Staff Paper Series

Staff Paper P69-12 June 1969

INTEGRATED REGIONAL INFORMATION SYSTEMS

By

Wilbur R. Maki

Department of Agricultural Economics

University of Minnesota
Institute of Agriculture
St. Paul, Minnesota 55108

P69-12

June 1969

INTEGRATED REGIONAL INFORMATION SYSTEMS

Wilbur R. Maki

INTEGRATED REGIONAL INFORMATION SYSTEMS [1]

Wilbur R. Maki [2]
University of Minnesota

By an integrated regional information system I mean the entire hardware, software and analytical capabilities for computer processing, storage, and retrieval of data focusing on regional problems, particularly those dealing with income redistribution, economic growth and environmental quality. Also, both decision models and information flows are included within the scope of the concept. However, in this discussion, decision models are confined to a review of simulation models, development planning models, and resource management models. Information flows are examined in the context of decision centers, information systems and the relation of information to research and policy.

PART I: DECISION MODELS

Decision models are a category of relationships, organized systematically into a computational sequence, that take into account information needs of a particular set of decisions, for example, the factors affecting the rate and pattern of regional economic growth and development. Included among decision models are representations of regional economies that show the linkages between public policies and regional outcomes, specifically, in the context of river basin planning, state planning and programming, and metropolitan area planning.

Simulation Models

Simulation models are viewed as numerical representations of a portion of reality of concern to both decision makers and analysts.[3] By dealing

with only a portion of reality, impacts of changes in economic relationships and events, such as the level of federal grants or income tax collections, can be traced somewhat more easily to specific segments of a regional economy. To the extent that the model accurately and adequately shows important relationships and interactions among activities, the derived changes can be viewed for important clues concerning the effectiveness of different public policies and programs.

River basin planning

Hamilton and associates, in their recent book on Systems Simulation for Regional Analysis,[4/] describe an actual computer simulation model of the Susquehanna River Basin. Important relationships between the water sector of the river basin and its demographic and employment sectors are examined with reference to planning and decision making.

I refer to river basin planning because it can be viewed as intentional regional change on a grand scale, with a focus, perhaps, upon what might be called the "resource productivity cycle". By resource productivity cycle, I mean the sequence of activities that are partly place-oriented and partly people-oriented, including resource-input, output-producing, consumption, and waste-disposal activities (fig. 1). While the resource input-producing activities may include micro-cycles, such as the conversion of organic materials into fish, the resource-output-producing activities are an essential part of the macro-cycle that involves conversion of fish, for example, into economically valuable outputs for human consumption. Fish may be acquired by sportsmen or by commercial food-producing enterprise. In either case, some waste

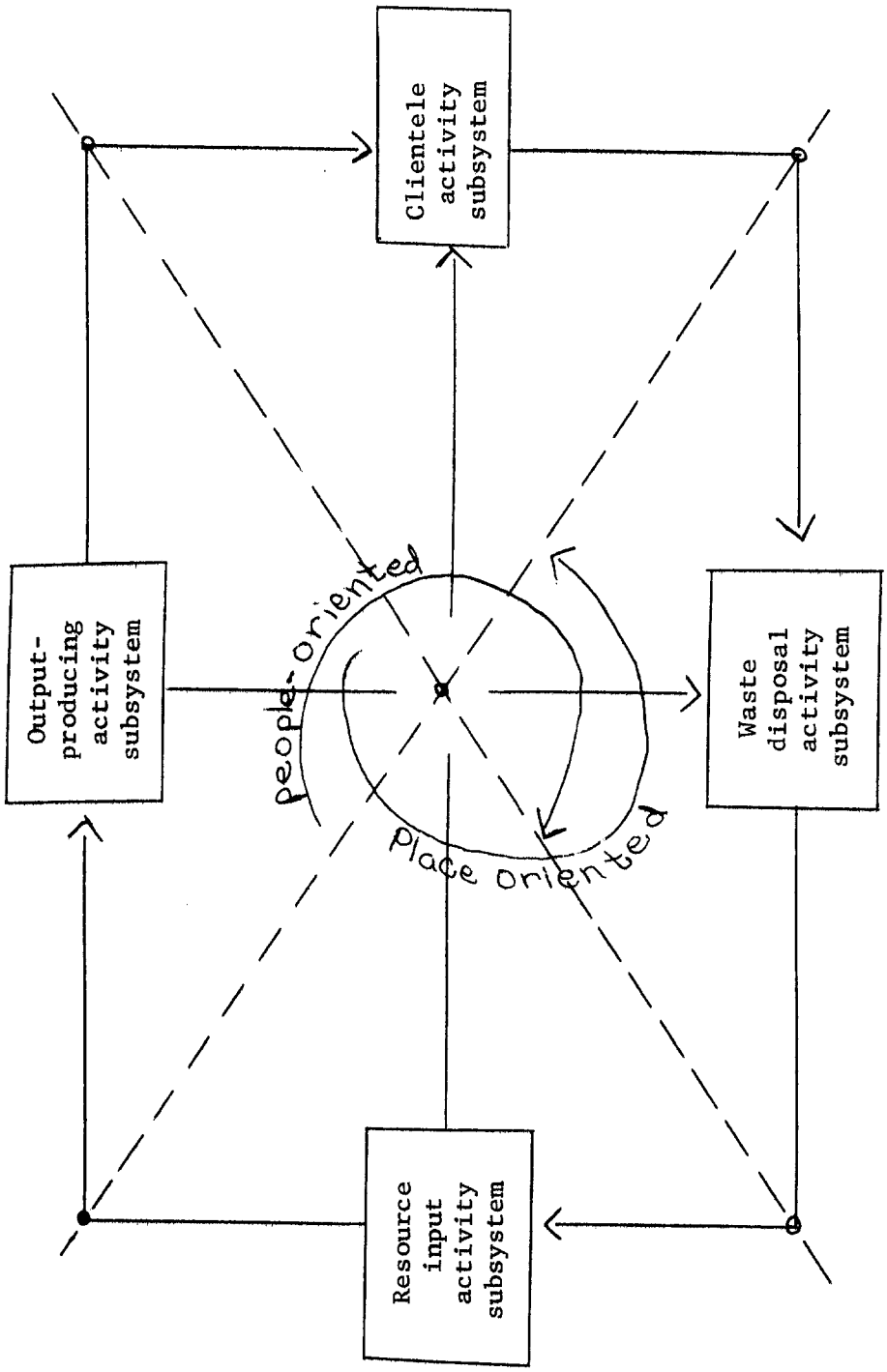

Fig. 1. Resource productivity cycle.

results from these activities which, when accumulated, impose serious problems of environmental management. Further resource input-producing activities are endangered by inappropriate waste-disposal practices. Thus, the entire resource productivity cycle can be depicted as a set of interdependent events linked in time and space by the rows and columns of a series of input-output tables.[5/]

Input-output relations, along with commodity flows into and out of the Missouri Basin, have been studied by Prescott as part of the Corps of Engineers investigations of water transportation needs and potentials along the Missouri River.[6/] Nineteen principal commodities involved in inter-regional commerce that originated from the 10 Missouri Basin States were examined in detail with reference to the states from which these commodities originated and the states to which these commodities moved. The pattern of inter-regional commodity shipments was intended to serve as a guideline for a study of inter-modal competition among transportation systems in the Missouri Basin.

Finally, Missouri basin planning has percipitated a number of economic projection models, the most notable of which is the Office of Business Economics (OBE) projection model.[7/] Initially, population employment and income projections were prepared for each subregion of the Basin for the 1960-2020 period. Given a series of national economic projections, a shift-share approach was used in accounting for a portion of regional change in terms of national-growth and industry-mix effects (with both effects being derived from national projections). Only the regional-share effects were projected for each sub-basin.

More recently, a series of economic areas has been delineated by OBE for use in the preparation of a revised series of economic projections for river basin planning.[8/] Each of the economic areas focuses upon a central city, frequently one of 50,000 or more population. Evidenced by the regionalization is a growing realization that economic projections are better prepared in the context of economic rather than hydrologic regions.

State planning and programming

Population and economic projections are widely used and accepted among state agencies and the preparation of state projections has become a highly fashionable activity.[9/] One reason for underwriting an official state projection series is consistency: It is better to have one set of projections, even if the set is all wrong, then to have two different projection series, or even worse, a dozen projection series.

What the state population and economic projections intend to provide is a series of statements about alternative economic futures facing the state, and the related public policies and programs associated with each of these futures. State governmental agencies recognize that, in cooperation with federal and local agencies, they have at their disposal a wide variety of inducements for influencing both public and private decisions and, thus, the rate and pattern of state economic growth. The economic and demographic implications of alternative sets of inducements can be spelled out within the context of the simulation models that were used initially to generate the given set of economic and population projections. What is assumed in the use of an official state projection

series, therefore, is one and only one set of public policy instruments and programs.

Metropolitan area planning

A third set of simulation models pertains to metropolitan area planning, for example, the eight-county area focusing on Des Moines, Iowa.[10/] Metropolitan area planning requires, not only projections of total area population and employment, but detailed breakdowns of these projections by economic sector and geographic location.

