposal meets the checklist criteria, it is passed on to step three.

Step 3: Data from the developer's proposal is prepared for computer input (HUD's application format requirements should be established with these needs in mind), and input into the NUCOMS System. NUCOMS computer runs on some developer proposals may quite obviously indicate lack of financial and/or economic viability, and thus the proposal would be returned to the developer as unacceptable.

Step 4: The output of the NUCOMS evaluation stages would then be submitted to a minimum quantitative acceptability test. This would consist of a codification of acceptable outputs from the Advanced NUCOMS model. It should also be noted that up to this point the evaluation process has been quite mechanical and procedural and has required little or no attention from busy upper-level personnel.

Step 5: Step five would involve evaluation and weighting procedure. For example, some proposals may rank lower on some factors but quite high on others. Additionally, HUD policy guidelines, which may change over time, may suggest that certain performance criteria be given special weight.

The establishment of these weighting factors is obviously a matter of public policy. Stage five, therefore, envisions a team of high-level policy-makers who establish these weightings. This need not be done for every developer proposal but only when it is desired to change the policies reflected in weightings.

Step 6: Step six in the review process concerns the qualitative factors pertaining to the acceptability or non-acceptability of the new community proposal. Some of these qualitative factors can be dealt with by evaluating the proposal against a checklist. This step, too, is one that can be dealt with on a routine basis by subordinate personnel.

Step 7: If the developer's proposal has passed all of these checkpoints successfully, it now goes to an evaluation team. Note that this is the first step in the process that the valuable time of these persons is called upon. This final step is one in which subjective factors are weighed. The results of the previous steps are available as inputs into this process, along with the system data base which makes relative evaluation of competing proposals possible. In addition, the output of the formal risk analysis procedures, which establish the degree of uncertainty in the New Community projections, can be considered by the evaluation team.

The focus of this part of the New Communities Evaluation system has been to develop an interface between the computer simulation analysis system (NUCOMS) and the non-technologically oriented public policy-maker who must use the results from the computer simulation analysis as an input to his decision-making. The success or failure of this particular model, designed in a Phase One contract, will have to await implementation in a Phase Two project. Irregardless of the success or otherwise of this particular model, however, the problem of providing a proper educational backing to both the computer specialists and others who will design the computer-based analysis systems, and the public policy-makers who will have to utilize the outputs of those analyses in their decision-making will increasingly be one of critical importance.

Potential Application of Interactive Time Share Procedures

One approach to the problem of the public decision-maker/computer analysis system interface now being considered for possible implementation in future development of a more advanced New Communities Analysis system is the utilization of interactive time share computer programming in a conversational mode. The use of such techniques could be applied in the utilization of other policy analysis schemes as well, thus providing the policy-maker with a means of interacting directly with the computer analysis models.

As illustrated by several instructional urban simulation models we are using in classes at Temple University, a remote computer terminal is utilized to type out instructions and questions in regular English language format, and the user types in the requested decision information in simple English language or numerical format. Figure 5 illustrates such an interactive conversational mode environment. Computer programming in this instance is in FORTRAN, and is run on a time share CDC 6400 computer at Temple University. These programs have also been run by us on UNIVAC 1108 and General Electric Mark Two (commercial) time share machines, as well as the CDC commercial (Kronos) time share service.

The application of such procedures to public policy analysis computer models, whether as we hope to do with the NUCOMS project or in other similar applications, has a number of significant implications for the policy-maker/technology interface problem:

- --Policy-makers can interact with the analysis system directly.
- --Policy-makers gain confidence and skill in working with computer analysis modes, and this sense of confidence may subsequently carry over into the use of computer techniques for other applications.
- --Policy-makers are enabled to utilize the computer analysis system directly themselves without having to rely upon intermediaries. This may be important in terms of lessening policy-makers' reliance on anonymous technicians whom the public cannot hold accountable to them at the ballot box (a critical aspect of political accountability in a democracy is that the voters may hold decision-makers to account at periodic elections, but if the policy decision-makers' decision alternatives are in reality structured by technical personnel, this element of democratic political accountability fails).
- --If political policy-makers are enabled to utilize sophisticated computer-assisted analysis models through utilization of time-share interactive conversational mode formats, without the necessity to know computer programming they may be encouraged to explore policy alternatives which they would not if they had to utilize the services of time-delaying and/or security-leaking assistants.

The utilization of such techniques, then, may make computer-assisted public policy analysis projects much more useful (and much more likely to be utilized) to policy decision-makers. Just as technological developments and potentials in the computer industry pose challenges to political decision-makers, so also are challenges posed to the computer specialists to adapt their work and abilities to the environmental needs of the policy decision-maker.

