Method for synthesis: The I.D.E.A. and C.I.D. methods

The text that follows is a slightly edited version of a document by C.A. Doxiadis extracted from Ekistics – An Introduction to the Science of Human Settlements *(London, Hutchinson, 1968), Chapter 9, pp. 386-400.*

Introduction

After defining the frame which prepares the stage of synthesis we have to establish the process by which we will proceed from one stage to another in order to:

- cover the whole area in the proper time period;
- cover all aspects of our problem at the right time and at the right scale and details;
- create as tightly knit a system of answers to our problems as possible.

To achieve this we have developed the Isolation of Dimensions and Elimination of Alternatives (I.D.E.A.) Method, combined with the Continuously Increasing Dimensionality (C.I.D.) Method. This method had been under development for years, but was presented for the first time in 1966 when it was implemented in the study of the Developing Urban Detroit Area (UDA).

Before starting an analysis of the Method it is useful to point out that if the subject is small we may be able to cover it mainly by the isolation of several phenomena and the comparison of all possible alternatives. If the number of alternatives is large – which is the usual case – then a systematic approach for the gradual elimination of alternatives should be employed.

In order to make the I.D.E.A.-C.I.D. Method more easily understood I will present it not as a theoretical case, but as it was actually implemented in the Detroit project.

From the beginning of this study in 1964 it was recognised that the UDA suffered from the usual problems of having been studied in small pieces and for short periods of time; therefore only on the basis of the extrapolation of existing present trends. The only remedy for such a situation was to study the area on a scale large enough to include dynamic changes in the foreseeable future, in terms of both space and time. A preliminary study of how far the Urban Detroit Area could extend had indicated that it could cover a surface of 23,000 sq. miles, 200 miles from north to south and 150 miles from east to west, including 37 counties (25 in Michigan, nine in Ohio and three in Canada) (fig. 1). Beyond these limits the UDA could not expand as such since it would enter the urban areas of Chicago to the west and Cleveland-Pittsburgh to the east.

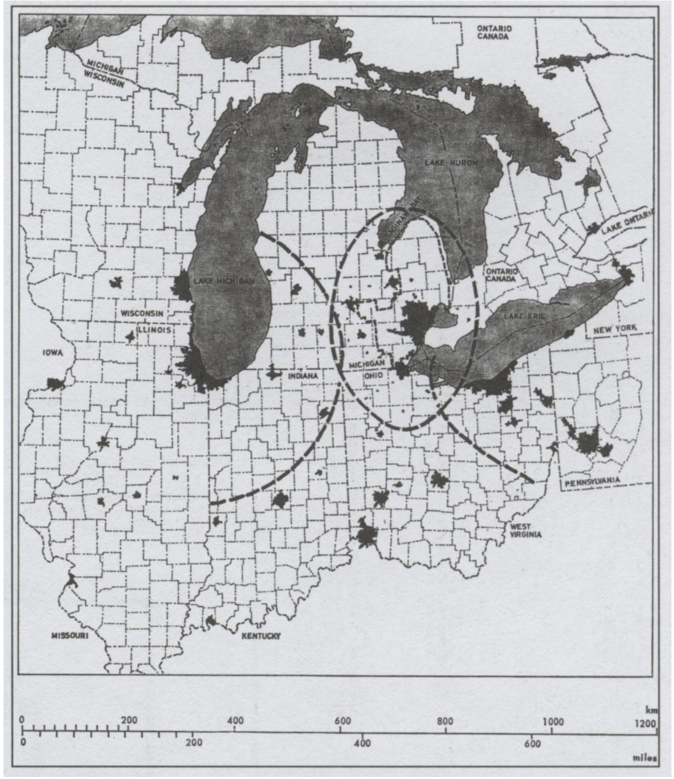

Fig. 1: Urban Detroit area.

The Urban Detroit Area has to be studied over several decades, since major projects sponsored by the Government or private industry are usually conceived many years before their implementation, and only prior physical planning can help towards their being conceived and implemented without the usual clashes between partial private plans which have been conceived early and general public plans which follow them at a time when commitments have already been undertaken by many decision-makers of urban development.

In order to attain the goals of this study we realised that we must proceed to the systematic conception of possible alternatives, then to their systematic evaluation and the elimination of those which were less satisfactory, and finally to the selection of the most suitable. To reach this end we had to *isolate* several phenomena in order of importance, at the phase and scale at which the examination was being made, and proceed by *eliminating* those solutions which were the weakest in relation to the phenomena selected. This method is the Isolation of Dimensions and Elimination of Alternatives Method or, the I.D.E.A. Method.

The application of this method makes it imperative that one start with phenomena of the greatest importance, and these are the ones which influence developments at the macroscale. This requires, therefore, continuous increase of the scale so that greater numbers of parameters or dimensions can enter into every successive step, and phenomena of a lower order can gradually be taken into consideration. This is the Continuously Increasing Dimensionality Method or, the C.I.D. Method.

The method for synthesis is based on the simultaneous application of both methods of Isolation of Dimensions and Elimination of Alternatives and Continuously Increasing Dimensionality (I.D.E.A.-C.I.D. Method), and the study is organised by steps in each of which we isolate phenomena and eliminate alternatives at the proper scale.

Each step is divided into two movements, as follows: *Movement* 1:

Assumptions about the phenomena to be isolated which define the alternatives, that is the *input* into our system. *Movement 2:*

Criteria on the basis of which the alternatives that do not comply, or do not comply as well, with our goals can be eliminated, which leads to the output of the step.

The final output of every step becomes the input of the next one. The selection of phenomena, criteria and scales for every step is based on experience about their importance.