Because the land-use map is an important means of conveying information for metropolitan area planning, one focus of economic analysis is the activity patterns and related urban-rural land requirements associated with increasing population densities and suburban expansion. Origin-and-destination studies are used extensively to find out where people originate and terminate in their trips to shop or to work as a basis for locating urban-regional infrastructure (i.e., housing and urban amenities, schools, health centers and hospitals, transportation networks and open space).

Of fundamental concern in the preparation and use of simulation models for metropolitan area planning is the lack of understanding of the underlying forces affecting the form and function of a metropolitan area and its component parts.[11/] As metropolitan areas grow, for example, we're not certain existing built-up areas will become more intensively used in the future than in the present, or that built-up areas will expand instead. We wonder whether the inner city will specialize in low-cost housing and services for the disadvantaged people of the area, state

and region. Or, will middle-income people move back into the inner city in close proximity to their downtown place of work? Will the metropolitan center continue to fulfill its upgrading function by providing the young, the sick, the poor, the unskilled, and the suffering souls of this world who see a better day around the corner with the opportunities to improve their lot in life and become self-supporting and productive members of society?

To fulfill the upgrading function of a metropolitan center, means that jobs must become accessible to job seekers, which means, in turn, that transportation systems must be redesigned, housing areas must be relocated and social services must be re-distributed so that people in need have access to the services at the moment when the services are needed most. Models of intra-urban activity sub-systems that might serve as a basis for comparing the implications of alternative roles for the inner city, and of alternative forms of future inner city development, would be, therefore, welcome additions to existing urban analytical capabilities.[12/]

Development Planning Model

A state economic model with some breakdown sectors geographic location of sectors is presented as a prototype model. The prototype model is based on work recently completed as part of a doctoral dissertation at Iowa State University.[13/] I have attempted to summarize and synthesize the dissertation findings in a series of statements that relate changing regional economic structures to problems of regional development and planning.

Economic structure and governmental organization

In both Iowa and Minnesota, comprehensive planning functions are being localized in a single state agency -- respectively, a State Office of Planning and Programming and a State Planning Agency. In these two states at least, a state agency is entrusted with a comprehensive planning responsibility, including organization of information and knowledge.

In Minnesota, a regional planning and development system is being proposed "as a device for solving areawide problems, for improving intergovernmental relations, for enhancing state capabilities to conduct comprehensive statewide planning, and for carrying out policies aimed at insuring a proper balance between urban and rural growth and development." Formation of regional planning and development councils (RPDC's) is being recommended, therefore, as a means of enhancing the coordination of state and local plans with those of the federal government.

The RPDC's would function as the recognized agencies authorized to receive state and federal grants for planning and development purposes from the following programs:

1. Section 403 of the Public Works and Economic Development Act of 1965;
2. Section 701 of the Housing Act of 1954;
3. Omnibus Crime Control Act of 1968;
4. Specified future programs.

Of particular relevance to the implementation of regional research efforts are the powers and duties of the RPDC's, including preparation of regional development plans, review of local governmental plans and applications, provide technical assistance to local governments, and

receive grants from State and federal governments. Overall coordination of the RPDC's would be achieved through the State Planning Agency. Altogether, 10 RPDC's would be organized -- one for each of the 10 outstate multi-county planning areas (fig. 2). Thus, each substate functional economic area in the State would be organized as a decision-making entity in the area of comprehensive development planning.

Regional change and interindustry relations

Regional development implies regional change, which is assessed and projected in terms of the components of change -- population, market demands, growth in outputs, employment, income and wealth (fig. 3). Components of regional change can be identified further in the context of an inter-industry transactions table and the inputs and outputs relating to this table. The conceptual core of the table is the demand-generating activity area, namely, exports, household consumption, state and local government purchases, federal government purchases, and business capital formation. The regional industrial structure is conditioned, therefore, by the export and local demands and by the resources that are available within the region to satisfy these demands.

For a majority of Minnesota regions, market outlets limit resource use. Access considerations are critical in accounting for the intensity of resource use in each of the regions. Access, rather than resources per se, can be viewed, therefore, as the limiting factor in export and local market development.

Given the market-constraint orientation to output-producing potentials of a region, the output-per-employee ratio assumes a critical