PROMUS SYSTEM

FIGURE I.

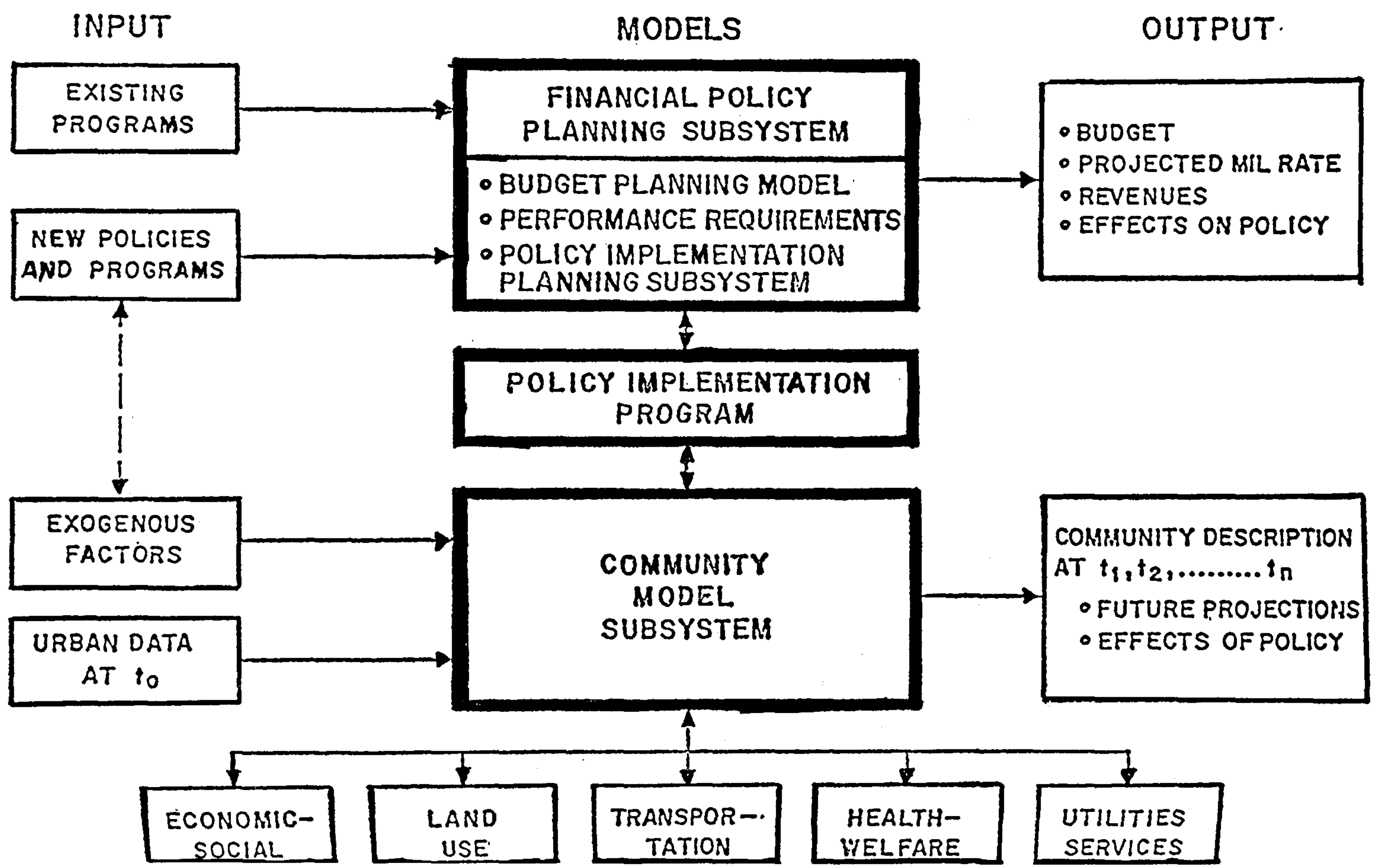