In the Detroit report we applied this method in eight steps and 16 movements, progressing from a theoretical number of tens of millions of alternatives to some tens, a few and finally one (fig. 2). Necessarily, since many assumptions had to be made about probable conditions and solutions based on de-

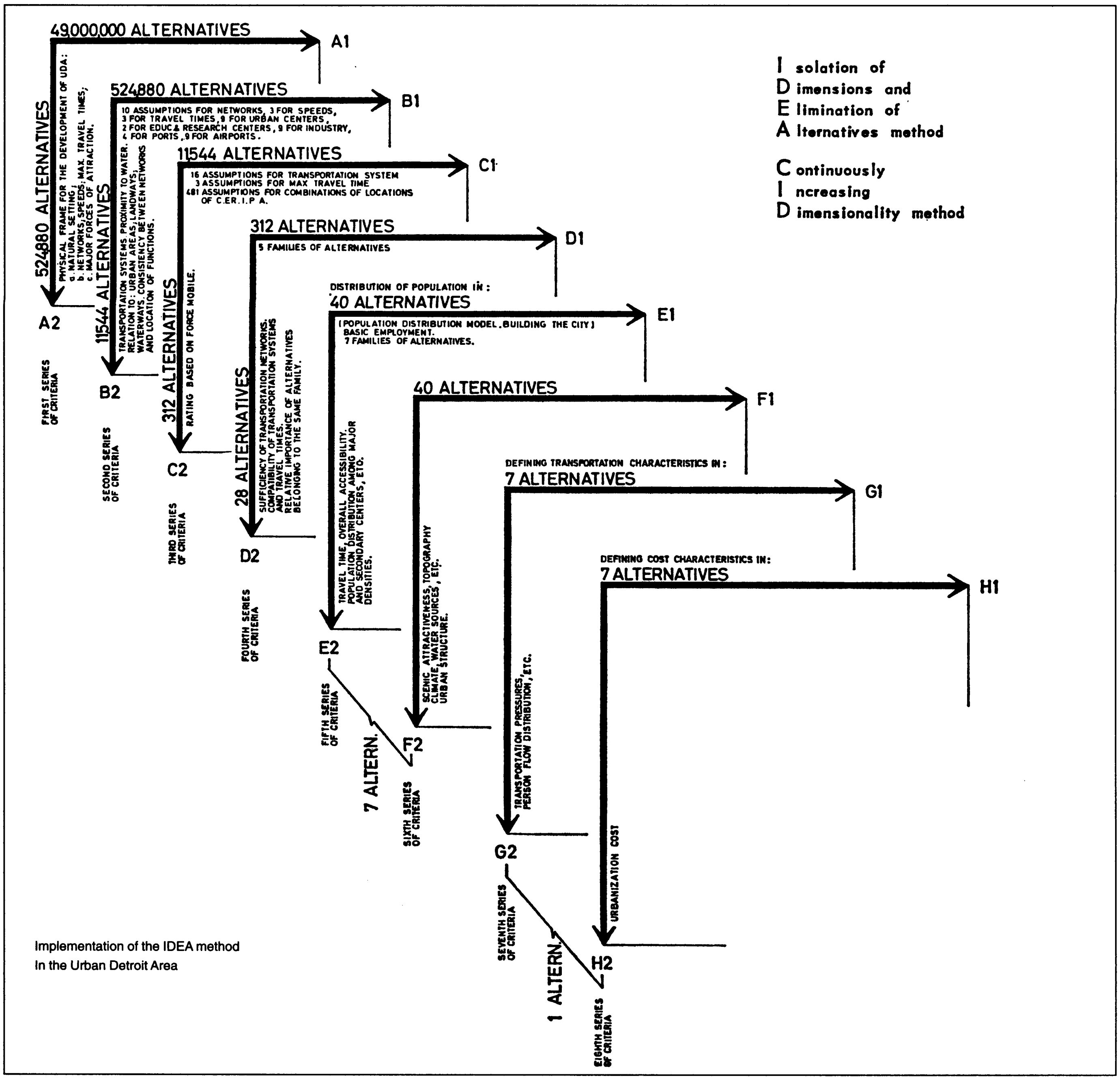

Fig. 2: Methodology.

sirable goals, the implementation of this whole system has no finality at all. Decisions can only be taken by the population of the UDA; or in some cases by the administrations of the counties concerned, but the whole system does not need to change. If we feed in a new assumption at a certain step we will simply find some more corresponding alternatives and we will proceed with them. Because of similar considerations the last steps are even more indicative of how a final solution can be selected since, before this takes place, many decisions have to be made about basic assumptions of this study, such as the future lines of transportation of a high order, the creation of a new Urban Centre of a high order to relieve the pressures on the city of Detroit and allow it to develop properly, etc.

Simulation models

In order to facilitate the application of the I.D.E.A.-C.I.D., or in simpler terms, the I.D.E.A. Method, we need a number of models which allow for the simulation of situations under certain conditions, and the comparison and evaluation of several alternatives based on the assumptions made. Such models are sometimes very simple (as the models for the rating of basic functions in relation to other functions and localities) and can be studied on the basis of simple calculations; or are so complicated that they require the use of computers, such as the accessibility and comparison models which compare alternatives under varying local conditions.

All these models can be elaborated in very great detail and fed into computers. This is not necessary, however. On the contrary, in this early phase it was thought much more practical to proceed using alternately simple and detailed elaborated models in accordance with the actual needs and possibilities of each case, in each separate step. In any case we must be aware that every step of our work needs different types of models depending on the scale and dimensions we are using and the Ekistic unit we are dealing with. I find, for example, that it is almost ridiculous to use transportation models in too small communities where the traffic volume is very small.

The models used in this study are the following:

- Projections of urbanisation trends based on the change of land use from agricultural to urban.
- Projections of general growth trends.
- Projections of densities of habitation (residential densities).
- Projections of population distribution based on established trends.
- Force-mobile model.
- Population distribution model (several variations of the parameters entering were attempted – use of computer).
- Comparison models (of the various alternatives with local conditions – use of computer).
- Transportation models (use of computer).
- Cost models.
- Human community models.

In addition there is a necessity for the use of abstract models which can illustrate the impact of new forces on the existing structure and form. These can be very simple initially and become more elaborate in the more advanced phases. If, for example, we want to study the possible expansions of the settlement, assuming several alternatives for the location of the new central forces, we proceed as follows. We build tentative models showing several possibilities, such as the related problems for the centre, the arterial system, etc. (fig. 3) and conclude by the selection of the most reasonable alternatives which then have to be calculated carefully and compared with corresponding mathematical models.