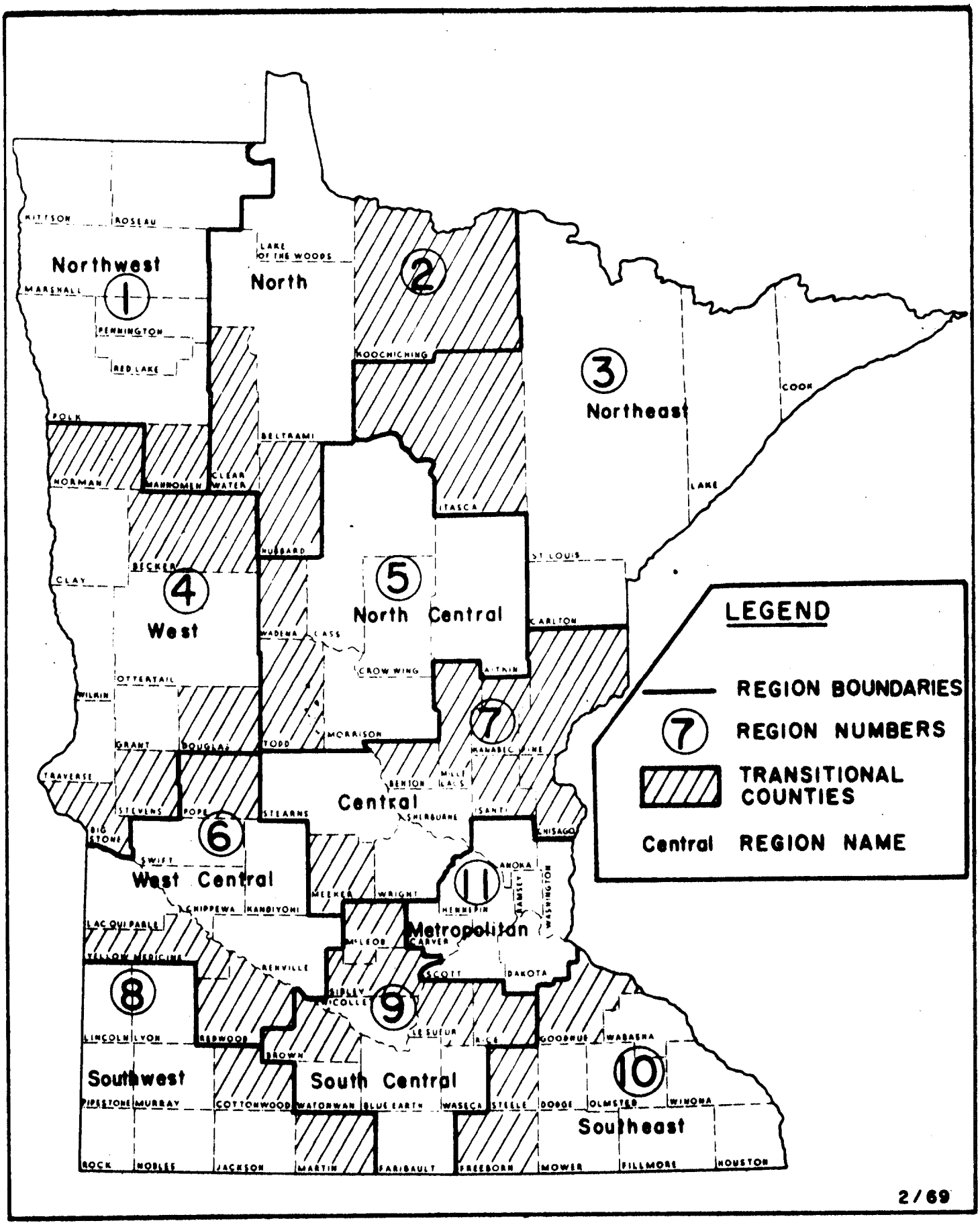

Fig. 2. Minnesota Regional Systems

STATE PLANNING AGENCY
STATE OF MINNESOTA
ST. PAUL, MINNESOTA

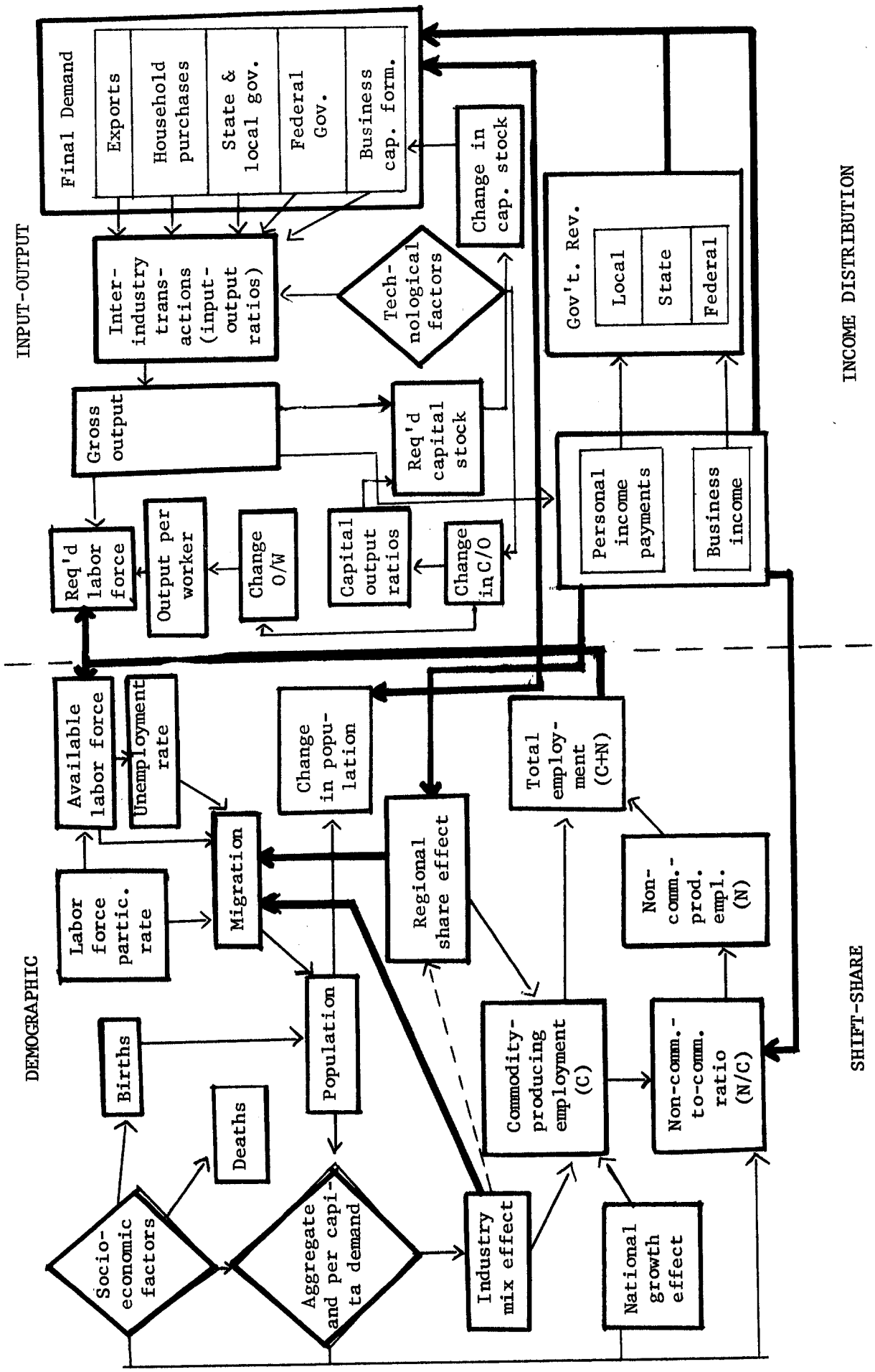

Fig. 3. Regional change and interindustry relations.

importance in accounting for the level of regional employment. Output per employee, in turn, is dependent upon the industry mix and related capital stock. Capital stock influences, not only output per employee, but, also, the competitive position of local industries in export markets.

The interindustry transactions table relates market demands to income and revenues generated locally by the total industry output. Analytically, income payments and government revenues can be derived by use of input-output relations in conjunction with estimates of market demands. To derive future levels of income and revenues, however, current household consumption levels must be obtained.

A demographic approach provides an alternative analytical basis for deriving initial estimates of employment -- estimates that can be corrected subsequently by the derived future levels of employment required to produce the total output needed to meet current market demands. A base-year population, for example, 1960, is specified first and its death and birth expectations are translated into future population forecasts for a wholly closed population system (except for biths and deaths). Migration into and out of the region, however, invalidates the initial population forecasts.

Migration, both in and out, is extremely difficult to forecast because of the difficulty of relating migration to appropriate causal factors and because of the difficulty of forecasting the causal factors. Once migration is projected, however, a residual future population can be derived. Labor force participation rates can be applied

to specified age and sex groups to obtain a total available labor force. An appropriate unemployment rate can be applied to the total labor force to obtain a forecast of total available employment in the region. Both labor force participation rates and the unemployment rate are affected by factors outside the demographic model.

To improve the utility of the demographic model, a third analytical scheme is introduced in the study of regional change, namely, a shift-share model that involves a relatively high degree of data aggregation.[14/] In the shift-share model, national projections provide a basis for deriving changes in commodity-producing employment associated with a national-growth effect and an industry-mix effect. A regional-share effect accounts for a final source of variation in commodity-producing employment. Finally, the noncommodity-to-commodity producing ratio, when applied to the derived commodity-producing employment, yields a derived total employment that should be equivalent to the derived employment figure based on the input-output model. Discrepancies in the two estimates or projections must be adjusted by means of changes in regional-share effects.

The combined industry-mix and regional-share effects are near-equivalent to net migration levels. Above-average growth in regional employment is represented by a positive combined industry-mix-and-regional-share effect, while above-average growth in population is represented by net in-migration. Thus, the two concepts are comparable and being comparable they can be used as linkages for achieving consistency between the demographic and economic models. An advantage of the threefold approach to

achieving internal consistency among component parts of a larger analytical scheme is the access provided to a maximum range of information -- not only to a wide range variety of data sources but also to a wide variety of conceptual approaches.

Cause-and-effect relations

Component parts of a regional demographic-economic system are represented next by a series of mathematical relations organized recursively to illustrate the cause-and-effect chains that are characteristic of policy-oriented models.[15/] In the recent Iowa study from which the illustrated material is obtained, a series of 59 dependent variables, and their explanatory variables, have been organized into subgroupings under the categories cited earlier -- final demand and interindustry transactions, input-output relations, employment and population, income payments, and governmental revenues and expenditures (table 1 and fig. 4). Input-output relations are used to derive the first series of dependent variables while the household consumption relations are used to derive the intermediate series of dependent variables (see table 2). Computationally, the two series of relations account for the first half of the stages in the cause-and-effect sequence. Only 42 of the 59 equations in the prescribed model are involved, however, in the estimation of the first eight levels of the expanded computational sequence.

Derived income payments and governmental revenues are data inputs for obtaining projected future outlays and outputs. The computational procedure is futuristic in its outlook, therefore, and extends substantially beyond the confines of a single interindustry transactions table.

Table 1. Functional class and computational order of 59 equations a state-substate development planning model.[1/]

Functional class	Computational order of specified equation														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Final demand totals:															
Household consumption	1	2													
State and local government	3														
Federal government	5														
Business capital	6	7													
Gross state product							35	34							
Realized output															
State totals		10	8	9	11										
Areas						36									
Employment and population:															
State totals	12					14	15								
Areas	38						37								
Area outlay and product:															
Household consumption	51							52							
Gross area product								58,59	57[2/]						
Government outlay and taxes:															
Areas (local)									53[2/]	54[2/]	55[3/]	56[4/]			
State totals (fed., state, local)	17[2/]					16	18	20,24	22			19 23,24	21, 26		
Personal income payments:															
Areas	43		42					39	40, 44	41	45	27	46		
State totals	32	30,31					28	29,34					33		
Area government revenues														48,48	50

1/ Based on: James A. MacMillan, Public Services Systems in Rural-Urban Development, Unpublished Ph.D. Thesis, Iowa State University Library, Ames, Iowa, 1968.

2/ Not included in fig. 3.