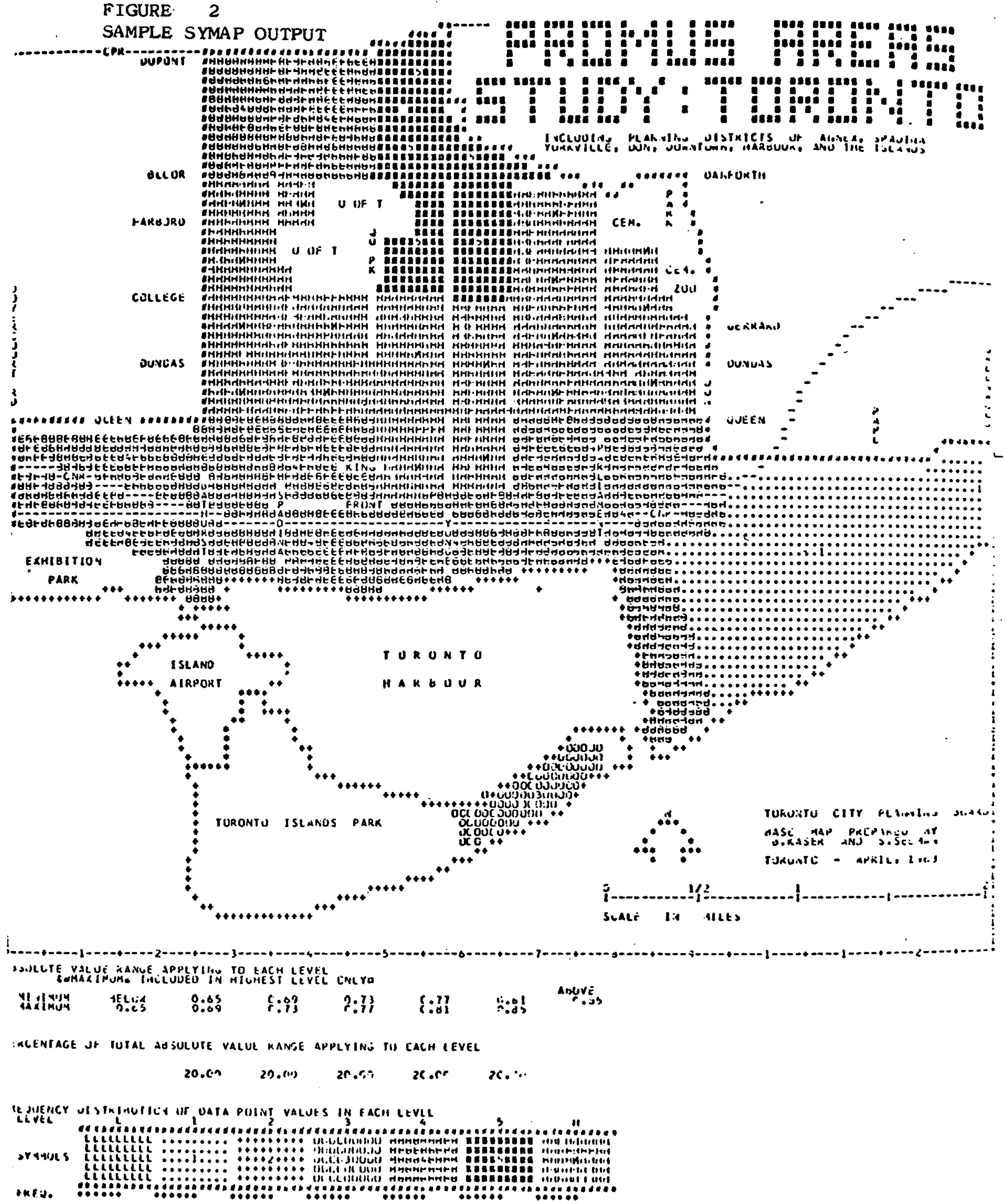