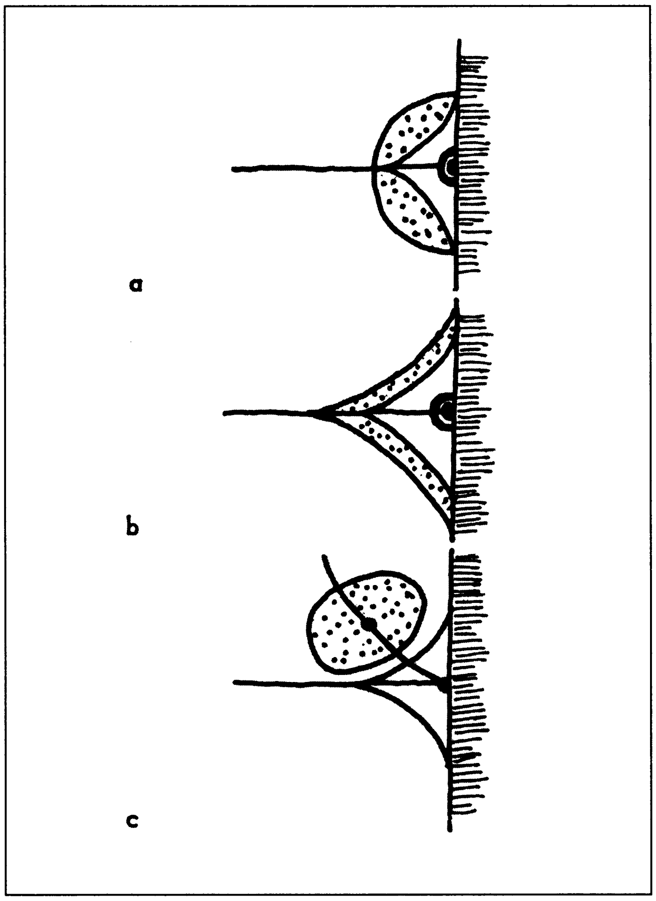

Fig. 3: Comparisons between several alternatives of dynamic growth.

Present and new trends

The next question that arises is how we can conceive future alternatives which can be compared in the different steps determined by the models to be used. The usual mistake is one of relying only on an extrapolation of existing trends. Because of forces inherent in all settlements, there is a certain course of development which is followed by the city itself. Unless major changes take place, this course is not expected to alter, and can be foreseen within reasonable limits of approximation.

Because of this, the conventional method of foreseeing and planning for the future is based on the extrapolation of present trends in an attempt to determine where the present course is leading. If this is done for such problems as transportation, it will result in the planning of new arteries to take care of the existing trends as they develop. Because of this approach, the new action taken in major cities tends to serve existing trends, and by doing so intensifies and stabilises them. Even if there was a natural tendency to change the present trends in some section of the city (because, for example, of the construction of a major factory in a different location) the opening of new arteries in accordance with the existing trends keeps development closer to the projected lines than it would have been otherwise.

It is quite clear that such a course leads to impossible situations. It would have been all right if existing trends were to lead to a better city, in which case it would have been reasonable to extrapolate existing trends. This, however, is not the case at all. On the contrary, experience has shown that existing trends create a snowballing process around existing centres of activities, existing axes of transportation, etc., and lead to congestion and paralysis.

We should use this method of extrapolation of present trends into the future as carefully as we can, not in order to show where we must go, but to find out *where we are going* now and what such trends will lead to. If the present trends are leading towards impossible situations, we must discover these situations, determine the dangers created for the city and the problems it will have to face in the future.

On the basis of these considerations we proceeded for the UDA to extrapolate the city's growth through expansion to the year 2000 by five different techniques. To do this we adapted existing models to the requirements of this study and developed new ones. The five techniques are as follows:

- *Projections based on urbanisation trends:* In order to define these trends we based our observations on the change in land-use from agricultural to urban, for which very good statistics were available. This was done because the change in land-use between the years 1900 and 1960, for which we have data every 10 years, allows us to derive an equation for the change which we subsequently applied to the whole study area as fig. 4 shows.
- *Projections based on general growth trends:* The trends in the participation of each county in the total population of UDA observed from 1930 to 1964 were projected in order to estimate future population distributions by county.
- *Projections based on residential densities:* By extrapolating the trends in density changes observed from 1940 to 1960 in a way that takes into consideration the observed facts that lower densities near urban centres tend to increase at a higher rate than high densities, as well as the effect of saturation limits, we obtained a picture of the future size and shape of the city in the form of iso-density contours (fig. 5).
- *Projections based on established trends:* Trends in the change of more composite phenomena were studied, such as facilities, transportation, densities in relation to local factors and saturation levels, etc. On this basis, ratings were given to the various localities in relation to their overall growth potential, and, assuming again that present trends will continue, the future distribution of population in the UDA was estimated by the extrapolation of these trends.
- *Projections by the population distribution model based on the concept of accessibility:* A computerised mathematical model using the concept of accessibility was developed for the distribution of population in the study area. We are not yet sure how well this model corresponds to the phenomena themselves, especially as regards their details, but the use of several types of accessibility models shows that in the projection of the basic phenomena about wider areas, we get a good simulation of reality (fig. 6).

Some of these methods lead to conclusions which are comparable. Thus, by comparing and combining the projections obtained by these techniques we came to conclusions about which parts of the projections are more valid.

A study of the results of these projections about the urban area to be created by the year 2000 if present trends continue, shows that Detroit which in 1960 had a population of 3,540,000 within its urbanised area, will have about 8,000,000 people in the year 2000. It is easily concluded that as the city of Detroit already has very great problems and difficulties in its central area it would be unreasonable to expect it to cope with future pressures exerted by 4,460,000 more people (an increase of 126 percent), which implies an even greater percentage increase in the number of cars, the movements of people and goods, etc.

The analysis of the continuation of the present course leads to the conclusion that it is most necessary to change it.