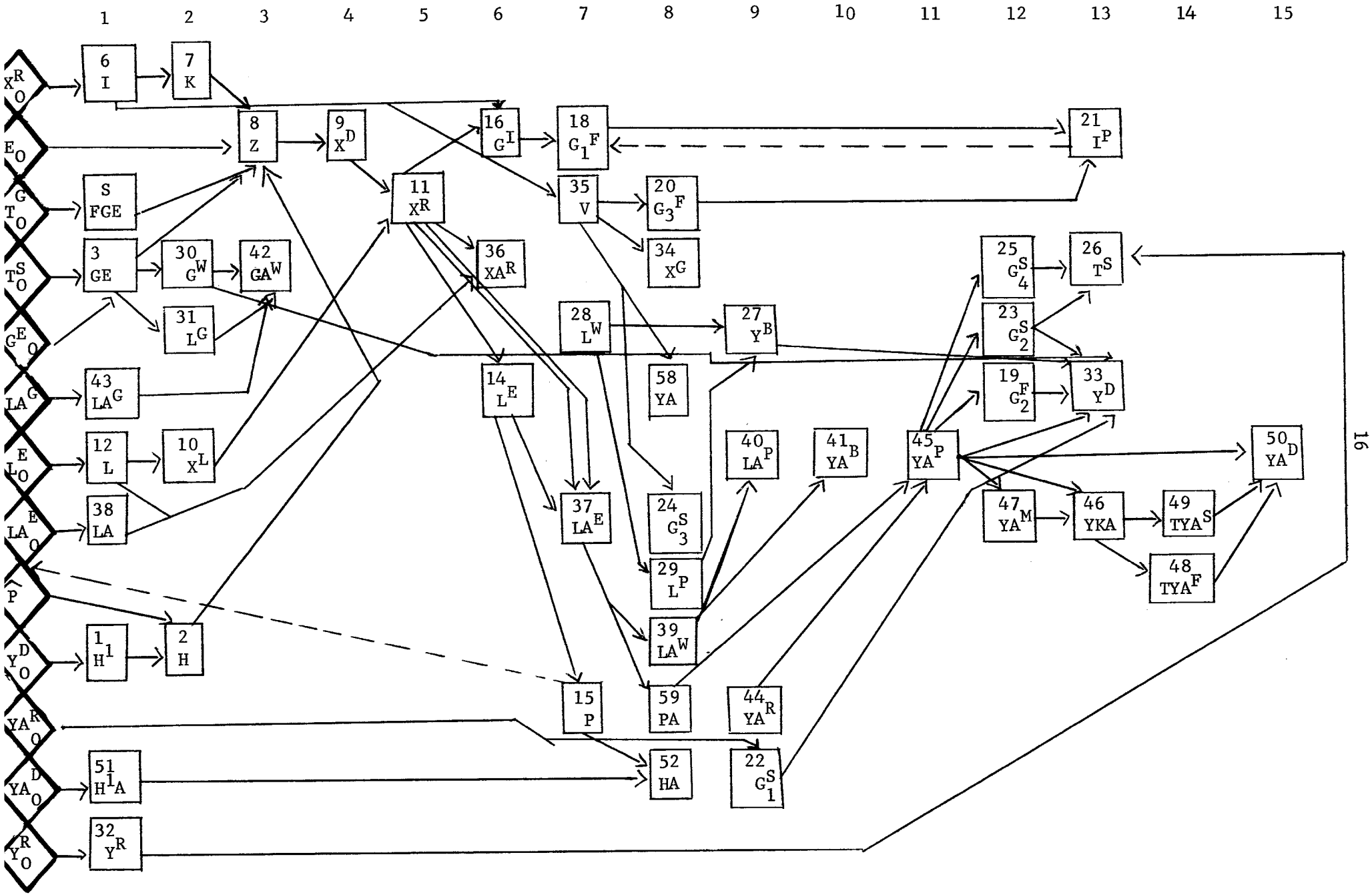

Fig. 4. Cause-and-effect relations.

Table 2. Computational sequence in development planning model.

Equation Number	State-level activities																																			Area-level activities																						
	Final demands							Output				Labor				Government outlay											Income and output									Output			Income payments									Revenue Expenses									Prod.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
1	O																																																									
2	X	O												O																																											
3			O																																																							
4				O																																																						
5					O																																																					
6						O																																																				
7						X	O																																																			
8		X	X		X		X	O																																																		
9								X	O																																																	
10						X				O		X																																														
11									X	X	O																																															
12												O																																														
13													O																																													
14											X			O																																												
15														X	O																																											
16						X					X					O																																										
17																	O																																									
18																X		O			X																																					
19																			O																											X												
20																				O																X																						
21																		X	X	X	O																																					
22		X																				O																																				
23																							O																							X												
24																								O												X																						
25																									O																					X												
26														X			X					X	X	X	X	O																																
27																											O	X	X																													
28											X																	O																														
29											X																	X	O																													
30			X																											O																												
31			X																												O																											
32																																O																										

Table 2. Continued

Equation Number	State-level activities																																			Area-level activities																							
	Final demands							Output				Labor				Government outlay											Income and output									Output			Income payments									Revenue Expenses									Prod.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
33																			X				X				X			X		X	O																										
34																														X				O	X																								
35						X					X																								O																								
36											X	X																								O		X																					
37											X			X																						X	O																						
38																																						O																					
39																																					X		O																				
40																																					X		X	O																			
41																																							X	X	O																		
42																														X	X											O	X																
43																																											O																
44																																												O															X
45																																										X		X	O														X
46																																														O	X												
47																																													X		O												
48																																														X		O											
49																																														X			O										
50																																													X			X	X	O									
51																																																			O								
52															X																																					O							
53																																																					O						
54																																																					X	O					
55																																																							O				
56																																																							X	O			
57																																											X														O	X	
58														X																					X		X																					O	
59																																					X																						O

The computational sequence does not incorporate, however, the shift-share and demographic models described earlier. Another series of computer programs must be written that would incorporate the additional computational procedures implied by the demographic and shift-share models.

Data inputs for development planning models are displayed in a social accounting framework in an earlier Iowa study as a means of identifying critical functional linkages between production, consumption, capital accumulation, and other institutional accounts (fig. 5). A regional social accounting matrix itself shows much more detail among both primary input and final demand entries than is found in the conventional input-output table. As demonstrated by Barnard, a social accounting matrix is an extremely useful organizing device for comprehensive development planning and programming at the state-level.[16/] The computational sequences formulated by MacMillan and Mullendore, provide a means of using state-level social accounting variables and relationships in substate computational programs.

Only the conceptual and computational phases of information production for development planning purposes have been discussed. By implication, however, a process of regional development planning has been identified, and the economic structure in which the process takes place has been delineated.

Needed now is a framework for using the wide range of data in development planning and programming. Such a framework will be sought in the concluding parts of this discussion. First, however, the data

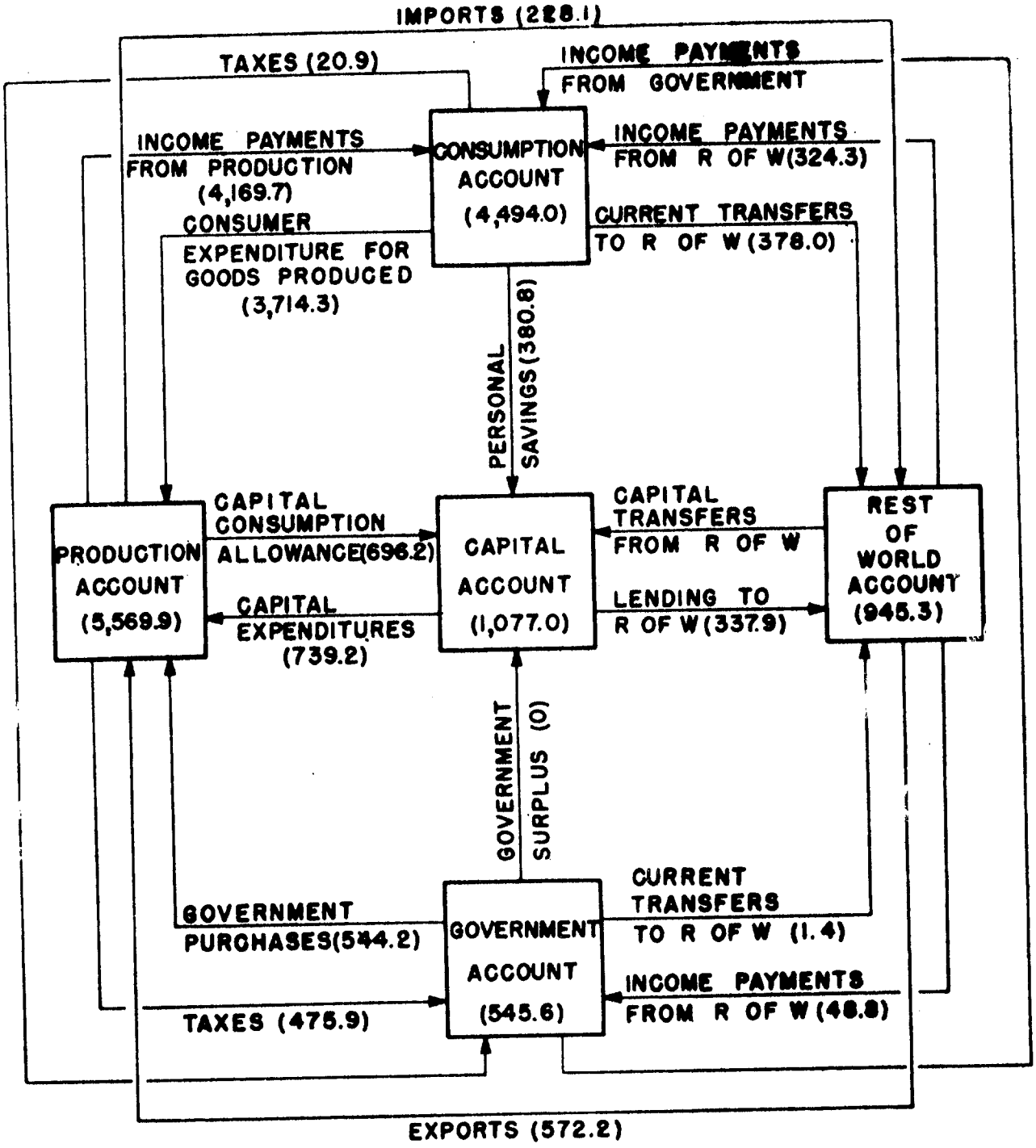

Fig. 5. Flow chart for an area economy.

requirements for state-level resource management and planning are examined, again in the context of an economic and organizational framework for regional development and growth.

Resource Management Model

Another class of decision-oriented economic models is illustrated by a resource management model depicting the operation of a State Conservation Commission. In describing the resource management model, the decision structure in the Conservation Commission is outlined and related control procedures are reviewed. Finally, a simulation strategy and evaluation procedures is prescribed on the basis of the results obtained from the model.