FIGURE 2

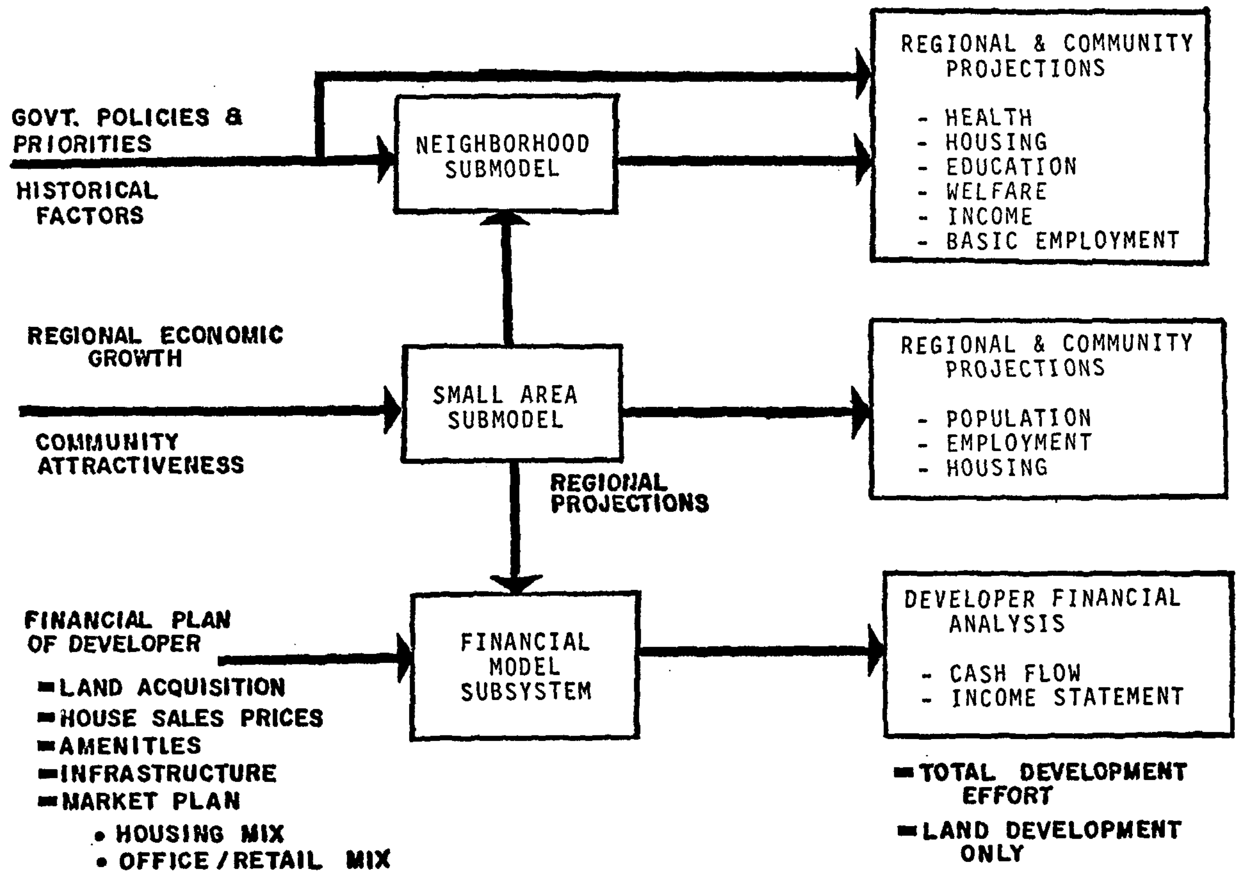
SAMPLE SYMAP OUTPUT



PERCENTAGE OF SOUND HOUSING UNITS - 1972

FIGURE III

BASIC NUCOMS STRUCTURE



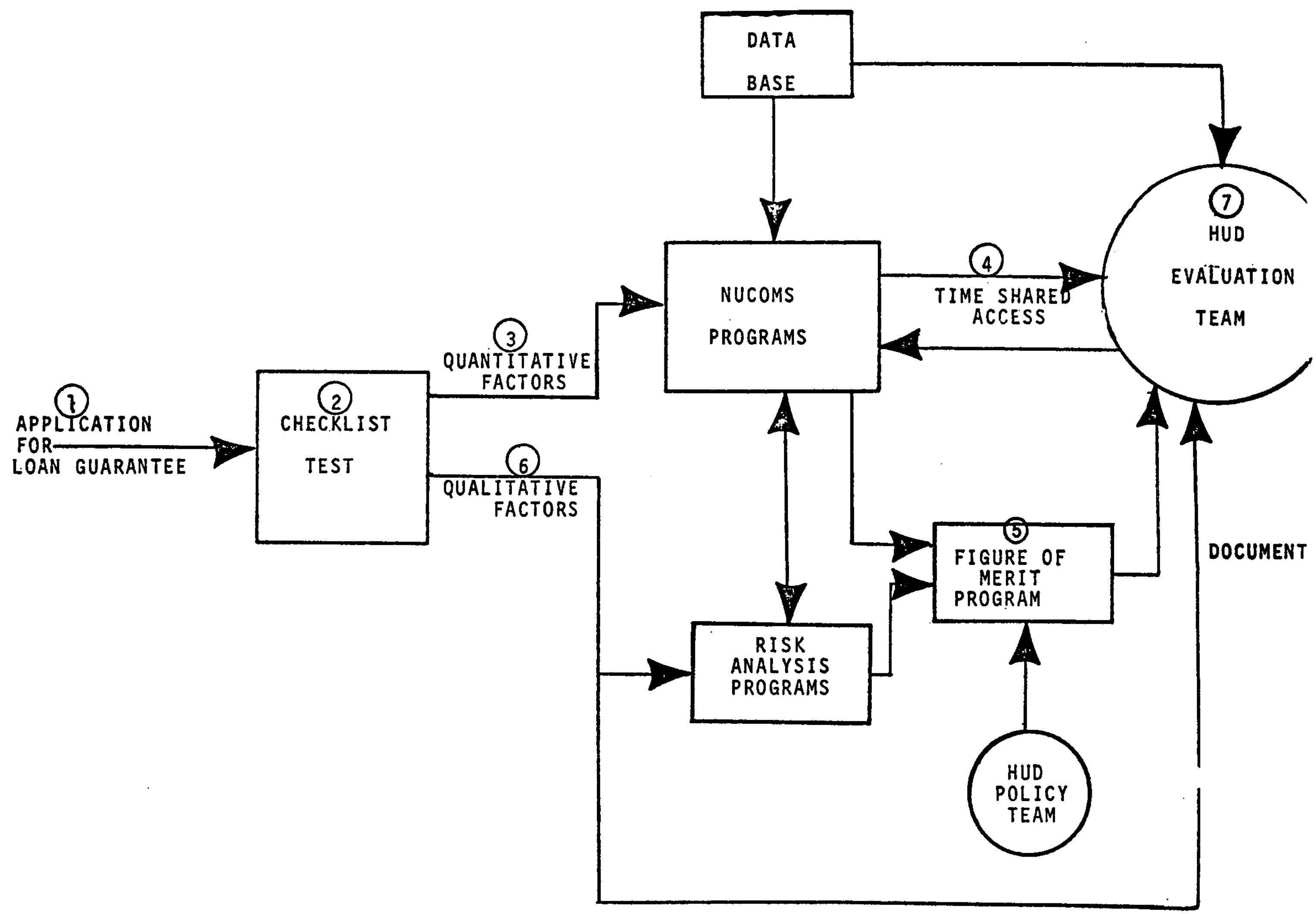


FIGURE 4 GENERAL SCHEME FOR USE OF NUCOMS PROGRAMS

FIGURE V

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THE NEXT ROUTINE IS INITIATIØN
WHAT DØ YØU WANT TØ DØ NEXT'
TELECLUG
THE BANK IS LØCATED AT 15,15 AND IS TEAM 6
NØ LØCATIØN MAY BE GREATER THAN 15,15 AND NØ
TEAM NUMBER MAY BE GREATER THAN 6.  FØR ALL
INPUT, USE BLANK TØ SEPERATE QUANTITIES

USE DECIMAL PØINTS ØNLY WHEN REQUESTED TØ DØ SØ.

FØR YES AND NØ TYPE QUESTIØNS SIMPLY ANSWER YES ØR NØ.
UNLESS ØTHERWISE SPECIFIED ENTER ALL ZERØS TØ EXIT FRØM
ANY RØUTINE WHEN ASKED FØR LØCATIØNS.
THIS PRØGRAM SETS UP THE GAME IN STØRAGE