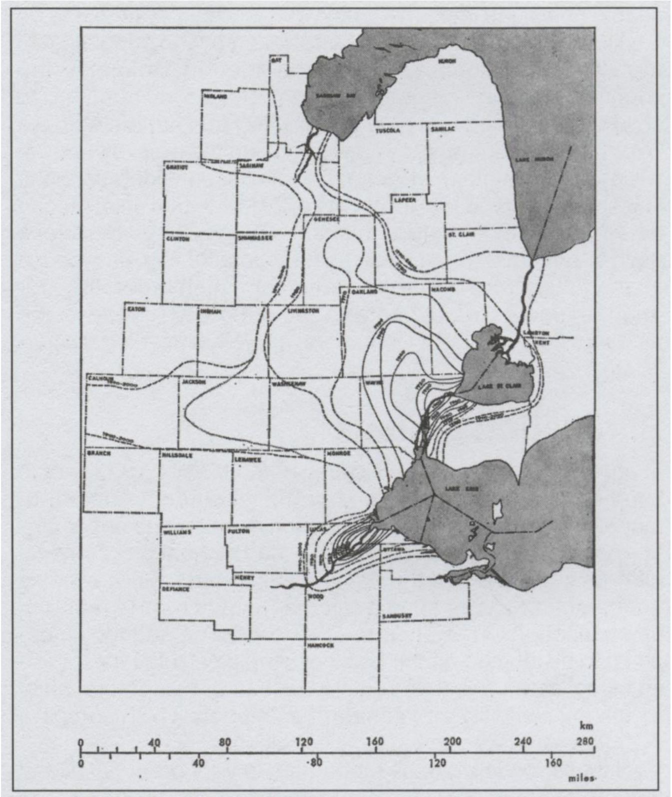

Fig. 4: Detroit area project – Expansion of area having more than 75 percent non-farm land from 1900 to 1959. Projections to years 1970, 1980 and 2000.

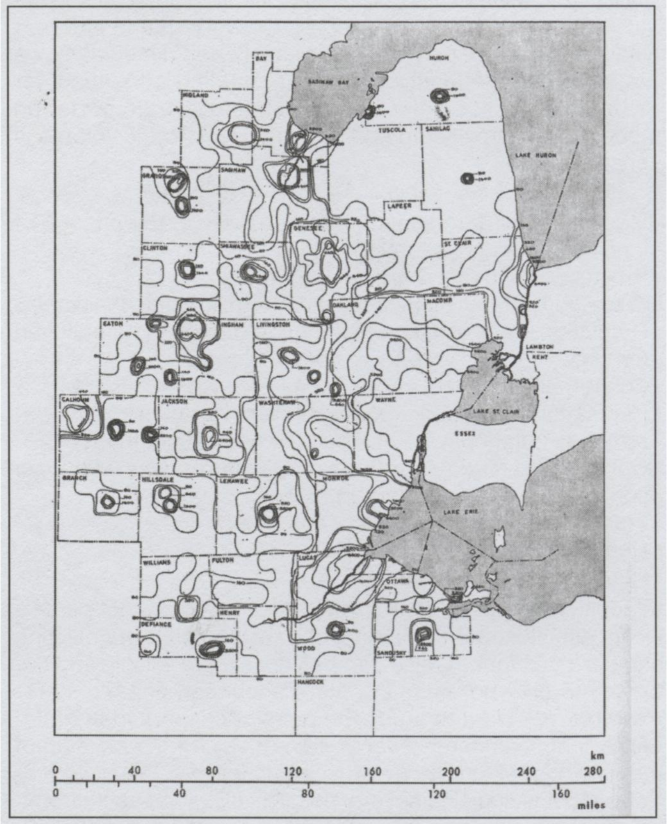

Fig. 5: Detroit area project – Estimated isodensity contours for the year 2000 corresponding to a total population in U.D.A. of 13,500,000 inhabitants.