Decision structure

User characteristics of the clientele of the state parks managed by the State Conservation Commission are described by Carruthers in his doctoral dissertation.[17/] Thus the first contribution of an extensive study of user characteristics is the formulation and fitting of a series of household level of use equations of the form,

$$U = a + b_1 Y + b_2 D + b_3 D' + b_4 Q + b_5 Q' \qquad (1)$$

where

U = annual man years of park use by households in prescribed distance zone and time period,

Y = all socio-economic variables,

D = mid-point of distance zone around park,

D' = distance to alternative park,

Q = quality index for park,

Q' = quality index for alternative park.

A variety of socio-economic attributes are used, therefore, in fitting a particular surrogate function for outdoor recreation demand.

Study of the administrative organization of the Conservation Commission revealed further justification for the particular model specified. The Conservation Commission, which consists of seven members appointed to six-year terms by the Governor, is charged with overall policy and decision-making responsibility. An appointed Director is responsible to the Commissioners and is in charge of the functional operation of the agency. He supervises the six organizational units of the agency, of which the Division of Lands and Waters and its Park Section are of particular interest in this study.

Specifically, the Parks Section is responsible for the management of approximately 30,000 acres of state land devoted to recreational purposes and administered as 92 parks, recreation areas and preserves. In total, the Parks staff consists of a Superintendent of State Parks, an Assistant Superintendent, three District Park Supervisors, 39 Park Offices, 21 permanent maintenance men, and 125 seasonal employees.

All funds used by the Division of Lands and Waters for maintenance, operation and capital improvements are appropriated by the General Assembly and supplemented by federal grant-in-aid programs. Since 1965, the General Assumbly has funded the Division with $10.4 million and, in addition, federal appropriations have been around $3.9 million Capital improvement appropriations over the 1969-1973 study period are expected to reach $15 million, supplemented by $2.5 million of federal

funds. Over an eight-year period, therefore, more than $30 million would be appropriated to the Division for capital improvements by the General Assembly and federal agencies.

All of the capital improvement funds are allocated to three subdivisions, namely, Parks, Water and Forestry. Analytically, three classifications are used for the funds -- improving existing site, developing new sites, and miscellaneous development (not included in the analytical model). Roughly a third of the total capital improvement funds are allocated to each of the three classes.

Outdoor recreation facilities under the jurisdiction of the Conservation Commission are classified into six categories, namely, state parks, state recreation areas, state preserves, state forests, natural lakes, and fish and game areas. (Altogether, 355 state-owned recreational areas are reported, covering approximately 156 thousand acres.) Only the parks and recreation areas are covered by the study, however, for which a quality index was derived to serve as a guideline for differentiation of sites.

The park quality index incorporates physical and aesthetic attributes in the form,

$$Q = P + R + S + F, \qquad (2)$$

where,

Q = quality index,

P = physical and aesthetic score,

R = recreation possibilities score,

S = park size score,

F = park facilities score.

Investment decision criteria include attendance of the area, size of the area, number and condition of the facilities in the area, manpower necessary to operate the area, and demands by the public using the area. While in the past many investment decisions were made politically (i.e., outside the decision structure of the Commission), new sites are being acquired now with reference to population agglomerations (i.e., demand factors).

Carruthers has prepared a flow diagram of a two-part model showing the flow of information from one component to other components (fig. 6). As indicated, households use level is influenced by the socio-economic characteristics of the household, distance to and quality of park, and distance to and quality of nearest alternative park.

The budgeting process in the Conservation Commission is exemplified by the steps prescribed for determining maintenance and capital improvement funds. Current stage appropriations are some function of previous state appropriations for all capital improvement purposes, while federal appropriations are a function of state appropriations. State park and preserve appropriations for maintenance and overhead costs also are a function of a time trend -- that is, regression on previous years appropriations. Finally, concession revenue, number of campers, and miscellaneous revenue are a function of level of park use, while the park maintenance budget is a function of the state park and preserve appropriation for maintenance and overhead cost.

Control procedures

Repair and replacement requirements by type of facility and park are equivalent to the product of the combined depreciation plus

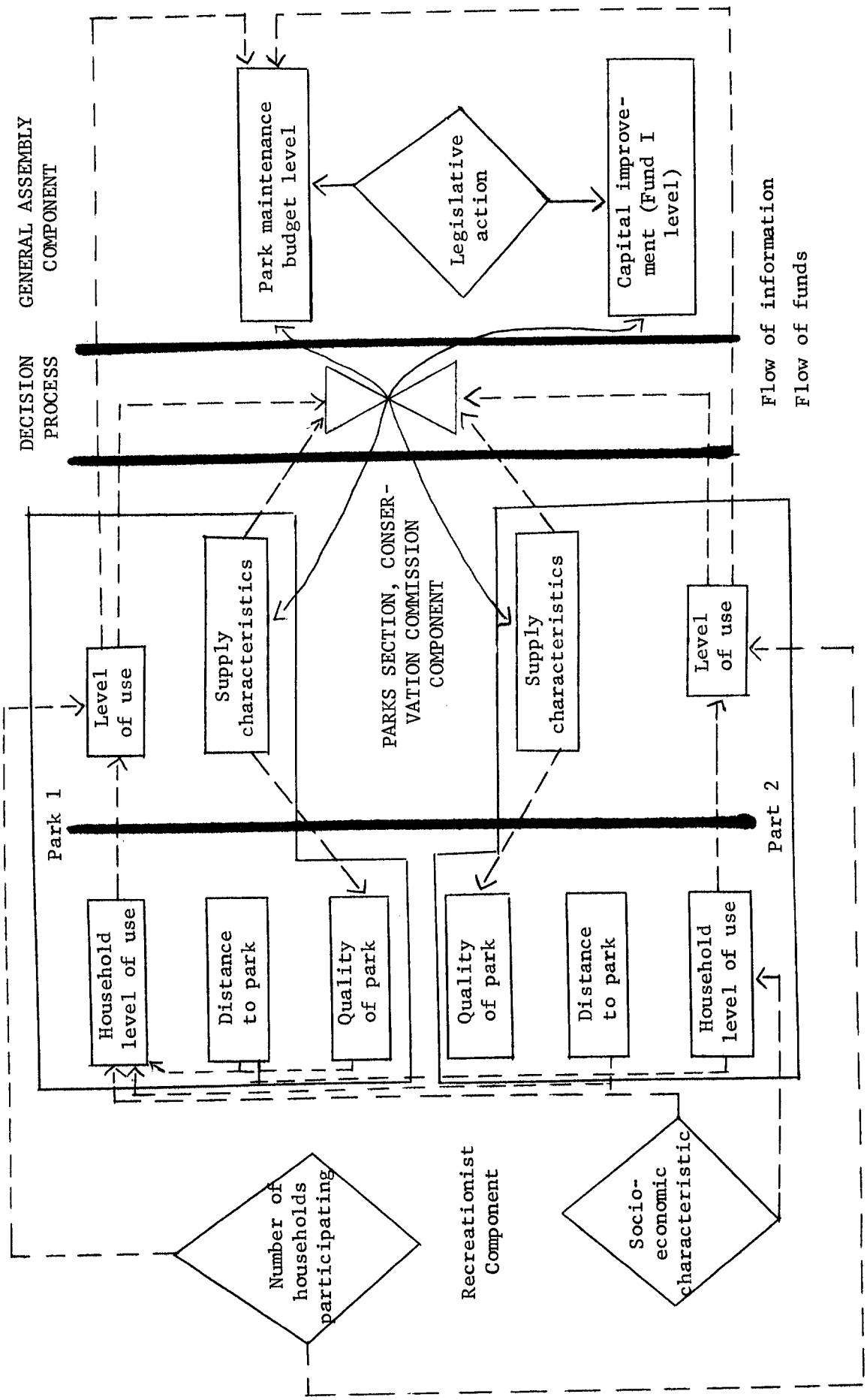

Fig. 6. Flow diagram of two-park model.

maintenance repair rate and total investment in the given type of facility. Finally, labor requirements per park are a function of level of use and land area.

Determination of activity area (i.e., picnic and camp grounds, beaches, boat landings, and trails) capital improvement requirements involves a somewhat more complex sequence of decisions. Three evaluations are made to determine if a park should receive capital improvement funds. First, if a park has a recreation possibility score greater than a prescribed level (i.e., 18 in Iowa study), it must offer most of the recreation possibilities listed and these activity areas must be well developed; hence, there is little need for investment capital improvement funds to further develop these areas. Second, if a park capacity greatly exceeds its level of use, there is little need for further expansion of the activity areas within the park. Third, the park must have some adaptability to development within the present boundaries. If a park is eliminated in any one of the three stages, the current year's activity area requirement for that park is set equal to zero.

A relative activity recreation possibilities score is used in determining the activities receiving capital improvement funds. Capital improvements are made to improve the activity score.

Procedures for determination of land acquisition and additional facility requirements are less complex than those for estimating activity requirements. The decision rule in this stage forces internal development of the park before land acquisition is allowed. (Specifically, the adaptability to further developments socre, AFDS, must be less than two and the possibility of expansion score, POES, must be equal to or greater than one).