HØW MANY HIGHWAYS RUNNING LEFT TØ RIGHT--MAX=2
*      1
WHAT IS NØ.   1 LEFT CØØRDINATE
*      7
HØW MANY HIGHWAYS RUNNING TØP TØ BØTTØM
*      1
WHAT IS NØ.   1 TØP CØØRDINATE
*      6
HØW MANY UTILITY PLANTS
*      1
WHAT IS NØ.  1 CØØRDINATES
*      5 9
HØW MANY TERMINALS
*      2
WHAT IS NØ.  1 CØØRDINATES
*      7 1
WHAT IS NØ.  2 CØØRDINATES
*      1 9
WHAT IS TAX RATE- USE DECIMAL PØINT
*      50.0
HØW MANY TEAMS
*      5
END ØF INITIALIZATIØN

THE NEXT RØUTINE IS BUY LAND
WHAT DØ YØU WANT TØ DØ NEXT'

BUYING LAND RØUTINE
LØCATIØN?
*      4 5
TEAM?
*      5
PRICE?
*      4000
LØCATIØN?
*      5 1
TEAM?
*      4
PRICE?
*      1500
LØCATIØN?
*      5 4
TEAM?
*      4
PRICE?
*      1000
LØCATIØN?
*      6 1
TEAM?
*      5
PRICE?
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