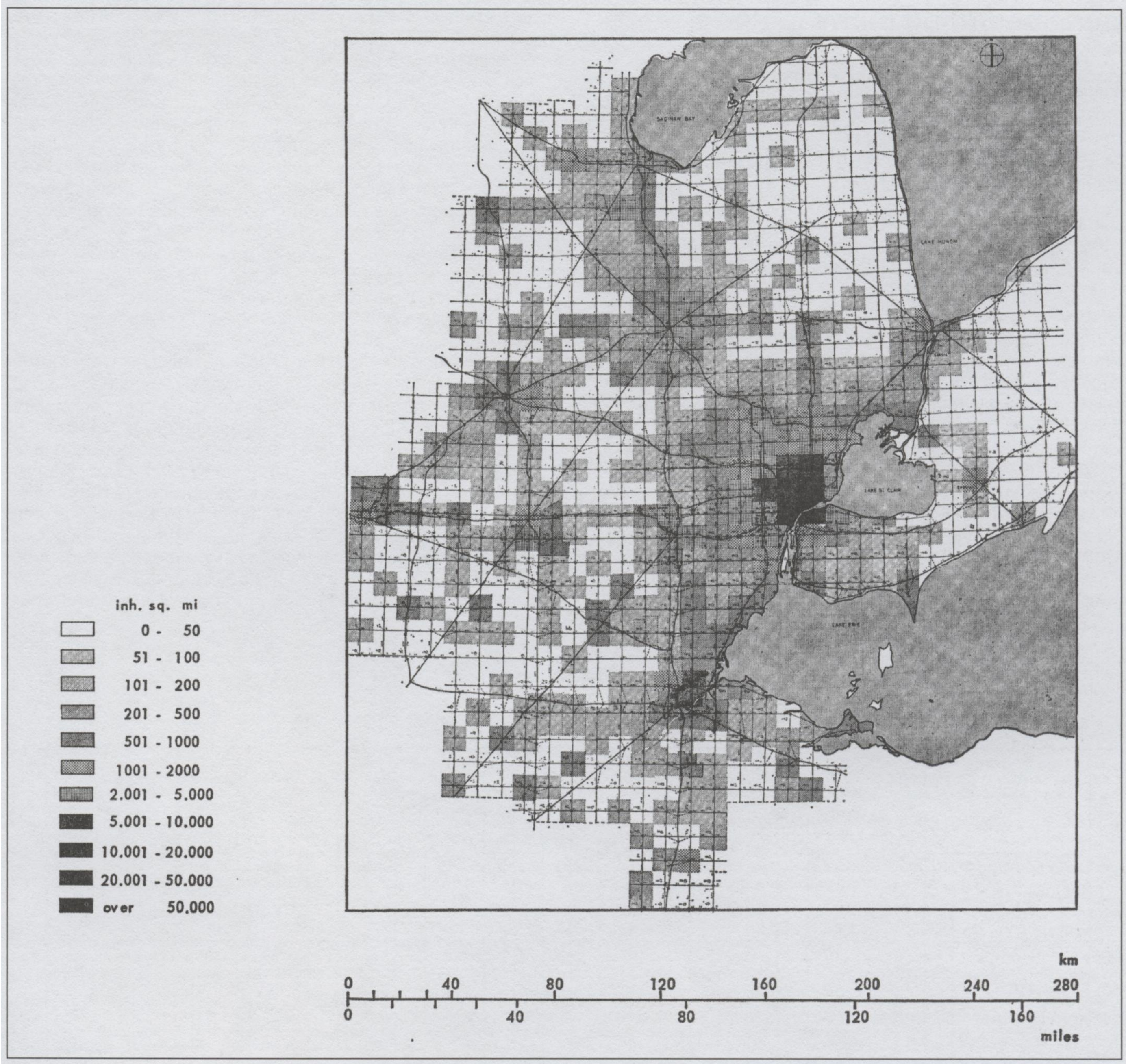

Fig. 6: Detroit area project – Population distribution by accessibility model for the year 2000
Single centre in Detroit – radial configuration of the higher order transportation networks
Speeds 100 and 250 m.p.h. – maximum travel time 30 minutes.

This is theoretically justified for all such urban areas, and specifically demonstrated for Detroit. In order to achieve this, goals must be set which can lead to a solution of the problems which make the present course unacceptable. These goals will have to be set further in the future and will define the desires for a better urban area which will avoid the weaknesses of the present and also the future towards which we are being led by present trends. As these goals will be set for a later date, in this case for the year 2000, it will be necessary to connect the situation defined by the future goals to the existing situation, in order to estimate how we can proceed from one to the other. We may, for example, desire a situation which is reasonable but not feasible for the target period of the study, or which may be unreasonable for any period.

We proceed by foreseeing alternatives and applying the Isolation of Dimensions and Elimination of Alternatives Method. We start with the question of how many alternatives there are about the future. If we consider that we want to base our alternatives on some basic assumptions about major urban centres, major industrial concentrations, major educational and research centres, major ports and airports and other important functions, as well as on different assumptions about population, densities of residence and work, transportation networks, speeds of transportation, maximum travel time and some other parameters, we shall have to estimate the number of alternatives that these basic assumptions create. If we present this in a theoretical matrix of possible alternatives, we will find that even if we accept ten alternatives for every one of the factors mentioned, we will be heading towards a total number of alternative combinations of the order of billions.

Implementation of the method

For practical purposes the process of evaluation and elimination started with an initial number of 49 million alternatives. This was a theoretical number corresponding to five assumptions for each basic parameter of the urban system (fig. 7).

In step A an effort was made to go from the theoretical thesis of five assumptions for each basic parameter to more meaningful ones. For example, as far as major functions are concerned, the consideration of the main transportation networks in the physical space of UDA led to the determination of the more important nodal points for their location. The number of assumptions referring to location of major functions was adjusted accordingly.

As far as parameters referring to people and their movements are concerned, a medium projection (equal to 15 million people by the year 2000), has been accepted for population; the study of the most probable patterns of communication networks, in combination with various sets of speeds, led to the acceptance of eight transportation networks; three variations of maximum travel time have been considered. Finally, densities have not been included in the parameters of the problem, because it was thought advisable to let the total human settlement acquire shape and texture corresponding to the assumptions made about functions and other parameters. Thus only a ceiling for densities is specified, leaving the decisions about them for future phases. The above assumptions and eliminations led to an output of 524,800 alternatives.

In step B the transportation networks were considered and those failing to satisfy a logical functional hierarchy were eliminated (fig. 8). The nodal points selected in step A for the location of major functions were further evaluated and the weakest among them were eliminated. The consistency between assumptions referring to Networks and assumptions referring to locations of major functions was critically examined and the inconsistent combinations, i.e. Networks with radial configuration coupled to locations of major functions determined from transportation lines of grid-iron configuration, were rejected. As a result, the number of alternatives was reduced to 11,544, which is the output of step B.

In step C the force-mobiles corresponding to the 11,544 alternatives were evaluated on the basis of a simple model used for the rating of groupings of major functions (fig. 9). This led to the selection of the 312 alternatives corresponding to the most reasonable force-mobiles.

In step D the surviving transportation networks were further evaluated and the weakest of them were eliminated because they were not considered sufficient for the proper servicing of the region. The compatibility of assumptions referring to maximum travel times with the assumed transportation systems were critically examined and the weakest combinations, as for example, high sets of speeds coupled to high travel times, were eliminated. Finally, families of alternatives with the same configuration of Networks and the same locations of major functions were considered, and the highest ranking group from each family as obtained from the force-mobile model was retained. The output of step D was 28 alternatives.

PARAMETERS OF PEOPLE		PARAMETERS OF FUNCTIONS																													
		URBAN CENTRES					MAJOR EDUCATIONAL AND RESEARCH CENTRES					INDUSTRIAL POLES					PORTS					AIRPORTS					OTHER FUNCTIONS				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
POPULATION	1																														
	2																														
	3																														
	4																														
	5																														
DENSITIES	1																														
	2																														
	3																														
	4																														
	5																														
TRANSPORTATION NETWORKS	1																														
	2																														
	3																														
	4																														
	5																														
SPEEDS OF TRANSPORTATION	1																														
	2																														
	3																														
	4																														
	5																														
MAX. TRAVEL TIME	1																														
	2																														
	3																														
	4																														
	5																														

This matrix which includes eleven types of parameters with 5 assumptions for each parameter leads to the conclusion that there are 49 million possible alternatives.