Additional facility requirements for a park are indicated by information on total investment in facilities and the level of use of park, which is the sum of levels of use by zone of residence for park clientele). Facilities standards are computed, first, as a product of the facilities standard per man day use and the total number of man days use of a park. (Facilities considered are shelter, bath houses, latrines, shower and toilet buildings, and parking lots.

Once the capital improvement requirements for each of the three purposes -- activity, land acquisition, and facilities -- are determined, the capital improvement budget is balanced. If the total parks systems requirement is greater than the budgeted level, the park with the lowest level of use is eliminated and the inequality is tested again; this process is continued until the total requirements are equal to or less than the budgeted level.

Finally, the feed-back loop in the decision model is completed by consideration of investment policy effects. Of critical importance in controlling investment policy effects is the scoring system, which, though based upon the desirability index, was developed deductively.

Each of the indices -- quality, physical and aesthetic, recreation possibility, size, and facilities -- is affected by maintenance expenditure and facility investment roughly as follows:

1. Park facilities score is increased by facilities investment and maintenance expenditure (and decreased by change in level of use and maintenance requirements);
2. Each of the five activities scores are affected by capital improvement in investment in a given activity;

3. A parks adaptability to further development score is negatively related to capital improvement investment in activities and positively related to change in land area due to land acquisition investment;
4. A parks possibility of expansion score is negatively related to change in land area resulting from land acquisition.

By recomputation of the quality index, the model has completed one full cycle. Thus the quality variables serve as links between the investment decision process and the level of use of the parks in the system.

In addition, two minor feedback loops are involved, namely, decisions to invest in facilities and land and decisions to acquire land. Addition of facilities, for example, leads to an increase in their requirements levels for the next planning period. Also, capital improvement investment leads to increased maintenance requirements.

Simulation strategy

Implementation of the 58-parks management model was preceded by review of internal data sources and acquisition of both secondary and primary data for estimating the parameters and the input variables of the model. A 1962 park visitors survey was used to estimate the level-of-use coefficients, while time series data were used to project state appropriations for all capital improvement purposes. The specified general information was read into the computer model along with standard addition parameters -- another form of general information.

A second form of data input for the computer simulation model is park characteristics and inventory information. Each of the five quality scores was derived from eavluation of forms used in the development

of park quality indices. Picnic and camp acreages, beach and boat landing area dimensions, and miles of trail by park were taken from Conservation Commission reports, while land and water acreage data were obtained from the Commission's preliminary outdoor recreation plan. Inventory data were obtained directly from the Parks Section of the Conservation Commission.

Simulation runs derived from the model are essentially time series projections of selected variables by park and for all parks in the system. In the first set of simulation runs, results were compiled on a park basis and for the system of parks to serve as a base-line series. Generally, the results how a tendency for intermediate and high use parks to become more crowded over time. For the system as a whole, intensity of use increases while land acquisition declines, partly because of a reduction in investment opportunities.

Evaluation and application

Besides projection, the model was developed to demonstrate implications of alternative policies and assumptions. Two sets of alternative policies were tested by the model, namely, improving park quality and changing the institutionally specified earmarking for capital improvement funds to allow more intensive development of existing parks.

To simulate improvement in park quality, facility and activity area standards in the model were increased by 20 percent over their base-line values. Results show that parks of intermediate and high use would be most affected by decision to increase standards, with the increase in capability making possible a decrease in intensity of use.

Accordingly, maintenance expenditures, activities investment and land acquisition would be greater under the alternate conditions. Also demonstrated is the greater emphasis on activity investment because of the increase activity standards.

Changing institutionally specified fractions of total funds for capital improvement was accomplished quantitatively in four steps, namely, raising the increment of facilities investment from 2 to 3 facilities each year, raising the facilities score constraint (from 2.5 to 3.0), increasing the distribution of total capital improvement funds (from 32 to 35 percent), and bounding the number of households participating from in a given zone and park by specifying the intensity of use was greater than 0.8 the participation level would remain constant. Thus, the first two changes represent alterations of decision rules, while the last change corresponds to a legislative decision to appropriate more funds to existing parks at the expense of land acquisition and new parks development.

Simulation runs for the second alternative differed markedly from the base-line series. Additional activity investment increased capacity, but the capacity increased failed to keep pace with the increasing intensity of use. A relatively heavy additional investment in facilities stimulates most of the increased use. However, the increased intensity of use is confined to the large parks. Small parks would be affected very little by the proposed policy change.

What are the implications of the base-line series and the alternative policy proposals for the management of a state park system? First, the results for low-use parks generally support the present proposal

to remove many of these parks from the state park system, giving management responsibilities to local agencies. Base-year participation in these parks is low and capital constraints on investment and facilities also are low, which results in low use and low land acquisition requirements. Because expenditure requirements are low for these parks, local agencies would be able to afford to assume responsibility for them.

Second, the results show that investment opportunities in the state park system will decline over time -- a conclusion that is partly based, however, on the nature of the model, which is a closed system. New parks must enter the system to relax the supply constraint.

Third, the alternative simulation runs imply a need for better balance between activities and facilities investment. Additional use of parks, stimulated by improvement of activity areas, reduces availability of facilities, especially when facilities investment fails to keep pace with increased use. Implied, therefore, is a need to consider activity and facility standards as interrelated and interdependent, with investment in both activities and facilities being made simultaneously.

PART II: INFORMATION FLOWS

The second part of the discussion deals primarily with the implementation of an integrated regional information system that relates information needs of decision makers and citizens to the information-producing capabilities of the regional analyst. What is sought is a strengthening of the processes of research-policy interaction and the feedback mechanisms for keeping researchers and decision makers informed of each others capabilities and constraints. Accordingly, the discussion

in Part II is covered under three headings, namely, decision centers and information flows, information systems, and the relation of information to research and policy.

Decision Centers and Information Flows

To establish the spatial-organizational setting for the preparation and implementation of an integrated regional information system, I will refer to the State of Minnesota and the regionalization of the State into 11 planning regions, each focusing upon a regional center (see fig. 1). Each regional center is essentially a communication center, a place for organizing information about the region and its relationships with other regions and with the Twin Cities metropolitan complex.

Decision centers

Of primary importance in understanding the spatial-organization of regional systems, is the role and status of the so-called regional center within a system of regional centers.

I prefer, however, to re-label the regional center a "mini-center" so that I can view it within a hierarchy of centers, starting with a "mega-center", namely, the Twin Cities, and including several "metro-centers" such as Duluth-Superior, Fargo-Moorhead, and Sioux Falls, as well as a larger number of "mini-centers". In addition, I wish to recognize an even larger number of smaller centers, typically of less than 10,000 population, namely, the local service centers surrounding a mini-center.

Surrounding each center is its relevant area of influence. A mega-region, for example, surrounds the mega-center, which, in the case of the Twin Cities, extends from Michigan's Upper Peninsula to eastern Montana. Surrounding the metro-center is a metro-region extending roughly 100 miles outward and including within its influence area a surrounding ring of mini-centers. Finally, surrounding each mini-center is a mini-region, of which their are roughly 40 in the mega-region of which the Twin Cities is the regional capital.

Essentially, all public and private control centers are located in the specified regional centers. Very few control centers are found outside these centers, with the exception of the functions residing entirely outside the mega-region. A hierarchic regional structure emerges, therefore, to facilitate implementation of centralized control of critical management and policy-making functions in both the public and private sectors. Obviously, residents and local business interests in the mini-regions resent the controls asserted by the metro- and mega-centers and the institutions in these centers (although it may be recognized or asserted that the alternative to control is chaos). An emerging need, therefore, is a new set of institutions that will facilitate citizen participation in the decision making that affects his welfare and about which he has strong feelings that preferably are channeled into constructive action. In short, institutions must emerge for relating the large and the small regions, and the residents of these regions, to one another.

Information flows

Viewing each of the regional and subregional centers as communication centrals implies existence of a communication network that links all centers into a regional system with differentiation occurring among centers. For example, principal control functions may locate in the mega-center, but other control functions may decentralize to metro-centers and mini-centers. Communication linkages may occur both vertically and horizontally, with organizations located in mini-centers communicating with each other as well as with organizations or offices in metro-centers and mega-centers. Mode of communication also may be differentiated by size and role of center, for example, local service centers may support much less face-to-face interaction than metro-centers. Rather, local service centers may be linked to mini-centers and larger centers by two-way communication networks.

Consider the probable content of the information flows between centers of varying size, for example, between federal and state offices or federal and municipal offices. Because state governments are concerned with problems of economic growth, much of the federal-state interaction focuses on the implementation of programs and policies for sharing in the benefits of national economic growth. Federal programs dealing with state economic growth cover a wide range of activities, including programs resulting in a redistribution of income among regions as well as improvement in the quality of the environment of both urban and rural areas. Recently, however, state governments have engaged increasingly in the implementation of federal and state programs for

facilitating industrial plant expansion and other means of increasing a state's tax base. Sub-state governments, on the other hand, have become more and more concerned with problems of environmental management, particularly of urban environments.