Fig. 7: Matrix of alternatives for the Urban Detroit Area.
Step A1: Input
49,000,000 alternatives

Parameters of people		Parameters of functions: Urban centres I	II	III	IV	V	VI	VII	VIII	IX	Educ. and research centres o	n	Industrial poles I	II	III	IV	V	VI	VII	VIII	IX	Ports I	VII	VIII	IX	Airports I	II	III	IV	V	VI	VII	VIII	IX
Transportation networks	No1																																	
	No2																																	
	No3																																	
	No4																																	
	No5																																	
	Nn1																																	
	Nn2																																	
	Nn3																																	
	Nn4																																	
	Nn5																																	
Sets of transfortation speeds	SL																																	
	SM																																	
	SH																																	
Max. travel time	45'																																	
	30'																																	
	20'																																	

Following considerations made in step A we reach an output of eight types of parameters (with two to nine assumptions for each parameter) which lead to a total of 524,880 alternatives.

Fig. 8: Matrix of alternatives for the Urban Detroit Area
Step A: Output and Step B: Input
524,880 alternatives

Parameters of people			Present trends: Major functions at present locations (Co ERo IC PO AO) 0	Serial Number	Parameters of people			New alternatives: Major functions at present locations (Co ERo IO PO AO) 0'	Major functions at new locations: Co, ERo, I0 P0 A1 1	I0 P0 A2 2	I0 P0 A3 3	I0 P1 A1 4	I0 P1 A2 5	I0 P1 A3 6	I0 P2 A1 7	I0 P2 A2 8	I0 P2 A3 9	I0 P4 A1 10	I0 P4 A2 11	I0 P4 A3 12	I1 P0 A1 13	I1 P0 A2 14	I1 P0 A3 15	I1 P1 A1 16	I1 P1 A2 17	I1 P1 A3 18	I1 P2 A1 19	I1 P2 A2 20	I1 P2 A3 21	I1 P4 A1 22	I1 P4 A2 23	I1 P4 A3 24	I2 P0 A1 25	I2 P0 A2 26	I2 P0 A3 27	I2 P1 A1 28	I2 P1 A2 29	I2 P1 A3 30	I2 P2 A1 31	I2 P2 A2 32	I2 P2 A3 33	I2 P4 A1 34	I2 P4 A2 35	I2 P4 A3 36	A1 37
No1	SL	mtt 45'		1	Nn1	SL	mtt 45'																																					
		mtt 30'		2			mtt 30'																																					
		mtt 20'		3			mtt 20'																																					
	SH	mtt 45'		4		SH	mtt 45'																																					
		mtt 30'		5			mtt 30'																																					
		mtt'20'		6			mtt 20'																																					
No2	SL	mtt 45'		7	Nn2	SL	mtt 45'																																					
		mtt 30'		8			mtt 30'																																					
		mtt 20'		9			mtt 20'																																					
	SH	mtt 45'		10		SH	mtt 45'																																					
		mtt 30'		11			mtt 30'																																					
		mtt 20'		12			mtt 20'																																					
No3	SL	mtt 45'		13	Nn3	SL	mtt 45'																																					
		mtt 30'		14			mtt 30'																																					
		mtt 20'		15			mtt 20'																																					
	SH	mtt 45'		16		SH	mtt 45'																																					
		mtt 30'		17			mtt 30'																																					
		mtt 20'		18			mtt 20'																																					
No5	SL	mtt 45'		19	Nn5	SL	mtt 45'																																					
		mtt 30'		20			mtt 30'																																					
		mtt 20'		21			mtt 20'																																					
	SH	mtt 45'		22		SH	mtt 45'																																					
		mtt 30'		23			mtt 30'																																					
		mtt 20'		24			mtt 20'																																					

Following considerations made in step B we again reach an output of eight types of parameters but with a smaller number of values assumed for each parameter (two to eight) which lead to a total of 11,544 alternatives.

In the matrix C0, C1, C2, C3, indicate the location of the major urban centre C at the nodal points 0, 1, 2, 3, respectively. The same method of notation is used for the alternate locations of the remaining major functions as well. Example : P2 denotes the location of the major port P at the nodal point 2.

Fig. 9: Matrix of alternatives fo rthe Urban Detroit Area.
Step B: Output and step C: Input
11,544 alternatives