Different levels of regional centers can be grouped together in terms of their problem orientations, for example, a mega-center may become increasingly concerned with issues of income redistribution (e.g., the relative position of peripheral regions vis-a-vis core regions), improverishment of social services, and lack of opportunity for residents of peripheral areas. On the other hand, the metro-center and the metro-center functions of the mega-center are likely to become more and more oriented to problems associated with economic growth. Economic growth can be achieved through public intervention, but only at the metro- center scale and within the metro-region setting. Problems of environmental quality thus become the paramount concerns of the mini-center because these problems are the ones over which local institutions and municipalities may have the greatest control and influence. Potentials for achieving income redistribution and economic growth at the mini-center or mini-region level are small, indeed, as compared with the potentials for achieving both objectives at the mega-center level or even at the metro-center level. The primary concerns of local communities of the future, therefore, are likely to focus on the quality of life and the quality of environment in the community and in the mini-region of which the community is a part.

Information systems

An integrated information system, according to computer systems planners, must have integration in at least computer hardware, software systems, functional compatibility, planning, training programs, and services. An integrated regional system would have hardware systems with compatibility for the processors located in each of the mini-centers as well as in a metro-center or mega-center. Software compatibility implies that the library programs of the central processors would not be revised with the inclusion of remote terminal or individual computer access. Functional capability would include interactive capability in which one can accomodate on-line activities on a "real time basis", a time-sharing capability in which multi-programming services are provided concurrently to many users. Integration of planning activities implies interchangeability of many informational sources, such as program libraries and data files, but without complete standardization of programming or of languages. Further, a coordinated training program would be essential in facilitating use of the information system within the educational structure. Finally, integration with respect to services implies that a remote service centers could utilize the resources of more than one regional center, including resources of regional centers outside of their region.

Hardware configuration

Envisioned for the State of Minnesota is a centralized CDC 6600 system that would be the nucleus for the initiation of a state-wide development program involving (1) a communications terminal and medium-speed processor serving only the remote stations, (2) a communications interface that connects a medium speed processor to the communications

line and which transmits information to and from the user terminals, (3) a series of user terminals with batch processing capabilities (including a 300 card per minute input, a 300 line per minute printer, a console and a visual display), and (4) a series of remote teletype terminals. Thus each of the mini-centers of the State of Minnesota, which also are sites for a decentralized system of higher education, would be linked to the University of Minnesota CDC 6600 by CDC 200 User Terminals having at least teletype communication capabilities with the central.

Data files and retrieval programs

The Minnesota Analysis and Planning System (MAPS) provides an organized software capability for relating the regional computer model input requirements to the computer hardware and related programming capabilities. Dr. John Hoyt, who is director of the MAPS project, is implementing the software component of the integrated regional information systems by providing a massive, computer-based storage of socio-economic data for each of Minnesota's 87 counties and 11 mini-regions. As stated by Hoyt, "It will provide to local and state government -- and to the state institutions of higher education -- a common data base for policy planning, research, and program administration. The operational system will eventually be remotely accessible, by a telephone line linkage at regional research and service centers located about the state and will include programs that will enable the user not only to recall specific data but also to analyze it in relationship to other information in the basic data file and to other user data uniquely relevant to the area or problem under consideration".

The development of MAPS is being supported by the Computer Systems Division of the Economic Development Administration in Washington, D.C. as a prototype for the development and implementation of similar systems in all other states. A generalized storage and retrieval system (QWICK QWERY) has been installed on the University's CDC 6600 computer at the University Computer Center. An initial data file of 1375 statistical attributes for each of the counties of Minnesota, North and South Dakota, Montana, Wisconsin, and Michigan is available and an additional county attribute list totaling about 5,000 additional items for each county will be added during the final six months of 1969.

Economic models and information needs

We have looked at a variety of economic models for generating data believed to be useful in regional development planning. We also have referred to software capabilities and hardware configurations for systematically implementing the economic models in a computational sense. We have not discussed, however, a regional development planning model that shows how a region can move from its present state to a preferred future state. Admittedly, we have failed thus far to relate expertise to participation at the regional scale.

By facing up to failure in relating analysis to policy, we turn to the choice of appropriate economic models and computational strategies. As a first try in sorting out problem areas and economic models, I suggest two categories of concern, namely, economic growth and quality environment. Problems of economic growth are handled at the state-level in cooperation with federal agencies, while problems of quality environment are handled at the mini-region level with state and local governments

being involved in the resolution of these problems. Thus, two specific decision centers are identified -- one at the state level and one at the sub-state level; in so doing we have identified the kinds of information that we are asked to generate.

Note that the information orientation for the prescribed model building is administrative as well as hierarchical. Note, also, the information needs of citizens and of those who are influential in establishing social goals and the directions in which a state or region moves on specific policies and programs. Together, the observations support a two-fold involvement of university researchers in the formulation, implementation and extension of their economic models and concepts dealing with problems of growth and development and of environmental quality.

Information, Research and Policy

I will conclude the discussion of integrated regional information systems with a description of some regional studies underway at the University of Minnesota and a statement on the role of information in relating research to policy. Again, the dicotomy between economic growth and quality environment mentioned earlier provides a cue in organizing the concluding comments in terms of the density of human settlement.

Densely-populated areas

The core region of the Upper Midwest is a seven-county mini-region that now supports nearly two million people. Consider that one-half

of the State of Minnesota is concentrated in the seven-county area and that much of the remaining population is located in the mini-centers and the more densely populated mini-regions along the western extremity of the American Manufacturing Belt: Clearly, the State of Minnesota, in terms of human settlement, is a land of contrasts. Consider also that the portion of the State's population residing in the seven-county core region is increasing rapidly: Would you conclude, however, that the settlement contrasts favor overwhelmingly the high-density pattern?

Note, first, that out-state residents have moved to the Twin Cities area in search of social services and job opportunities. For most rural areas, only the Twin Cities performs the vital upgrading function sought by the young people of today. Young people migrate from rural areas to the core area partly because they are "pushed" by the lack of educational and job opportunities locally. They are "pulled" to the core area by superior opportunities, which thus contributes to the one-way flow from sparsely-populated to densely-populated areas.

Not one urban center in Minnesota presently equals the Twin Cities in the range of choice for its residents, with the possible exception of Duluth-Superior and Rochester. But Duluth lacks job opportunities and Rochester lacks variety, thus leaving the Twin Cities as the principal magnet for drawing the mobile foot-loose segment of the State's population. Both Duluth and Rochester, however, approach the minimal level of population and income essential for a viable urban center that offers a variety of location advantages for both businesses and residents. Within a decade, moreover, a half-dozen urban places in Minnesota

will approach the minimal levels of population associated with a self-sustaining economic base and related residential and business functions.

Each of the presently growing places in Minnesota is a satellite city -- a mini-center within 100 miles or so of the Twin Cities. A concerted effort towards population and industrial decentralization from the core region to the mini-regions focusing on the satellite cities of the Twin Cities could swing the balance from excessive metropolitan concentration to vigorous economic growth in outstate regions. Needed, however, are coordinated and imaginative efforts on the part of state and federal agencies working together to encourage a more rapid flow of private investment funds from present sources of excess supply to the satellite mini-regions and their major urban centers. Information pertaining to the nature and magnitude of economic inducements to achieve industrial and population decentralization is needed, also, along with an appreciation of the role of the urban-regional infrastracture in facilitating a shift in private locational patterns.

Sparsely-populated areas

I will focus suggestions concerning policy-oriented regional research on sparsely-populated areas partly because of my current research in West Central Minnesota. As a joint effort of the Department of Agricultural Economics and the Center for Urban and Regional Affairs, local leaders in a 14-county West Central Minnesota pilot area and interested parties in state government and the University, a series of field studies are being planned.

Arrangements are being made to undertake field work within the area and to relate these studies to the information needs facing the Regional Development and Planning Council for the 14-county region, of which the study seven-county area is a part. The field studies would provide information inputs for a series of workshops to be held in the study area later in the Fall. In addition, a graduate level course in Regional Development Systems is scheduled for the Winter Quarter as a third-stage activity in the coordinated research-education-planning effort.

Research topics now being discussed include the following:

1. Regional systems;
2. Quality of life;
3. Settlement alternatives;
4. Focal areas and investment opportunity;
5. Public services and labor mobility;
6. Urban-regional interdependence;
7. Rural-urban amenities;
8. Waste disposal;
9. Transportation and open space;
10. Alternative development programs;
11. Development project proposals;
12. Information and communication systems.

The 12 study topics are re-grouped under four major headings, of which two pertain to the make-up of the study area while another two pertain to relationships between the study area and the rest of the State. Topics 4 to 6 and 7 to 9 pertain to "economic growth" and

"quality environment", respectively, and focus, therefore, upon local problems and state-local relationships. Topics 1 to 3 and 10 to 12 deal with "regionalism and human welfare" and "regional development approaches," respectively; hence, both state-local and state-federal programs and the broader regional setting for "economic growth" and "quality environment" are being considered.

Relationships among topics in the West Central Minnesota studies are illustrated in fig. 7. The first group of topics -- "regional systems", "quality of life", and "settlement alternatives" -- provides the setting for the discussions of "economic growth" and "quality environment" in the area. The social contribution of the area's resource base, which is responsive to both market and technological forces, is represented, first, in rising levels of human resource productivity, i.e. output per worker, which, in turn, supports increasing levels of per capita income. Income is one measure of social welfare; other measures include components of a quality environment, of which two are identified, namely, a wide range of choice and widespread citizen involvement in area social, economic and political affairs. Both "economic growth" and a "quality environment" are important considerations in assessing the "quality of life", which is measured in terms of the components of social welfare identified by President Eisenhower's Commission on National Goals and used by Dr. John Wilson in the study that ranked Minnesota No. 2 in "quality of life".