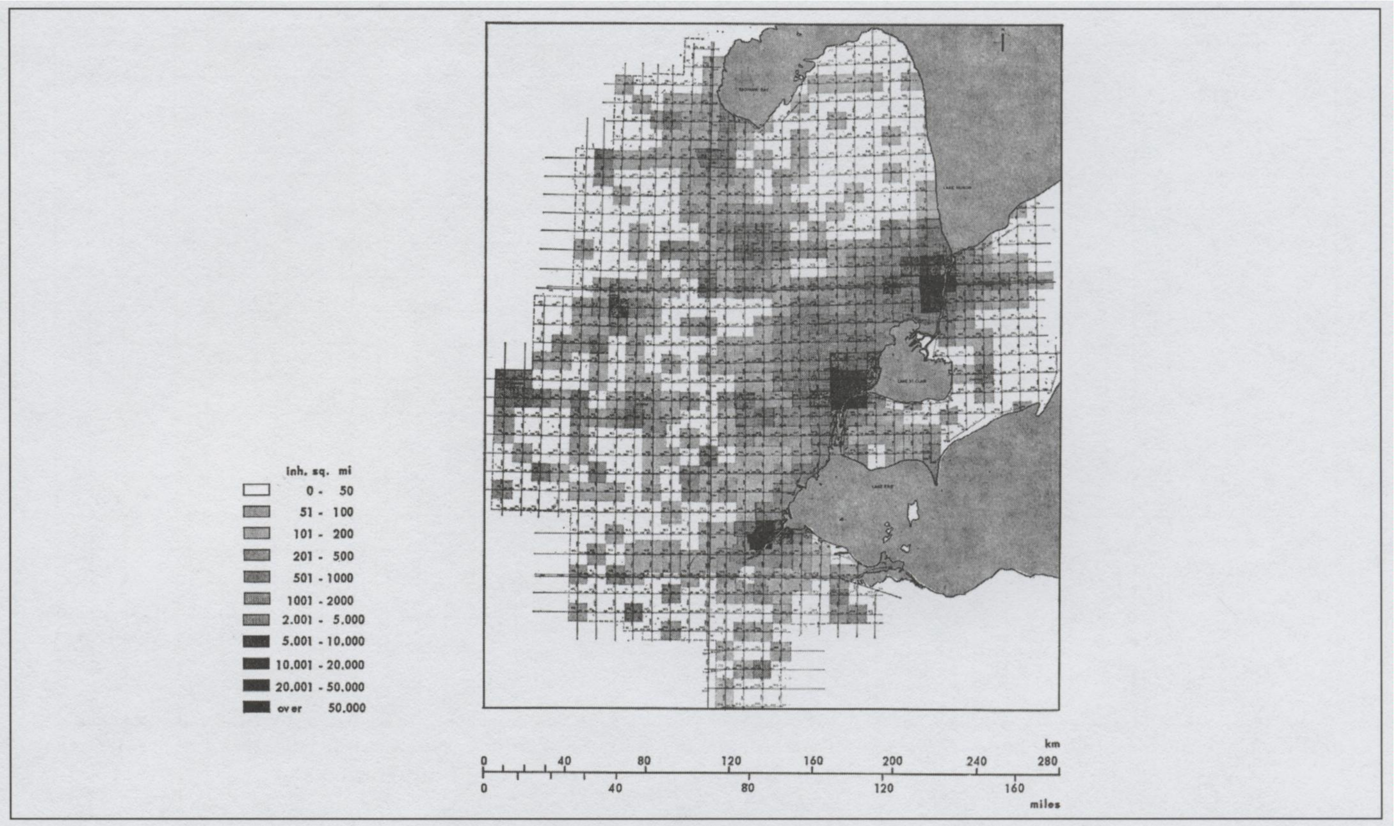

Fig. 10: Detroit area project population distribution by accessibility model for the year 2000. Twin centres in Port Huron Area - grid-iron configuration of the higher order transportation networks - speeds 60 and 100 m.p.h. - maximum travel time 45 minutes.

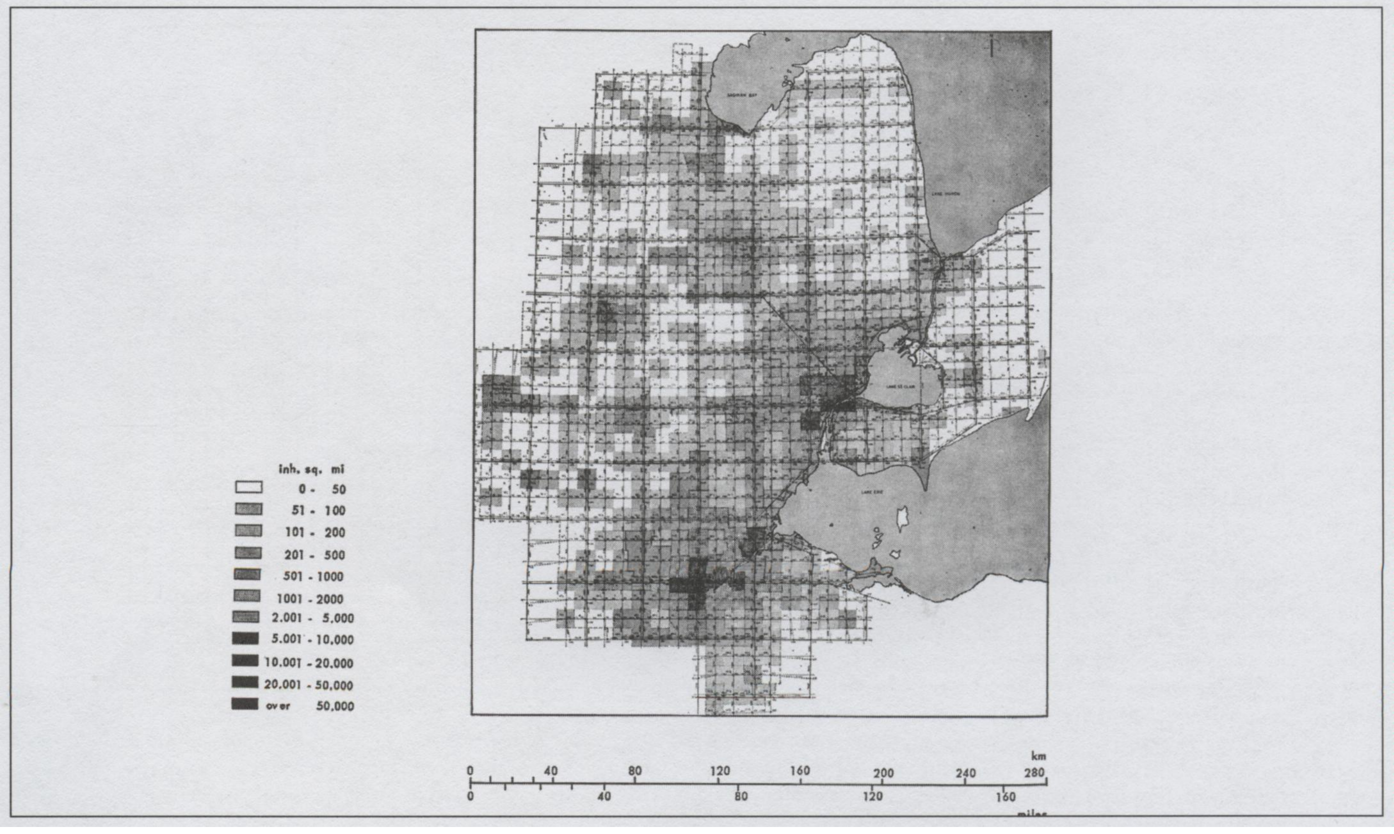

Fig. 11: Detroit area project population distribution by accessibility model for the year 2000. Twin centres in Toledo Area - grid-iron configuration of the higher order transportation networks - speeds 100 and 250 m.p.h. - maximum travel time 30 minutes.

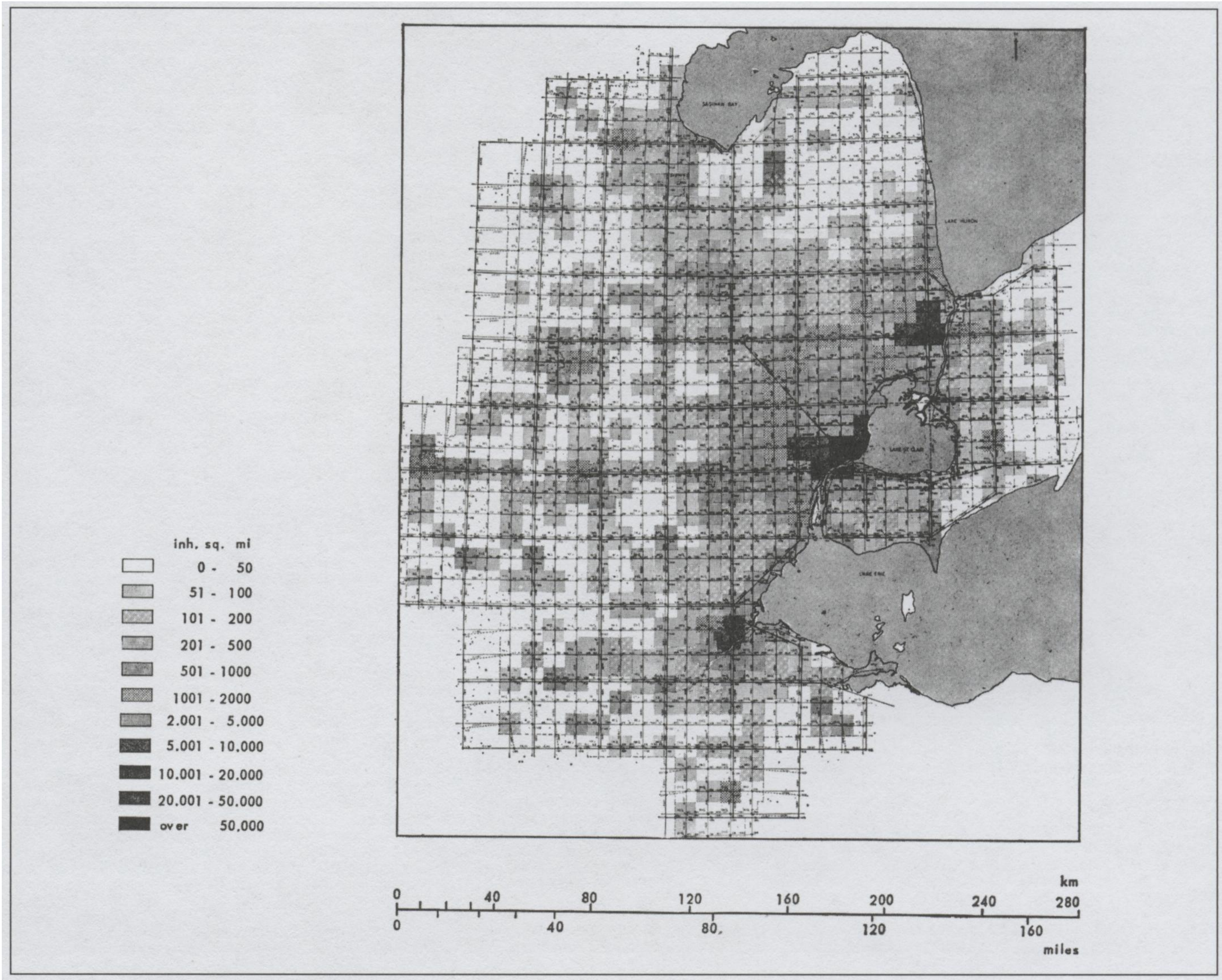

Fig. 12: Detroit area project population distribution by accessibility model for the year 2000. Twin centres in Port Huron Area - grid-iron configuration of the higher order transportation networks - speeds 100 and 250 m.p.h. - maximum travel time 30 minutes.

In steps E and F a new dimension was introduced, i.e. the basic employment and its spatial distribution over the UDA, leading to an increase in the number of alternatives from 28 to 40. The total population assumed for the year 2000 was distributed by means of a mathematical model based on accessibility to employment, and the resulting population and density distribution patterns were evaluated. The evaluation took into account criteria based on the five Ekistic elements, i.e. Nature, Man, Society, Shells and Networks. Seven alternatives represent the output of these steps (figs. 10 and 11).

Steps G and H elaborated on the transportation and cost characteristics of the seven alternatives. Criteria such as pressures on the Central Business District of Detroit, cost of transportation networks, cost of urbanisation, etc., were used, leading to one alternative (fig. 12).

It may be asked how this method works for minor settlements, or for single shells. To answer this I will present the case of one auditorium. We must first define the required space. We may then find that this is larger than the scale permitted on the basis of economic criteria. The result may be a multi-level solution with balconies allowing us to respect all the assumptions and stand the test of all criteria. Such action has to take place on a two-dimensional table such as the one on which every phase of the I.D.E.A. Method is based, a table presenting the action in the two movements of assumptions and evaluations, and the tests (fig. 13).

spatial needs of man		personal					social	
		intellect	sight	senses	hearing	body	max density	capacity
criteria	economic					1 person/m^2	1 person/m^2	2 person/m^2
	time							
	psychologic		max distance 60 m		max distance 40 m			
	safety	balconies of no more than 45°				1 person/m^2		

Fig. 13: Implementation of the I.D.E.A. and C.I.D. methods in an auditorium. One phase of our work.