While the Economic Base Studies are confined to an economically declining area, the larger research effort is concerned, also, with economic and environmental forces affecting the quality of life in an

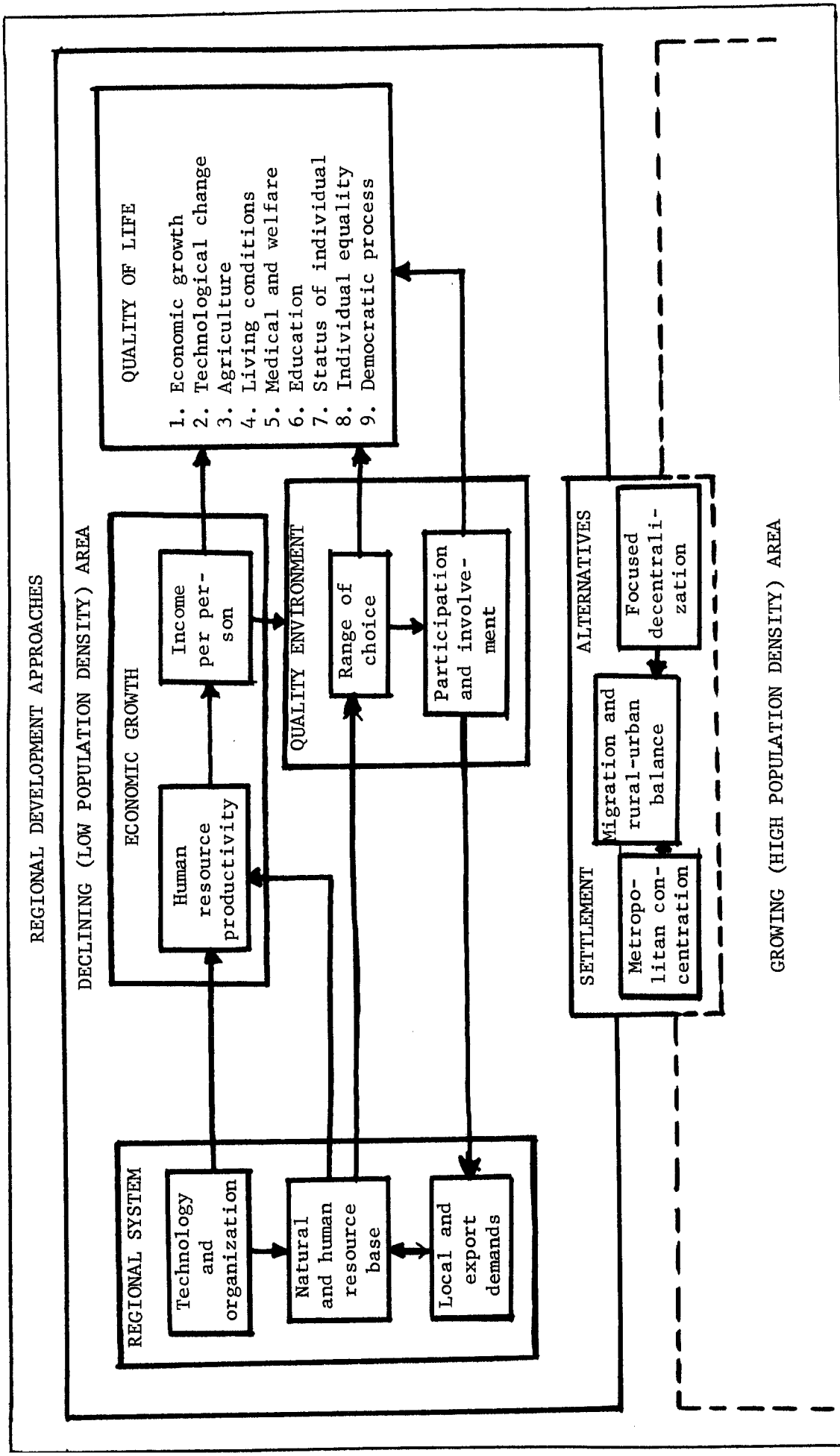

Fig. 7. Economic Base Studies and Regional Development

economically viable area. The two types of areas are inter-related through the migration process.

Historically, inter area migration in Minnesota has been dominated by the Twin Cities area. Future migration patterns may shift, however, as a result of new settlement trends, of which two are cited -- metropolitan concentration and focused decentralization. Metropolitan concentration implies continuation of historic trends in the concentration of Minnesota's total population in the Twin Cities Metropolitan Area. Focused decentralization implies dispersion of population and industry to regional centers throughout the State.

Alternative regional development approaches for West Central Minnesota are being formulated and assessed in terms of the data and concepts presented earlier. Area information and communication systems are envisioned that will facilitate the development and planning processes in West Central Minnesota by improving area access to information and expertise.

Additional work on the Economic Base Studies is being proposed currently under topics 4, 5, 6, and 7. With the additional funding a research team would be organized for a short period of intensive study of the economy of the 14-county pilot area, particularly the seven transitional counties and their economic linkages with the seven core counties. Economic growth topics would be emphasized because of high unemployment and migration rates and low per capita income levels in the area. Rural-urban amenities would be assessed, also, because of the importance of amenities, or the lack of them, in accounting for high rates of rural-to-urban migration.

Within the context of area economic growth and environmental quality, local data would be assembled, and analyzed by the research team for use in a series of area workshops scheduled in the late fall months. The workshops would focus on development approaches, with particular attention being given to area inventories, area priorities and area development potentials. Because of the planning and development content of the research and workshops, both activities would be related to the functions and role of the proposed Regional Development and Planning Council for the Planning Region that will be organized from the 14-county pilot area. Thus, the Regional Council concept would provide the central rationale in the organization of the research and workshops.

FOOTNOTES

1/ Based on materials prepared for Seminar on Urban and Regional Models, Department of Economics, Kansas State University, Manhattan, Kansas, April 24-25, 1969.

2/ Professor and Research Coordinator in Resource and Community Development, Department of Agricultural Economics and Center for Urban and Regional Affairs, University of Minnesota.

3/ Richard Stone and Alan Brown, A Program for Growth: I. A Computable Model of Economic Growth, Chapman and Hall, Great Britain, 1962.

4/ H. R. Hamilton et al, Systems Simulation for Regional Analysis, The MIT Press, Cambridge, 1969.

5/ Walter Isard, Paper prepared for Western Regional Science Association, Newport Beach, California, February 1969.

6/ James R. Prescott, Potential Water-Born Transportation in the Missouri Valley Basin, Unpublished report prepared for the U.S. Corps of Engineers, Department of Economics, Iowa State University, Ames, Iowa, 1967.

7/ Office of Business Economics, U.S. Department of Commerce, Economic and Population Projections for the Missouri Basin, 1960-2020, Unpublished data prepared for Missouri Basin Inter-Agency Committee, 1968.

8/ Preliminary Report on Economic Projections for Selected Areas 1929 to 2020, Vol. I, United States Water Council, Washington, D. C., March 1968.

9/ Sydney Sonenblum, "The uses and development of regional projections", in: Issues in Urban Economics, Harvey S. Perloff and Lowdon Wingo, Jr. (eds.), Johns Hopkins Press, Baltimore, 1968, p. 141-186.

10/ Walter E. Mullendore, An Economic Simulation Model for Urban and Regional Development Planning, Unpublished Ph.D. thesis, Iowa State University, Library, Ames, Iowa, 1968.

11/ Maurice E. Kilbridge, Robert P. O'Block and Paul Z. Tiplitz, "A Conceptual Framework for Urban Planning Models", Management Science 15:2B-2666, February, 1969.

12/ Anthony Downs, "Comment: intrametropolitan development," in: Issues in Urban Economics, Harvey S. Perloff and Lowdon Wingo, Jr., (eds.), Johns Hopkins Press, Baltimore, 1968, pp. 419-429.

13/ James A. MacMillan, Public Service Systems in Rural-Urban Development, Unpublished Ph.D. Thesis, Iowa State University Library, Ames, Iowa, 1968.

14/ See: Wilbur R. Maki and Richard E. Suttor, "Analyses for Area Development Planning," in Research and Education for Regional and Area Development, Iowa State University Press, Ames, Iowa, 1966, pp. 193-214.

15/ Wilbur R. Maki, Richard E. Suttor, and Jerald R. Barnard, Simulation of Regional Product and Income with Emphasis on Iowa, 1954-74, Iowa State Experiment Station Research Bulletin, September, 1966.

16/ Jerald R. Barnard, Design and Use of Social Accounting Systems and State Development Planning, Unpublished Ph.D. thesis, Iowa State University Library, Ames, Iowa, 1965.

17/ Garrey E. Carruthers, An Analysis of Public Investment in Iowa State Parks and Recreation Areas, Unpublished Ph.D. thesis, Iowa State University Library, Ames, Iowa, 1968.